Dairy marketing in sub-Saharan Africa

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Preface

Marketing is recognised as one of the main constraints to the development of dairying in sub-Saharan Africa, yet there has been very little research on the subject and very few researchers have firsthand experience in dairy marketing.

This Symposium was organised under ILCA's Cattle Milk and Meat Thrust as part of the Cattle Research Network's programme aimed at developing a research programme and coordinating research collaboration among Africa's national agricultural research systems, the International Livestock Centre for Africa (ILCA) and other institutions. Its main objectives were to develop a comprehensive overview of what is already known about dairy marketing systems and policies in sub-Saharan Africa and to identify key research problems so as to facilitate a coordinated research effort among the interested parties.

The Symposium was organised in six parts:

- A general overview of dairy production, marketing, international trade and food aid in sub-Saharan Africa

- Dairy technologies and dairy processing, with a focus on supporting smallholder production and marketing

- Dairy demand and consumption patterns

- Marketing efficiency

- Dairy marketing and dairy policies in various countries and

- Primary data collection problems, focusing on survey planning and non-sampling errors in dairy marketing research.

The organisers attempted to get broad geographic representation in the Symposium programme. However, there is relatively greater representation of East Africa, where more dairy marketing research and development has taken place.

The Symposium did not address methodological issues and problems in dairy marketing research. Foremost among these are the problems of poor data quality and varied procedures in data collection. There are also difficult methodological problems in the analysis of marketing efficiency and demand for dairy products, which will be apparent in reading the papers dealing with these subjects. Researchers planning to study these topics should be aware of these problems, which are yet to be worked out.

The Editors worked with several of the authors on technical aspects and problems of methodology and interpretation. That some problems still remain in some cases is testimony to both the difficulty of the problems involved and the 'state of the art' in dairy marketing research in sub-Saharan Africa.

Acknowledgements

The Symposium on Dairy Marketing in sub-Saharan Africa was held at ILCA headquarters in Addis Ababa, Ethiopia, from 26 to 30 November 1990.

Forty people took part in the Symposium, 23 of whom were authors of papers. The Editors and ILCA are deeply grateful to all those who contributed, whether as authors, chairpersons of the different sessions or as formal discussants of the papers presented.

Special recognition must be extended to Edward Jesse of the University of Wisconsin and to Ousmane Badiane of the International Food Policy Research Institute both for their constructive and extensive comments on papers presented and for their closing review and synthesis of the Symposium.

Appreciation is extended to the discussants: J.A. Akinwumi, G.C. Ashimogo, Ousmane Badiane (two papers), Getachew Asamenew, Ben R. Henson, M.A. Jabbar, R.L. Kurwijila, Stephen Mbogoh, John Nankumba, Luis Navarro, John Rowe, Kenneth Shapiro, Keffing Sissoko and Gary Storey.

Sincere thanks are extended to the chairpersons of the nine sessions: E.A. Ololoku, Emanuel Onucheyo, Luis Navarro, Kenneth Shapiro, J.D.O. Ochuonyo, Abdullah Said, Arend J. Nell and Stephen Sandford.

Interpreters Mme Elisabeth Benamard and Mme Tilly Gaillard did an excellent job of providing simultaneous interpretation, from English into French and vice versa, of the entire programme. Two papers originally written in French were translated into English by Siegfried Debrah and Mme Henrieta Jibril.

Hans Jansen, M.A. Jabbar, Siegfried Debrah, Senait Seyoum and Gary Mullins took turns recording and summarising the discussions of each paper. This forms an important part of the proceedings and their contribution is gratefully acknowledged.

Woinishet Demessie typed or reformatted all the papers and Abebe Misgina checked all tables for accuracy. Their dedication to accuracy is much appreciated. Finally, the Editors wish to acknowledge the efforts of Ato Worku Sharew and Paul Neate, who edited the text of the proceedings, and the staff of the ILCA Publications Section, who processed and printed the proceedings.

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Symposium on Dairy Marketing in Sub-Saharan Africa: Summary and review

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Introduction

Dairy marketing is a key constraint to dairy development throughout sub-Saharan Africa (SSA). Marketing problems must be addressed if dairying is to realise its full potential to provide food and stimulate broad-based agricultural and economic development. Dairy development is a source of broad-based economic growth for two reasons: first, it is labour-intensive and second, it is associated with relatively large income and price elasticities of demand. The labour-intensive aspect is important in absorbing underemployed rural labour and in spreading benefits broadly among the rural population. The relatively high price and income elasticities of dairy products imply that increases in market supplies of dairy products are not likely to result in severe price falls.

This is further reinforced by the existence of substantial dairy imports in much of SSA and the rapid rate of increase in demand accompanying rapid population growth. In the first case, increases in domestic production can be substituted for imports. This will allow increased domestic production to be injected into the market without increasing overall supply, which would otherwise tend to depress prices. However, the second case is most important because rapid population growth provides a rapidly expanding demand for dairy products and challenges supply to keep pace. The population of SSA is projected to grow at an annual rate of 3.1% to the year 2000, while the urban population is growing at 6.9% a year. At present about 74% of sub-Saharan Africa's population is rural, but by 2020 rural and urban populations are expected to be equal (World Bank, 1989: pp. 33, 269, 278).

The rapidly growing urban population creates a rapidly expanding urban demand for milk and is the primary focus of dairy development efforts. However, most rural people do not live near large urban centres. In seeking to ensure that

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agricultural development plays its crucial role in overall economic development, the role of dairying in rural development should not be overlooked. Rural dairy development is probably both more important in terms of its potential contribution to broad-based (hence equitable) agricultural and general economic development, and more challenging in terms of the complexity and difficulty in bringing about its development. However, peri-urban dairying and rural dairy production face very different marketing constraints.

Kenneth Shapiro (University of Wisconsin, Madison, Wisconsin, USA; personal communication) summed up the need for more research in dairy marketing as follows:

> *"The African development literature is relatively thin on livestock in general, but thinner still for dairy, and woefully inadequate for dairy marketing. Outside of Kenya, Nigeria and Zimbabwe, it is hard to learn much about the subject and even those countries call for much more attention."*

Symposium objectives

The ILCA Symposium on Dairy Marketing in sub-Saharan Africa was organised because there was a need to develop a comprehensive overview of what was already known about dairy marketing systems and policies in SSA and to identify key researchable problems in order to better coordinate collaborative research with national agricultural research systems (NARS). Its specific objectives were to:

- identify and describe different marketing systems and the needs of different types of dairy producers in different regions of SSA

- identify the substantive issues in dairy marketing research

- draw policy makers' attention to research issues and current research results in dairy marketing

- publish a proceedings that will be a useful reference on African dairy marketing systems, policies, research issues and methodology and

- strengthen research, information and training links between ILCA, NARS and other institutions interested in dairy marketing research.

Organisation of the proceedings

The proceedings is organised into seven parts. Part I includes this summary and review and the rapporteurs' closing review of the Symposium. The remaining chapters are divided into parts II through VII and broadly form the outline for the

remainder of this summary and review chapter. None of the papers directly addresses dairy policy issues, although several discuss or allude to such issues. References to dairy policy will be summarised in this section, as will the discussions of the working sessions on "Data collection and management" and "Research priorities".

Part II presents overviews of SSA dairy production (Chapter 3), dairy marketing and development (Chapter 4) and dairy imports (Chapters 5 and 6). Part III consists of Chapters 7 and 8, which deal with small-scale dairy processing, while Part IV (Chapters 9 to 12) deals with consumption and demand studies in Mali, northern Nigeria, southern Nigeria and Lesotho.

Part V presents three papers on efficiency of dairy marketing: one carried out in Bamako, Mali (Chapter 13), and two in and near Addis Ababa, Ethiopia (Chapters 14 and 15). Part VI (Chapters 16 to 21) describes dairy marketing systems in six countries: Kenya, Zimbabwe, Tanzania, Malawi, Ethiopia and Madagascar. Primary data collection and management issues (Chapter 22) are presented in the final section.

Overview of production, marketing and imports

Overview of dairying in sub-Saharan Africa

A.J. Nell (Chapter 3) provides a comprehensive yet succinct overview of dairying in SSA. The agro-ecological zone, the livestock production system and the tsetse challenge are identified as the main variables in defining options for milk production in SSA. Nell, following Jahnke (1982), distinguishes five agro-ecological zones and five milk production systems in SSA. The agro-ecological zones include arid, semi-arid, subhumid, humid and highlands. Livestock production systems are pastoralism, agropastoralism, mixed farming, intensive dairy farming and peri-urban milk production. Two or more production systems exist in each agro-ecological zone. Tsetse challenge is present in all zones, except the arid zone, and severely limits dairying, occurring in over 70% of the humid zone.

The potential for commercialisation, i.e. development of marketable milk, depends to a large extent on the production system. Pastoralists and agropastoralists have very limited potential, but are, nonetheless, major suppliers of milk in some regions. Bamako, Mali (Chapter 9), and Kaduna, Nigeria (Chapter 10), are examples of urban centres supplied primarily by agropastoralists.

Nell states that, in mixed farming systems, cattle tend to be used for draft, with milk production being of secondary importance. However, dairy production in

the mixed farming system is attractive as it offers the possibility of higher continuous income and risk diversification.

In intensive dairy farming systems, farmers produce their own roughage and purchase additional concentrates. Where milk prices are favourable, farmers respond to extension training and improved marketing, as in the dairy development projects in Kenya and Tanzania. This has also been the case with peri-urban and urban dairy farmers (e.g. in Addis Ababa, Bamako and Dakar) who rely mainly on purchased feed, are commercially oriented and respond readily to improved input supply and marketing systems.

Thus, the potential for input intensification and increased milk output is limited in pastoralist and agropastoralist systems. However, in mixed farming, intensive and peri-urban dairy farming systems, there is a potential for input intensification, increased output per cow, per farm and per unit area as well as a potential for economical development of infrastructure to support dairy development. These are the systems that will respond to rapidly increasing urban demand for milk.

Dairy marketing and development

Shapiro et al (Chapter 4) provide an overview of marketing factors that currently influence the development of the dairy sector in SSA. They identify a number of issues for further discussion in their literature review which they frame around eight hypotheses:

1. The domestic supply of milk has increased erratically overall and unevenly across countries, but there is substantial opportunity for production gains.

2. Increases in population, urbanisation and income will combine to generate more rapid growth in demand for dairy products than has generally been projected.

3. There is strong and increasing demand in secondary cities that will make dairying profitable in a large number of areas.

4. Farmers have several marketing channels from which to choose and, hence, they can avoid exploitation by traders and the negative effects of government monopolies.

5. There are significant opportunities to develop small-scale processing plants to serve smaller urban settlements and milksheds.

6. Underutilisation of capacity is a major problem for the dairy-processing industry, and (imported) milk powder may be important in ameliorating it.

7. Imported dairy products can play a valuable role in the development of African dairying, but not in Operation Flood-type programmes.

8. The world dairy situation has changed and there will not be large surpluses available for food aid.

These hypotheses summarise the main points which are comprehensively dealt with in the paper. The authors do not attempt to test these hypotheses but lay a good groundwork for more intensive, location-specific investigations. On balance, the authors say that they are optimistic about the prospects for sustained growth in African dairying, but not without some changes in current marketing, pricing and institutional practices.

Dairy imports into sub-Saharan Africa

The major dairy exporting countries of the world include those of the European Economic Community (EEC), the United States of America (USA), Canada, Australia and New Zealand, with the EEC and New Zealand dominating. Only 5% of world dairy production is traded; thus world prices are very sensitive to small changes in either supply or demand in the principal exporting countries.

World export prices have been kept low over most of the past two decades by the large surpluses created by dairy price support programmes and export subsidies, particularly in the EEC and the USA. The high cost of sustaining price-support programmes in the EEC and USA has brought about measures to reduce production. Consequently, stocks of butter and skim-milk powder have fallen dramatically, leading to considerable increases in world dairy prices.

Dairy imports by SSA countries are small relative to total world trade, comprising about 6% of world exports in 1985 at the peak of imports into SSA. This accounted for about 20% of the dairy consumption in SSA, for an overall self-sufficiency ratio of about 80%. However, the self-sufficiency ratios vary widely among countries. For example, Zaire, Côte d'Ivoire and Gabon have self-sufficiency ratios of less than 10%. Fourteen of the 39 SSA countries have self-sufficiency ratios of less than 50%.

Food aid has made up a very significant part of SSA dairy imports, increasing from 21.2% in 1977 to 57.2% in 1986 (Chapter 5). During 1984–86, dairy aid contributed over 50% of the dairy imports of 23 countries and over 80% in 12 countries (Chapter 5).

Total dairy imports declined by nearly half from their peak levels in 1985 to 1988 (Chapter 4). This decline resulted from a combination of forces affecting international dairy trade, namely the reduction of surpluses in exporting countries which, through reduced price supports and/or production quotas, led to: (a) dramatically increased international prices; (b) a reduction in surpluses for dairy aid and structural adjustment programmes and rationalised exchange rates in several SSA countries. This was particularly important in Nigeria, which is the largest importer of dairy products in SSA.

These forces point to a reduced role for dairy imports in meeting the rapidly rising aggregate demand, assuming that real domestic prices do not rise relative to world prices. While recent evidence shows world prices rising relative to African dairy prices, the long-term trends in these price relationships will depend on how domestic production responds to rising demand. The extent to which non-concessional dairy imports might play a role in meeting future African dairy demand is unclear.

A point about the availability of foreign exchange for dairy imports can be raised, but von Massow (1989) pointed out that in Nigeria, the largest importer of non-concessional dairy products, dairy imports accounted for only 2% of aggregate export earnings. Thus, the extent to which foreign exchange will be an overriding issue in future dairy trade needs to be considered country by country. Shapouri and Rosen (Chapter 5), updating the earlier analysis by von Massow (1989) regarding the effect of policies on dairy imports, also found that the rate of change in dairy imports were not explained by population growth rate and income changes nor by changes in real prices. They concluded that a significant part of the increase in dairy imports was stimulated by progressively overvalued domestic currencies which favour imports and penalise exports.

In Chapter 6, Ngigwana focuses on dairy imports and their influence on domestic dairy marketing and development in Tanzania. Self-sufficiency rates in Tanzania increased from 86% in 1977–79 to 94% in 1984–86, while the share of food aid in total imports increased from 60% to 87% over the same period (Chapter 6).[2] Current per caput consumption is estimated at 15 to 20 litres per annum, but effective demand is declining because of declining income. Estimated production from the traditional dairy sector provided 75% of total production, most of which was consumed within the sector itself and virtually none of which reached commercial processing facilities.

Out of the estimated 472 million litres produced, the seven commercial processing plants, operated as parastatals by Tanzania Dairies Limited (TDL), processed about 4 million litres in 1989. This was less than 1% of the total dairy output. These seven plants processed milk from large-scale, parastatal dairy farms, and reconstituted imported milk powder and butter oil. Dairy imports made up about 39% of the processed milk in 1987 and the seven plants operated at about 30% of installed capacity overall. Food aid has been very important in increasing the throughput of milk in the dairy processing plants and in helping to reduce the costs of processing milk. Proceeds from the sale of World Food

2. Self-sufficiency is total domestic production divided by total consumption. Thus, self-sufficiency can increase due to a reduction of consumption brought about by reduced imports, by increased domestic production with consumption unchanged, or by a combination of consumption, imports and production changes.

Programme (WFP) and EEC dairy aid are being used to finance agricultural development.

As most small-scale, peri-urban producers sell through the informal marketing channels, the future role of the commercial dairy processing plants is seen as serving more distant small-scale producers. However, in order to competitively accomplish this role, these plants must develop an extensive and low-cost collection system. Under present conditions, this may therefore not be the best way to bring about increased supplies from rural producers in Tanzania.

Policy

None of the Symposium papers deal exclusively with policy aspects but many discuss policies related to dairy development, production, marketing and trade. There is often conflict among the objectives of economic policies and dairy-related policies are no exception in this regard.

The Symposium participants agreed that dairy development should not be justified in terms of the need to deal with undernutrition because other foods can satisfy human nutritional requirements more cheaply. Rather, its justification and overall objective should be to promote economic development and help satisfy a growing demand for dairy products. However, even these objectives often have become secondary to the concerns of a cheap-food policy. Cheap-food policies have been reinforced by very low world prices of dairy products and overvalued exchange rates, both of which have encouraged imports. High levels of imports adversely affect domestic production and slow the pace of dairy development. The reduced pace of dairy development may eventually prove to be in conflict with the aims of a short-term cheap-food policy. This is particularly true if world surpluses of dairy products are reduced by changing policies in the exporting countries leading to rising world dairy prices (which appears likely) and if exchange rates are normalised in the importing countries. Pricing policies of imports vary from country to country and the degree to which domestic production is adversely affected depends on how imported products are priced relative to domestic products.

The need is cited for a more favourable price policy to promote smallholder dairy development and for price stability, which is of great importance. Price stability does not imply, however, that there should not be regular seasonal variation in prices to help even out seasonal surpluses and deficits that are common in Africa and exacerbated by fixed prices throughout the year.

Nell (Chapter 3) argues that inadequate and inefficient support services are a major constraint on dairy development. Long-term support involves step-by-step development of production of good-quality animals, development of production systems, extension, provision of inputs and services and marketing. The main

focus should (in the short term) be on improving small-scale processing and trade of fresh milk.

Formulating a correct balance between direct government involvement and indirect government facilitation of private initiatives is important for an efficient delivery of support services. Consideration must also be given to how these support services can be phased to meet the incremental needs for technological change.

Dairy processing

Outside of Kenya there are few examples of the successful linking of smallholder dairy producers through a formal marketing system involving large-scale processing plants. While Zimbabwe has a well-developed formal dairy marketing system for large-scale commercial producers, it has yet to involve very many small-scale peasant producers. In other countries, modern European-style dairy processing plants seem to have been developed with a view to accommodating dairy imports. Most are operated at only a small fraction of designed capacity and produce mainly reconstituted milk. Very little local fresh milk is processed in these plants.

Without informal marketing systems to efficiently distribute milk from smallholder urban and peri-urban producers to urban consumers, dairy production and consumption would be very much lower than it now is in many sub-Saharan African countries. O'Connor (Chapter 7) argues that future dairy development should start at the producer level, to guide rather than drive individuals and cooperatives to solutions of their marketing problems. He argues that educational programmes, financing, infrastructural development and more suitable marketing arrangements will be needed to facilitate such development.

Shapiro et al (Chapter 4) reinforce this, quoting Bachmann (1987):

"It is in fact possible to manufacture the highest quality dairy foods with extremely simple tools and means. It is also true that most dairy foods can be made with the help of relatively few basic processes provided that the manufacturer has the necessary skills and experiences. Complicated machinery and sophisticated processing methods have not been invented to make better dairy products, but to save labour and nothing else."

The perspectives of O'Connor and Bachmann would tend to refocus investments in dairy marketing to a local-producer orientation. This focus should give rise to more involvement of private individuals and small cooperatives in dairy marketing systems. At the same time, it appears that relatively simple marketing systems, featuring small-scale processing, could play a major role in urban dairy marketing in many sub-Saharan African countries.

In Tanzania (Chapter 8), data show that the ability of centralised plants to collect, process and market local milk supplies has been declining over the last decade. While producer milk prices vary widely depending on the remoteness of production points from major urban consumer areas, retail prices for products such as butter and cheese are more uniform in urban centres across the country. Against this background a number of small-scale milk processing projects have been initiated. Kurwijila's analysis of some of these pilot projects shows that small-scale processing in Tanzania can be profitable, provided it is done in remote areas where raw milk prices are relatively low and correct choices are made as to product type/quality, processing equipment and organisational set-up. Why this would not also apply to peri-urban producers is unclear but lack of critical inputs such as rennet, cheese-cover and starter-culture continue to limit the smooth operation of small-scale processing. Thus, local solutions to some of these problems are required if smallholder dairying/processing is to succeed and develop in Tanzania.

Dairy consumption and demand

Shapiro et al (Chapter 4) cite some highly aggregate, rough estimates of dairy demand in sub-Saharan Africa, synthesised from various studies by the World Bank (1990):

Consumption per caput: 27 kg LME per year

Growth in total demand: 4% per year

Income elasticity of demand: 0.8.

They note that these figures are not based on direct estimates but rather inferred from production and trade statistics. Several other studies are cited in which estimates of per caput consumption are based mainly on FAO production and trade year-books. One of these, by Senait Seyoum (1988), points out the great variability underlying such averages among West African countries, "guesstimating" that rural per caput consumption ranges from 6 kg in the West African highlands to 55 kg in the arid zone; and urban per caput consumption ranges from 22 kg in the humid zone to 58 kg in the highlands.

Shapiro et al (Chapter 4) state that reliance on production and trade data by most analysts reflects a dearth of dairy consumption studies in Africa, a fact that is most troublesome when projecting future demand based on increases in income and urbanisation. They note that some recent studies have found relatively low income elasticities in the range of 0.35. They further note that Africa's towns and cities are growing rapidly, that income is expected to grow slowly and that it is important to separate the effects of income and urbanisation on dairy demand. They indicate two aspects of urbanisation needing further study. The first relates to the fact that urban populations are growing more rapidly than rural populations

and urban per caput dairy demand is much higher than rural demand. The second has to do with the geographic pattern of urban growth; even small towns can offer important and growing markets for dairy production and an opportunity for a broader base in rural development.

The Symposium included four dairy consumption studies (Chapters 9–12). These studies have many similarities in their general approach, but have important differences as well. The dairy consumption surveys and their analysis are fraught with difficulties at every step. In the first instance, secondary data suitable for estimating demand parameters are unavailable in most SSA countries so primary data must be collected. However, due to cost and time constraints only a limited time span can be covered. This makes collection of data on price changes difficult at best. In many areas prices vary seasonally so repeated surveys over seasons and over two or three years may produce observations on a number of different price levels that may be sufficient to estimate price effects on consumption. On the other hand, obtaining cross-sectional data can also be problematic. If the survey covers a large geographical area it may extend over several months. Employment, income or prices may vary both between seasons and places, which would create problems in interpreting such cross-sectional survey data.

In addition, constructing the survey questionnaires and interviewing respondents properly so as to elicit accurate and complete information is no simple task. Data collected must fit with an appropriate demand model and/or *vice versa*. It is important to involve specialists in demand analysis who are also familiar with data potentials from consumption surveys. Methodological issues were not addressed in the Symposium, but certainly need to be dealt with in planning future consumption surveys. Appropriate models and econometric estimation procedures are crucial if consumption surveys are to contribute significantly in providing useful demand parameters for predicting future growth in demand.

Be that as it may, the surveys can and have yielded useful data about dairy consumption patterns among various population groups and income levels. The Bamako, Mali, study (Chapter 9) describes the patterns and levels of consumption for a range of dairy products. It covered a sample of 240 urban households stratified by income level. Average consumption was 12 kg of liquid milk equivalent (LME) per person per year. Rich households consumed 22 kg LME/person per year, spending 1.8% of their incomes on dairy products. Corresponding figures for medium-income and poor households were 11.8 kg and 2.5%, and 6.4 kg and 3.4%, respectively. Locally produced fresh milk, factory reconstituted milk and directly imported, readily usable milk were the most frequently consumed products, accounting for 34, 12 and 54% of total LME consumed.

Financial difficulties was cited as the most important reason for low or irregular consumption by poor households. Income and prices significantly affected the

level of consumption, but ethnicity, occupation of household head and the number of members per household were not significant variables in explaining per caput consumption. These results contrast with those from Nigeria (Chapters 10 and 11), where ethnic and religious variables were important factors in explaining the level of per caput dairy product consumption.

In the Kaduna, Nigeria, study (Chapter 10), 737 households were surveyed—489 in 13 villages surrounding Kaduna and 248 inside the city itself. Information was collected on family characteristics, i.e. number, age and sex of household members, education, employment, ethnic group, religion, income, wealth, frequency and quantity of consumption, expenditure on dairy products, prices and general preferences of different family members.

Local products included fresh milk, sour milk, yoghurt, butter and cheese. Imported products included evaporated milk, powdered milk, packaged liquid milk and other products such as baby formulae, yoghurt, butter and cheese.

Eighty-two per cent of all households consumed milk at least once a week. People of the northern ethnic groups tended to consume local products, while people of the south tended to consume more imported and derived dairy products. These differences were much less marked between urban and rural households.

Rapidly rising prices of imported dairy products have dramatically reduced consumption of imported dairy products in the Kaduna area. Besides price considerations there is widespread preference for locally produced products. Estimated overall income elasticities for liquid milk equivalents ranged from 0.30 (linear model) to 0.50 (log-linear model).

In the southern Nigeria study (Chapter 11), 982 indigenous households and 203 Hausa/Fulani households were surveyed. The Hausa and Fulani people, who are of northern Nigerian origin, have traditionally herded cattle and consumed milk. Seventy per cent of the indigenous households and 98% of the Hausa/Fulani households consumed some dairy products. Consumption prevalence and regularity of consumption of local products among the indigenous households was high around the points of production but low elsewhere, while regularity of consumption of imported products was high among both the indigenous and Hausa/Fulani households. There was a marked difference in the quantity of products consumed and expenditure on dairy products between ethnic groups, between urban and rural populations and between the south-west and south-east regions. Income and/or household size were the most important factors affecting the quantity consumed. Estimated income elasticities for total expenditure on all dairy products ranged from 0.43 for rural Hausa/Fulani households in the south-east to 1.18 for rural indigenes near Ibadan.

The analysis of the Lesotho household budget survey data (Chapter 12) showed a low level of dairy consumption—only 48% of the households reported

purchasing milk. Wide differences in consumption exist among income groups and consumption by the small proportion of households that produce milk was very high, at some 72 litres a year.

Marketing efficiency

Three Chapters (13, 14 and 15) deal specifically with marketing efficiency. Achuonjei and Debrah (Chapter 13) assess the efficiency of alternative market channels in the Bamako, Mali, milkshed. Mbogoh (Chapter 14) examines alternative sources of milk purchased by households in Addis Ababa, Ethiopia, and Debrah (Chapter 15) evaluates outlets to the point of first sale for intra-urban, peri-urban and rural producers within 85 km of Addis Ababa. While not their exclusive focus, other papers also allude to marketing efficiency.

Shapiro et al (Chapter 4) note that studies of agricultural marketing in Africa have generally found that farmers have a choice of outlets and that traders were reasonably competitive so that marketing margins reflected costs and not excessive profits. This seems to be the case for the informal and private dairy marketing channels. However, in many of the formal channels, margins fail to cover costs.

The main problems for efficient dairy marketing in the informal sector of SSA are:

- the small quantities supplied per farmer
- seasonal fluctuations in supplies
- the low volume of milk per square kilometre (low density)
- poor and seasonally impassable roads
- availability of transport and
- low level of education about collection and preservation of quality milk.

In addition, there are a number of operational problems contributing to inefficiency in the more formal marketing channels:

- irregular and delayed payments
- inefficient plant operations
- insufficient local supply and
- low capacity utilisation.

It is necessary to consider operational efficiency and the comparative efficiency of existing systems with potential alternative marketing structures. Much of the investment in dairy processing in SSA has been directed toward large-scale, state-operated processing plants, with satellite bulking schemes for collection of

milk from dispersed producers. These have largely been unsuccessful in promoting commercialisation of dairy production among small producers. Attempts to foster large-scale producers have not met with success either, these often being developed with the idea of accommodating reconstitution of imported skim-milk powder and butter oil.

A more decentralised and flexible approach is now being taken with more emphasis on small- and medium-scale processing by locating processing plants closer to producers and making them of sizes commensurate with volume requirements of various dispersed population centres.

Marketing systems

Dairy marketing systems

Chapters 16 through 21 give information of varying scope and emphasis about dairy marketing systems in six African countries: Kenya, Zimbabwe, Tanzania, Malawi, Ethiopia and Madagascar.

All these countries have parallel formal and informal marketing systems. The formal system consists of integrated commercial organisations for collecting, processing, packaging and distributing milk and other dairy products. It usually includes cooperative or parastatal organisations which operate under a number of gazetted regulations. The informal system usually involves simple traditional processing of, for example, butter, ghee, sour milk and cottage cheese and direct sales of unprocessed and unpackaged fresh milk. The informal system is mostly unregulated and usually requires no licensing. However, in some cases distributors are required to have licenses, a requirement that is, in many cases, difficult to enforce and is often circumvented.

Kenya and Zimbabwe (Chapters 16 and 17, respectively) are the only two sub-Saharan African countries that have well-developed, formal, commercial dairy marketing systems. In Kenya, the formation of the Kenya Cooperative Creamery (KCC) in 1925 marked the beginning of the formal dairy marketing system. Initially, KCC produced butter only, but over time it developed a full range of dairy product processing operations. The KCC was organised to serve commercial dairy farmers, but since independence in 1963 dairying has been transformed into a predominantly smallholder enterprise.

The relative importance of informal dairy marketing in Kenya seems to be declining. The annualised rate of growth in milk deliveries to KCC was 2.1% from 1963 to 1989 while the estimated growth rate in total milk production was about 2.8% from 1971 to 1987. However, studies indicate that nearly 60% of milk produced by Kenyan smallholders is consumed within the producing households. It is suggested that these quantities are larger than would be the

case if the nation-wide milk marketing system were better organised and more efficient. Delayed payments by KCC and by farmer cooperatives also indicate that the dairy plant operations and administration have room for greater efficiency.

Zimbabwe (Chapter 17) also has a well-developed formal marketing system but contrasts with Kenya in that large-scale commercial dairy producers predominate in this system. Indeed, until recently the formal system exclusively served the large-scale commercial sector. With the formation of the Dairy Development Programme under the Agricultural Development Authority, the formal marketing system has been extended to the small-scale, peasant sector. The informal marketing system is limited to the remote, peasant sector where small surpluses of fresh or sour milk are sold to neighbours.

The existence of an already developed commercial sector offers some advantages in fostering small-scale milk production in the peasant sector. The commercial sector is a source of breeding stock; has a sophisticated array of production inputs available to the large-scale producers, some of which will be useful in the development of small-scale systems; and finally, the range of state services developed to support the large-scale sector (dairy and veterinary services, research) can turn their attention to the small-scale producers.

At the same time, small-scale producers face most of the same regulations imposed on large-scale producers. Some of these, particularly the stringent conditions relating to facilities, milking parlours, milk rooms etc, pose major barriers to entry (Chapter 17). Nevertheless, the dairy development programme in Zimbabwe seems to be making progress towards promoting small-scale dairying in the peasant sector.

In Tanzania (Chapter 18) the formal marketing system is not well developed and is deteriorating because of several interrelated problems. Liquid milk production has been growing at 1.9% per annum while population has grown at 2.8% per annum. The formal marketing sector is composed mainly of operations of the Tanzania Dairies Limited (TDL). Eighty per cent of TDL's revenues are from sales of standardised, pasteurised milk, of which 90% comes from recombining imported raw materials. The combined output of TDL represents 5% of the total milk supply in the country. Only 30% of TDL's capacity is currently utilised.

Prices in the formal marketing system are controlled and are as low as half those in the informal system, which operates under the forces of supply and demand.

The following are some of the problems given as causes of this state of affairs:

- shortage of foreign exchange to purchase spare parts for equipment and inputs for processing such as chemicals, culture and packaging materials

- inadequate collection vehicles and lack of spare parts for maintaining existing vehicles

- underutilisation of processing facilities due to low milk intake, power supply and water problems and machinery breakdown

- small, scattered production units

- declining production on state farms and

- government intervention policies, including control of producer and retail prices, that have worked counter to their intended objectives.

Despite the predominance of traditional cattle in dairy production and of the informal dairy marketing system, little investment has been channelled into this sector. Nearly all the traditionally produced dairy products are marketed through traditional informal marketing channels. Only recently has emphasis shifted more towards improving traditional herds. As mentioned earlier, emphasis on small-scale processing with simple technology would seem to be worthwhile at this stage of dairy marketing development in Tanzania.

Malawian dairy development policy is geared towards supplying milk to the main urban centres, with the objective of achieving self-sufficiency in dairy production. To this end, three strategies are pursued: (1) establishment of state-owned and parastatal farms, (2) promotion of medium-sized commercial farms and (3) introduction of smallholder dairy development schemes. Nankumba and Mangisoni focus on the third strategy in Chapter 19.

The formal marketing system consists of milk collection centres which deliver to Malawi Dairy Industries. Most of the farmers in the survey reported selling through the formal marketing channel, though some reported selling to middlemen, directly to consumers and to groceries and "Indians". The main reason for the predominance of the formal marketing channel among these producers is their involvement in the dairy development scheme which features loans to purchase crossbred cows and equipment and repayment through monthly deductions by Malawi Dairy Industries.

The authors note that marketing is fraught with difficulties. Lack of efficient storage systems and delayed payments discourage farmers from selling their milk through bulking groups to the Malawi Dairy Industries. Farmers also incur all losses when milk spoils, which leads to the break up of bulking groups.

Coppock et al (Chapter 20) report on dairy processing and marketing in a semi-arid pastoral system in the Borana Plateau of southern Ethiopia. Household surveys described seasonal milk production and allocation of marketed surplus of dairy products, incidence of calf morbidity and mortality and human consumption of dairy products and grain. Dairying was controlled by women. Overall, 69% of production, net of that consumed by calves, was used as fresh

milk, with the remainder soured for consumption or butter processing. Quantities marketed were greatest in wet seasons and wealthy families close to markets sold the largest amounts of fresh milk and butter. Poor families sold much less, though dairy income was relatively more important for the poor, who used the money to purchase grain. Technical interventions to improve milk processing are largely irrelevant as milk surpluses are decreasing as the ratio of cattle to people has declined and continues to do so.

Ranaivoson (Chapter 21) reports on dairy marketing in Madagascar. Towns, hamlets and villages offer a ready market for fresh milk and dairy products and account for the expansion of dairy production in their immediate vicinity. Marketing is mainly through simple traditional channels with prices determined by market forces.

The traditional channels include direct sales to consumers and sales to middlemen including cycling milkers, small-scale butter and cheese producers, milk-collection centres and dairy plants. The cycling milkers, who are apparently unique to Madagascar, are experienced milkers who contract with several farmers to milk their cows and deliver fresh milk to regular customers by bicycle. They normally pay the farmer at collection but occasionally after the milk is sold.

There are nine large-scale dairy plants in Madagascar, seven of which are state-owned. These plants operate at very low levels of efficiency in relation to their capacity, and depend on imported products for most of their through-put. Local milk meets only 6% of their current capacity. Even if all marketable milk were delivered to the plants, they would still operate at only 19% of their capacity.

The main constraints to marketing efficiency reported in the study include: low farm prices and regulated low profit margins, poor roads, high costs of fuel and spare parts, competition with heavily subsidised imported products and low purchasing power of consumers.

Primary data collection problems

Most analyses of African dairy marketing must start with the collection of primary data from field surveys. The most difficult aspect in such surveys is to minimise non-sampling errors. This aspect of African marketing research is so important that a paper dealing with survey planning and non-sampling errors was included in the programme. Rowe and Decosse (Chapter 22) provide an excellent paper in which they present an iterative survey approach.

Their paper presents techniques that help avoid non-sampling errors. The authors argue that successful surveys are the product of detailed planning and seemingly inordinate attention to minimising non-sampling errors. They discuss the need to approach the survey planning process in an iterative manner in which all stages of the survey are considered with respect to their contribution to the

whole. The potential impact of non-sampling errors on the selection of optimal survey methodology, the design of questionnaires and the interview process are all discussed.

Research issues and priorities

Data and rigorous quantitative analysis of the factors affecting production, marketing efficiency, consumption and international trade and the linkages between these are very sparse throughout sub-Saharan Africa. The formulation of appropriate policies and development strategies for the dairy sector requires reliable quantitative information on all facets of production, marketing and consumption.

The Symposium identified a wide range of areas in which research is needed to guide effective policy-making and strategies for dairy development. The priority research areas include:

- production/supply response
- demand and consumption patterns
- effects of dairy imports and
- marketing systems and marketing efficiency.

Production and supply response

Because of the general lack of data bases on aggregate or regional production, input use and product and input prices, much supply response research should focus on micro production response.

For guiding dairy development strategies, Nell (Chapter 3) stressed the need to investigate the effects of different marketing systems and production support systems (provision of credit to buy improved cattle, and provision of veterinary services, extension services and input supplies) on output and the economic returns of different production systems. He argues that investigation should include analysis of opportunity costs of dairying, the division of labour among household members and the role of farmers' organisations in dairy development.

While micro supply analysis can provide insight into possible aggregate supply response, the need remains for more aggregate response estimates to guide policy and development strategies. Some key issues needing quantification are farmers' responses to farm prices, reduction in risk and uncertainty, changes in costs of inputs, opportunity costs and improvements in support services and technology. These needs are continuing and help define the types of data bases to construct and maintain.

Demand and consumption

To guide in the development of appropriate marketing systems and policy, there is a need for many more dairy consumption studies throughout sub-Saharan Africa (along the lines of those reported in Chapters 9 through 12) focusing on consumers' preferences and consumption patterns for different dairy products as they relate to prices, income and certain demographic factors. The studies presented (Chapters 9 to 12) have reported on many of the difficulties in planning and conducting demand studies in SSA and it is essential that these problems be overcome in future efforts. The development of appropriate demand systems for guiding survey design and data collection is also important. Data requirements for complex demand systems or models are onerous and testing is needed to determine the simplest adequate demand models for estimating price and income elasticities and other demand-related parameters.

Noting that income is expected to grow slowly but that Africa's towns and cities are growing rapidly, Shapiro et al (Chapter 4) stressed the need to quantify the effects of income and urbanisation on future demand and the importance of separating the effect of urbanisation on demand. Moreover, even small towns are shown to offer important markets for dairy products so that the geographic dispersion of urbanisation is important to consider in planning broad-based dairy development.

Effects of dairy imports

Research is needed to determine the linkages between markets for imported and domestic dairy products and the expected behaviour of domestic producers. On the market side, information is needed on the geographic dispersion of different imported products, consumers preferences and their substitutability for domestically produced products. On the producer-response side, analysis is needed to determine the effects of imports on farm-level prices and their response to these prices.

In some cases, particularly in countries with high imports and poor prospects for dairy development, there is a question of whether or not dairy development should be promoted and if so at what level. Analysis of comparative advantage in dairy production among trading countries is needed to guide dairy development policy.

Marketing systems and marketing efficiency

Very few dairy marketing efficiency studies have been done and those are very limited in scope. A neglected area of efficiency research is the management and operational efficiency of the various market functions. That excessive profits are

absent does not necessarily imply that operations throughout the marketing channels are carried out at least cost. Much more analysis of the efficiency of operations for the different marketing functions is needed especially in the state-operated, formal marketing systems.

There is a dichotomy in dairy marketing systems between traditional, small-scale systems and modern systems with large-scale processing plants. The traditional systems are based on simple processing, usually by the producers, of such products as butter or ghee, simple cheeses and milk. These products are marketed directly to consumers or indirectly through middlemen. The modern large-scale plants suffer from poor management, lack of supplies and seasonal fluctuations in supply and many have not been successful. This dichotomy may have arisen in part because the motive for investing in large-scale modern plants was to accommodate dairy imports rather than to meet the marketing needs of small-scale producers.

A recurrent message from the Symposium was the idea that future development of dairy marketing systems needs to focus on the producers' requirement in supplying consumers with the range of products they want. It is necessary, therefore, to investigate the full range of processing technologies, which vary in sophistication and scale from simple on-farm processing to modern large-scale processing plants, and to identify the most efficient technologies and marketing structures among the many alternatives. An advantage of small-scale dairy processing may be the opportunity it offers for private investment in dairy marketing systems.

A major constraint in developing dairy marketing based on small-scale processing will be the shortage of experienced personnel to operate small dairy processing plants. This constraint also applies to the supply of analysts who are knowledgeable about the full range of dairy processing alternatives.

The issue of hygiene was raised in consideration of alternative marketing channels. In some cases, it was felt that poor hygiene and potential health problems from lack of pasteurisation was reason to ban sales of unpasteurised milk through informal marketing channels. However, studies demonstrating significant health problems (i.e. from brucellosis and tuberculosis) related to sales of unpasteurised milk are not cited. It is suspected that the undeclared and real objective of banning unpasteurised milk sales is to eliminate competition from the more efficient traditional marketing systems. Even if health problems do exist, the question still remains as to whether it is in the public's interest to solve hygiene-related problems by means of expensive processing, as this would, if enforceable, clearly reduce milk consumption. While it is thought that many consumers do boil their milk, an information campaign to educate consumers to the possible hazards of unboiled or unpasteurised milk may prove to be more in the public's interest than regulations banning sales of unpasteurised milk.

References

Bachmann M. 1987. Products and processes, possibilities and limitations of decentralized milk processing. In: *Dairy development in East Africa*. Bulletin of the International Dairy Federation 221:95–96. International Dairy Federation, Brussels, Belgium.

Jahnke H E. 1982. *Livestock production systems and livestock development in tropical Africa.* Kieler Wissenschaftsverlag Vauk, Kiel, Germany. 253 pp.

von Massow V H. 1989. *Dairy imports into sub-Saharan Africa: Problems, policies, prospects.* ILCA Research Report 17. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 46 pp.

Senait Seyoum. 1988. *Patterns of consumption of dairy products in West Africa.* LED Working Paper 11. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 52 pp.

World Bank. 1989. *Sub-Saharan Africa: From crisis to sustainable growth.* World Bank, Washington, DC, USA. 300 pp.

World Bank. 1990. *Dairy development in sub-Saharan Africa: A study of issues and options.* World Bank, Washington, DC, USA. 178 pp.

Rapporteurs' closing review

Edward V. Jesse and Ousmane Badiane

Part I. Edward V. Jesse

We (O. Badiane and myself) will share the responsibility of presenting the review and synthesis of this excellent Symposium. Our task is a difficult one. Many splendid papers were presented and the discussion sessions have yielded many insights and recommendations regarding dairy marketing issues as they pertain to development of the dairy sector in sub-Saharan Africa. We are unable to provide a synopsis that adequately conveys all that has transpired, but we shall attempt to summarise and expand on some of the major issues.

The review will be structured around two basic questions applied to six general areas. The two questions are:

- What have we learned? This applies both to this conference and, more generally, to the store of dairy marketing research relating to sub-Saharan Africa.

- What are the implications of what we have learned for further research and policy?

The six areas[1] that will be addressed are :

1. Milk supply

2. Milk processing

3. Research methodology

4. Demand for milk and dairy products

5. Marketing efficiency

6. Dairy marketing infrastructure.

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1. Professor Jesse prepared summary comments for areas 1 to 3, Dr Badiane for areas 4 to 6.

Milk supply

Before I begin my summary, it is only fair that I expose my biases. I claim the dubious distinction of knowing less about the economics of dairying in Africa than anyone else at this Symposium (at least, that was the case until six months ago when Professor Shapiro and I began writing our paper). All of my work has been directed at dairy marketing in the United States. That means that my comments can be interpreted as representing either a **fresh** perspective or a **naive** perspective—I shall let you be the judge!

Regardless of your judgement, I must note that the problems and issues relating to dairying in sub-Saharan Africa discussed here are not altogether different from those in developed countries like the United States. Much of my time as a dairy marketing economist is devoted to such topics as the role of dairy subsidies, regulated pricing, efficiency of milk collection and processing and distinctions between large-scale (corporate) and smallholder (family farm) dairying. And much of what I heard in the last week is often said at US dairy conferences.

Let me illustrate with an example the large-scale–smallholder distinction issue. Wisconsin and California are the two largest milk-producing states in the US and together account for about 30% of total US milk production. The table below compares selected measures of size and productivity between them:

	Wisconsin	California
Milk production (billion litres)	11	9
Number of commercial dairy farms	30,000	1200
Number of cows per farm	50	1000
Milk production per cow (litres)	6400	8200
Number of cheese plants	350	10

Given these large differences, it is clear that national policies have a substantially different effect on dairy farmers in these two states. But they coexist quite peacefully, despite vastly differing farm production methods and marketing practices in use. More importantly, the production and marketing technology in both states is state of the art; Wisconsin dairy farmers (smallholders) are not using hand-me-down techniques from their larger California cousins.

What this says to me is that diverse production and marketing systems can exist side-by-side in African countries. There is no single model of "appropriate" technology or marketing system. Efficient smallholder methods can coexist with those specifically designed for larger dairy operations.

I shall divide my comments relating to supply issues into two categories: those pertaining to domestic supply response (in the economic sense) and those pertaining to imports and food aid.

Domestic supply response

This Symposium has confirmed that there is a good understanding of factors affecting milk supply response in sub-Saharan African countries. These factors are generic; they apply to dairy farmers anywhere and include:

- Farm-level prices

- Risk and uncertainty:

  - price risk

  - risk of rejection by plants (Malawi)

  - risk of delayed payment (KCC)

- Cost of inputs (labour, feed, fixed assets)

- Opportunity costs and

- Technology.

But while we understand the factors that influence supply and the direction of their influence, there has been little rigorous quantitative analysis of how farmers respond to these factors. In my opinion, this is a serious deficiency since it is impossible to craft appropriate policies without such knowledge. Let me give some examples:

- What would be the impact of increasing milk price subsidies? We cannot say without knowledge of supply elasticities.

- How would a subsidy on dairy feeds affect milk production? We cannot say without knowledge of dairy farmers' response to input prices.

- How would a seasonal price stabilisation scheme affect milk production? We do not know the effect of risk on milk producers' supply response.

This Symposium has demonstrated that we know much more about consumer behaviour than producer behaviour. I submit that the research focus has been imbalanced. Wise policy decisions require a better understanding of producer supply response.

A related issue concerns pricing subsidies to encourage expanded milk production. Is it necessary to provide "extra-market" incentives to sub-Saharan African dairy farmers? Quantitative evidence is ambiguous, but anecdotal evidence and the experience from other parts of the world all say yes. Dairy

subsidies are used practically everywhere, and production and marketing conditions in Africa suggest the need for even higher subsidies than exist in other countries.

If price subsidies are necessary to stimulate adequate milk production, then what should be the level of subsidy? The key element in answering this question is cost of production. Unfortunately, while there has been some progress in estimating cost of milk production, there has been no systematic approach used.

Measuring cost of production is difficult, and comparing individual country estimates across several countries is fraught with problems of different production and marketing practices and uncertain exchange rates. Nonetheless, consistency can be promoted if a common agency "sets the rules". In my opinion, ILCA is the logical institution to develop a common procedure to assure consistency in cost-of-production studies.

Imports and food aid

A common theme during this Symposium has been that the cost of dairy imports is likely to increase and that the volume of dairy food aid will be considerably less in the future. This is especially true in the short run, since skim-milk powder remains relatively scarce and expensive. The long-run situation is less clear, but significant changes in the dairy policies of developed countries suggest no major change from the status quo. Consequently, there will be greater economic incentives to promote domestic milk production in developing countries that have previously relied on free or subsidised imports of dairy products, mainly skim-milk powder. This is a very desirable situation from the perspective of a market-oriented development policy.

More generally, this Symposium has made it very clear that the net welfare effects of dairy food aid are not at all clear. We have learned that the positive effects of dairy food aid include a large local supply of dairy products, improved nutrition (at least in the short run) and increased processing-plant efficiency. Negative effects are reduced prices to domestic dairy farmers and reduced incentives for dairy processing plants to develop a local milk supply. The effect of dairy food aid on total demand for dairy products is uncertain.

Given the uncertainty about the net welfare effects of food aid, countries that continue to receive it should develop an appropriate pricing policy that will retain positive effects and minimise negative effects. Policies to consider include quantitative import controls and import pricing rules that do not discourage domestic production. I would also note that cheap, subsidised imports of dairy products have the same effects as food aid and until recently, the cost of imports has not reflected their true value in terms of what it cost to produce them.

Milk processing

The current mix of dairy products seems to be appropriate to local needs and preferences. A full range of dairy products is generally available and one possible research area might be into expanded markets for fermented and sour milk products. These products are compatible with the lack of facilities for adequate cooling of milk at the farm level.

Milk quality can be both an economic and a food safety problem. If poor quality jeopardises human health, then state intervention is necessary. If poor quality results in reduced product yields, then quality improvements can be encouraged by proper market signals. It appears that, in general, milk quality problems in sub-Saharan Africa are manifested in low yields and consumer complaints rather than serious health concerns. Consequently, quality premiums and penalties might be considered to improve milk quality.

Like products, existing milk processing methods seem appropriate to current conditions. In particular, we have been shown by ILCA that preservation and processing methods for smallholders are available. The issue is more one of how to enhance knowledge of appropriate technology. This calls for greater efforts to disseminate available knowledge.

Research methodology

A major dairy marketing research issue concerns the quality of data. It has been demonstrated that milk production data are questionable, at best. Price data are, perhaps, marginally better, but difficult to compare among countries because of varying exchange rates and differences between official and unofficial rates of exchange. Consumption data are better than production or price data, but still highly imperfect.

Data problems suggest that considerably more attention must be devoted to systematic collection of reliable and readily comparable data. It is impossible to measure progress toward a policy goal without knowing where you are. Efforts currently under way in the Gambia toward an effective agricultural statistics reporting system might serve as a guide in this regard.

We have heard reports based on many dairy consumption surveys. These surveys have used appropriate statistical methodology. Unfortunately, procedures have varied among surveys, rendering cross-comparisons either difficult or impossible. A "clearing house" is needed; that is, some means of coordinating survey designs, questionnaires and analytical procedures to enhance the value of the surveys beyond their immediate purpose. Can ILCA serve as this clearing house?

Finally, I want to raise the broad issue of the net benefit of dairy development in sub-Saharan Africa. Dairy development has several positive attributes. Dairy products are nutritious. Milk-producing animals can make use of feeds that cannot be used directly by humans. Dairy development has been demonstrated to be an excellent means of promoting rural economic development.

There are also negative aspects of dairy development. Marketing dairy products is necessarily complex and expensive and milk is subject to many forms of contamination. Milk is a relatively costly source of nutrients compared with grains and pulses.

How do these pluses and minuses balance? We really do not know because comprehensive cost–benefit analyses have not been conducted. Major goals in most sub-Saharan African countries are food security and enhancing rural development. I will risk accusations of heresy by asking the question, "Is dairy development the right strategy to achieve these goals?"

Part II. Ousmane Badiane

Given the limited amount of time I had to go through the two dozen papers presented at this Symposium, I am sure you will understand if I fail to mention some of the very interesting findings of these studies.

Mr Chairman, did you know that a substantial part of the findings presented during the last four and a half days are based on the survey of 9267 rural and urban households and 883 producer households in five African countries, namely Cameroon, Kenya, Lesotho, Mali and Nigeria? This may not look impressive when compared with the large number of studies carried out in many parts of Asia during the 1960s but for the African continent and its livestock sector, this represents a big step in the right direction.

What have we learned from these surveys and the many other papers presented here, about:

- demand for dairy products and factors affecting it?

- the efficiency of dairy marketing?

- the commercialisation of dairying in Africa?

I will first summarise the main findings of the Symposium in the above areas and then discuss research areas and implications not covered in the agenda. To give some figures:

- Per caput milk consumption in Africa ranges between 6 and 58 kg, with an average of 27 kg liquid milk equivalent. It has been growing at an annual rate of approximately 4%.

- Demand for dairy imports has been increasing at a rate of 8% a year to reach, in 1986, six times its 1961 level. The average share of dairy imports in consumption during this time has been around 20% and is much higher in urban than rural areas. Since the mid-1980s, however, dairy imports into Africa show a falling trend.

Determinants of demand

Besides the conventional determinants of demand such as income and prices, the level, composition and frequency of demand for dairy products seem to be very sensitive to:

- demographic factors such as ethnic origin, age and gender composition and education

- location, i.e. urban or rural and

- origin of products, i.e. local or imported.

On the role of income as a determinant of demand:

- per caput dairy consumption can be as much as three times as high among wealthier groups as among lower income groups

- the share of income spent on dairy products reaches 28%

- estimates of income elasticities range between 0.34 and 0.8.

On demographic factors, as may be expected, some of the papers have shown that populations with agropastoralist traditions consume significantly more dairy products than populations without such a background. The latter, however, frequently develop dairy consumption habits when exposed to dairy products.

On the location issue, studies in Mali and Nigeria have shown that urban populations consume substantially larger quantities of imported commodities than do rural populations, and the demand for imported dairy products in urban areas is more regular than demand for local dairy products. Dairy demand is generally higher in higher income urban centres than in rural areas. Dairy demand also tends to vary with agro-ecological zones, quantities consumed being much higher in arid and semi-arid areas than in the humid zone.

Last but not least, the composition of dairy demand has been consistently shown to be very sensitive to distance from and access to markets.

Marketing efficiency

The main determinant of the efficiency of dairy marketing systems is the economic distance separating production from consumption areas. This distance is a function of:

- physical distance

- quality of infrastructure

- availability of transport and

- number of marketing agents.

A consistent finding of many of the country studies is that the costs of transferring commodities from producers to consumers are lowest where the marketing chain is shortest. Small-scale producers generally use shorter, informal marketing channels. These specifics are crucial for the design of dairy development policies and I will come back to them later.

Although formal marketing channels reduce the risk and uncertainty faced by farmers, their efficiency has been found in a number of countries to suffer from irregular and delayed payments; lack of efficient transport and storage systems; and mounting deficits.

It should be noted that formal marketing channels are of less significance than informal channels, both in terms of the number of farmers involved and the volume of milk marketed.

In some of the studies presented, tests of marketing efficiency have been carried out. In Mali, for example, it was found that retail prices at different sale outlets were, in most cases, similar after adjustment for transportation costs. Efficiency tests carried out in two dairy market studies in Addis Ababa showed direct milk sales to be the most efficient marketing system.

Commercialisation of the dairy sector

Let me introduce this section by noting that the studies presented at this Symposium have put much more emphasis on demand factors and market organisation than on infrastructure and urbanisation and on their implications for the commercialisation of the dairy sector.

As already mentioned, the marketing of dairy products is particularly sensitive to distance (in terms of time) between areas of production and consumption. In one of the studies, quantities of dairy products sold annually were found to be closely and positively correlated with the frequency of sales, which itself was negatively related with distance to markets.

On the other hand, there is ample evidence in rural development studies that urbanisation has a strong effect on the demand for agricultural commodities through its impact on population size, income level and supply of consumer goods. The effect of urbanisation is particularly strong in the case of livestock products, given their higher income elasticity of demand. In fact, almost all of the studies presented here have shown dairy demand to be much higher in urban areas.

However, it is crucial to note that the impact on commercialisation and sectoral development will be highest where the process of urbanisation is more decentralised. Decentralised urbanisation promotes the creation of secondary urban centres, thereby stimulating demand near smallholder areas. Furthermore, by shortening marketing chains and raising the supply of consumer goods, it raises farmers' incentives to sell their products. Especially in smallholder dairying areas, in which large-scale dairy marketing systems have proven to be inefficient, there is a strong need to decentralise urbanisation. Therefore, the concentration of urbanisation should be looked at as a constraint to dairy development in Africa.

Implications for dairy research and policies

Let me start this section with a few comments on the relationships between livestock and dairy development and the role of marketing. I think that a meaningful and comprehensive way of looking at the issues debated here is from a rural development point of view. The question is then: "What do we need to know and what needs to be done to enhance the contribution of dairying to rural and overall development?"

Attempting to answer this question raises a number of other issues that should be the focus of livestock and dairy research and policy making. For dairying to contribute to rural development and food security, the rate of growth in the livestock sector needs to be accelerated. This raises the issue of technological advance for which a precondition is the commercialisation of the sector.

But if growth in the livestock sector is to have an effect on the economy as a whole, the livestock sector needs to be integrated and linked to the rest of the economy. Sectoral integration and linkages bring us to the issue of transaction costs on rural and agricultural markets and back to the problem of marketing. Now that I am back to the direct subject of the Symposium, I will quickly go over the research recommendations I see arising.

- So far, the Symposium has focused on the testing of marketing efficiency. However, in order to have information on how to improve marketing efficiency, market integration and sectoral linkages, research efforts will need to extend to factors determining the quality of market linkages, namely the costs of transactions on dairy markets. It is therefore crucial to investigate not only their level but also their structure and the factors underlying them.

- In many areas of Africa, dairy commodities are consumed with other products. Future consumption surveys and studies would need to include inter-commodity linkages.

- A key factor in marketing efficiency is the policy and institutional environment. The viability and adoption of improved technologies are similarly influenced by the same environment. A better understanding of the interaction between this environment and various dairying systems can be very useful in designing dairy development strategies.

- The specifics of dairying across systems and agro-ecological zones need further research to enable prioritisation and targeting of dairy development endeavours.

Now very briefly to policy recommendations. First, dairying is very likely to suffer, at least in the long-run, from stagnation in the overall agricultural sector, particularly in the cereals sector. A precondition to long-term development is, therefore, the establishment of a policy environment that is favourable to development in the agricultural sector as a whole. Second, governments can do a great deal to promote dairy development by providing support services and by supporting improvements in technology and rural infrastructure. In carrying out sector policies, interference with market forces in a way that reduces the quality of the integration of agricultural markets should be avoided.

An overview of dairying in sub-Saharan Africa

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Abstract

The main dairy production systems (pastoral, agropastoral, mixed farming, intensive and peri-urban) and their potential for commercialisation of milk production are described. The highest potential is in the mixed farming and intensive production systems. Dairy development experiences in Kenya, Tanzania and India are compared.

Introduction

Africa accounts for just over 2% of world milk production. The principal exporters of milk products are the European Community (EC), New Zealand and the USA, with the EC typically accounting for up to half of the total. Only about 5% of world milk production is traded internationally; thus, world prices are highly vulnerable to small changes in either supply or demand in the principal producing areas. High guaranteed support prices for domestic producers in many industrialised countries, combined with controls on imports and the subsidisation of exports, have distorted international trade and prices.

The high guaranteed prices and advances in technology led to the rapid growth of milk output in many countries over the past two decades, while demand stagnated or even declined. Thus large surpluses became available for export, often at highly subsidised prices, and world prices remained low. The introduction and progressive tightening of milk quotas in the EC has led to a

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1. The author participated in a World Bank study entitled *Dairy development in sub-Saharan Africa: a study of issues and options*. The material presented in this paper originates from this World Bank study. The contents of this paper present the views of the author and not necessarily the views of the World Bank.

two-thirds reduction in the export surplus. Similar measures in the USA and drought in New Zealand and the USA have further reduced export supplies. The result was an initial trebling of world prices followed by a fall-back in prices. For example, world prices of skim-milk powder rose from under \$600/t (f.o.b.) in 1985 to around \$2000/t in early 1989, fell back to \$1650/t in early 1990 and came down to as low as around US\$1000/t recently.

Dairying is a biologically efficient system which converts large quantities of inedible roughage to milk. It is to a certain extent a more efficient and intensive system, in terms of nutrients and protein production for human consumption from a given area or quantity of feed, than beef or sheep farming. Milk production is more efficient than beef production when the nutritional potential of the feed resource base is high and therefore capable of supporting high levels of production. It is a continuous production process and requires a continuous supply of feed of consistently good quality. Interruption of feed supply even for a short period causes a marked decrease in milk yield during the remaining part of the lactation. Beef production, on the other hand, is a non-continuous process and is often better adapted to the seasonal fluctuations that are so common in sub-Saharan Africa.

Population growth results in increased demand for dairy products. In addition, the income elasticity of demand for dairy products remains high over a wide range of incomes. Hence the market grows steadily as societies develop. Where conditions are suitable, dairying is preferred to beef production as it makes more efficient use of the available feed resources and provides a regular source of income to farmers. It is also much more labour intensive, providing employment in production, processing and marketing. However, milk production often requires the introduction of improved breeds of cattle, as well as increased levels of inputs, improved management, curative veterinary services and good marketing facilities.

Development of dairying is more difficult in Africa than elsewhere because the constraints and problems faced in Africa are more severe. However, there are potentials and opportunities for dairy development in some areas and the economic climate is currently much more conducive to indigenous production than it was in the past.

Dairy production systems

Opportunities for dairying in sub-Saharan Africa are largely determined by the agro-ecological zone, the livestock production system and the tsetse challenge. Five agro-ecological zones and five milk production systems may be distinguished in sub-Saharan Africa.

The classification for agro-ecological zones is based on the number of plant-growing days and temperature (Jahnke, 1982):

Arid zone: fewer than 90 growing days
Semi-arid zone: 90–179 growing days
Subhumid zone :   180–269 growing days
Humid zone: 270 growing days or more, with high temperature and high relative humidity
Highlands: this area ranges from semi-arid to humid but with an average temperature of less than 20°C during the growing period. It covers in general the area over 1500 m above sea level.

The following livestock production systems are recognised (see also Table 1):

Pastoralism (nomadic and transhumant): Livestock owners who exploit natural grasslands mainly in the arid areas. Pastoralists are with their herds always and move continually looking for fresh grazing areas. Nomads have no permanent home while transhumant herders have permanent homes in less arid areas. The main source of food for pastoralists is milk.

Agropastoralism: Agropastoralists are sedentary farmers who grow food crops and also keep livestock. Their livestock graze on communal land, fallow land and crop land after the harvest. Livestock are used for draught, savings and milk production. Shifting cultivation is a common practice.

Mixed farming: Food- or cash-crop cultivation is the main agricultural activity. Farm size is normally small, 1–5 ha, with a moderate to high cropping intensity. Maintenance of soil fertility is one of the main problems. Livestock are kept for draught, valorisation of crop residues, improving soil fertility and providing additional food or income from milk or meat.

Intensive dairy farming: In this system, farmers use part or all of their land to grow fodder crops for their dairy cattle. They may also purchase concentrates. Farmers may also use land for food crops or cash crops. The dairy animals do not provide draught, but their manure is used as fertiliser on crops. Milk is the main source of farm income. Intensive farming is mainly undertaken by small farmers using family labour, but commercial farmers using hired labour and parastatals also practise this system on a larger scale.

Peri-urban dairying: This system occurs around cities, where demand for milk is high. The main sources of feed are agro-industrial byproducts (e.g. brewery waste and oilseed cakes), cultivated fodder crops and crop residues. Milk is often sold directly to consumers in the city and is the main source of income for the farmers.

Livestock production is severely restricted in areas infested by the tsetse fly. Trypanotolerant breeds of cattle, sheep and goat are available but they have a low potential for milk production. Livestock production with improved dairy

Table 1. *Characteristics of different dairy production systems.*

	Pastoralism	Agropastoralism	Mixed farming	Intensive dairy farming	Peri-urban milk production
Priority of the farmer	Subsistence, Milk production, Livestock numbers	Subsistence, Meat/milk production, Draught	Draught, Soil fertility, Milk/meat production	Sale of milk	Sale of milk
Farmers' attitude	Aversion to risk	Aversion to risk	Spreading of risk, Integration	Cash income	Cash income
Species	Camel, sheep, goat, cattle	Cattle, sheep, goat	Cattle	Cattle	Cattle
Feed resources	Communal grazing	Communal grazing, Crop residues	Crop residues, Cultivated fodder, Communal grazing	Cultivated fodder, Purchased concentrates	(Purchased) roughage and concentrates
Farmers' mobility	Mobile	Sedentary	Sedentary	Sedentary, Absent	Sedentary
Type of enterprise	Extended family	Smallholder, Extended family	Smallholder	Smallholder, Commercial farmer, Parastatal	Smallholder, Commercial farmer
Milk production (surplus)	Seasonal	Seasonal	Mainly seasonal	Continuous	Continuous
Yield per cow per day (kg)	0.5–1	0.5–1	1–5	5–15	5–15
Average daily surplus per farm (kg)	1–5	1–5	2–10	5–20 (smallholder)	5–30 (smallholder)
Average land area per animal (ha)	5–10	2–5	0.5–2	0.5	0–0.5

continued

Table 1. *Characteristics of different dairy production systems* (cont.).

	Pastoralism	Agropastoralism	Mixed farming	Intensive dairy farming	Peri-urban milk production
Milk density (kg milk/km^2/day)	2.5	5.4	30	250	250
Inputs used	Veterinary services (vaccinations)	Veterinary services (vaccinations)	Veterinary services, feed, minerals, extension, credit	Concentrates, breeding services, credit, extension, training, veterinary services	Concentrates, roughage, breeding services, credit, extension, training, veterinary services
Main constraints	Land tenure system, animal nutrition, animal health, low milk density	Land tenure system, animal nutrition, animal health, low milk density	Animal nutrition, infrastructure, marketing, knowledge on integration, extension/training	Animal nutrition, genetic potential/breeding, infrastructure/ marketing, extension/training	Animal nutrition, genetic potential/breeding, extension/training
Potential for commercialisation	None/very limited	None/limited	Yes	Yes	Yes

breeds is possible in areas with light or seasonal tsetse challenge, but requires strict veterinary control.

The distribution of the various dairy production systems and the degree of tsetse challenge over the agro-ecological zones is shown in Table 2.

Table 2. *Dairy production systems and agro-ecological zones.*

Dairy production system	Agro-ecological zone				
	Arid	Semi-arid	Subhumid	Humid	Highlands
Pastoralism	+	+	-	-	-
Agropastoralism	-	+	o	-	+
Mixed farming	-	o	+	o	+
Intensive dairying	-	-	+	-	+
Peri-urban dairying	-	o	+	o	+
Tsetse challenge	-	-+	+ -	+	-+

- Production system does not exist.

o Production system exists under specific circumstances.

+ Production system exists.

For tsetse challenge:

- none or very limited

-+ tsetse in limited areas

+ - tsetse in 30-60% of the area

+ + tsetse in over 70% of the area.

Milk production density, expressed as kg milk/km^2 per day, indicates the collectability of milk. As a rule of thumb, a collection centre must collect at least 200 litres of milk daily to cover cost of personnel and transport or local processing. Milk production density can also be used to indicate the infrastructure that is warranted by local production. Some examples of milk production densities are given in Table 3.

Potential for commercialisation

The potential for commercialisation of milk production depends to a large extent on the production system.

In the pastoral production system, milk production per unit area is low and the producers have little or no control over the feed resources. Collection of milk for commercial processing is difficult due to the mobility of the producers and the small milk surpluses.

Table 3. *Milk production density in selected areas (kg/km^2 per day).*

Sub-Saharan Africa	1.5	India	28
West Africa	0.7	Operation Flood areas in India	40–100
East Africa	4.2	The Netherlands	930
Central Africa	0.2	Ireland	247
Southern Africa	0.5	Switzerland	256
Kenya	6.1	New Zealand	82
Mali	0.5		
Zaire	> 0.1		

Agropastoralists also have little control over the feed resources they use. Milk production fluctuates with the seasonal availability of feed and collecting enough milk for commercial processing is almost as difficult as in the pastoral system.

Cattle in the mixed-farming system are kept primarily for draught power and to provide manure as fertiliser. Milk production is often of secondary importance. Private land ownership, prevalent in the mixed-farming system, allows for improved feed production in the form of fodder crop cultivation and planting of fodder trees. Dairying in the mixed-farming system is attractive since it offers the opportunity to diversify operations, spread risks and provide continuous income. The quantity of surplus milk could justify the establishment of supporting infrastructure and collection and processing centres.

In the intensive dairy farming system, farmers produce their own roughage and purchase concentrates. Farmers are commercially oriented and invest in their enterprise.

Peri-urban dairy farmers rely mainly on purchased feed. They are commercially oriented and will respond to an improved infrastructure for input supply.

To summarise, the potential to increase milk output from pastoralist and agropastoralist production systems is limited and depends on costs of collection, transport and processing. Mixed farmers and intensive dairy farmers in rural and peri-urban areas have more control over their inputs, and improvements in inputs result in increased milk output. There is thus a potential to increase milk production per cow, per farm and per unit area, which would reduce the cost per litre of the required supporting infrastructure (input supply, animal health services and marketing).

Dairy producers

Pastoral herds are managed by household heads. Most animals belong to the men and their sons but a few belong to wives and daughters. The men are

responsible for managing herd welfare, organising access to pasture, water and health care, but most of the actual herding is done by boys. Men usually milk the cows and thus control how much milk is extracted and how much is left for the calves. However, among nomadic groups it is often the women who milk the cattle and who decide how much milk is kept for the family and how much is sold. Thus, in general, men control the amount of milk available for sale or consumption and women control the consumption, processing and sale but do not always have the benefit of the income. Men may try to reduce milk offtake to benefit calf growth and hence increase herd size, while women are more interested in having enough milk for the family and for sale or barter.

In mixed-farming systems, livestock are kept on small family farms. Generally, men are responsible for land preparation and women for planting and weeding. Women are often responsible for a major share of the livestock-related work, such as feeding, watering and milking.

Owners of dairy cattle in intensive dairy farming and in peri-urban milk production units are mainly small farmers but can also be small businessmen or (retired) government civil servants who depend wholly or partly on hired labour. Again labour distribution for the dairy activity depends partly on tradition, social and cultural factors. Tasks could be shared equally between members of the household, but women may do most of the routine work. Hired labour is not uncommon. Cash income from milk marketing may go to women but may be claimed by men, especially if payments are received once a fortnight or once a month and sums involved are large.

In promoting dairy production and marketing, all aspects of the farming system should be thoroughly investigated to avoid interventions that unduly increase the work-load of women or that lead to an unfair distribution of income. These aspects are important for defining the main target group for extension and training activities in dairy development.

Scale of dairy farming

Dairy farming in East and southern Africa (e.g. Kenya and Zimbabwe) started in the beginning of the century on medium- to large-scale farms using imported cattle. Keeping dairy cattle on specialised farms requires knowledgeable and skilled management. Private commercial farmers in Africa (e.g. in Kenya, Zambia and Zimbabwe) have proved that it is possible to achieve high milk production levels but this has not always been true of parastatals.

In general, private large-scale dairy farming is limited to a few areas in sub-Saharan Africa and is not expanding. The common experience is one of lack of capital and recurrent funds, including foreign exchange, and insufficient freedom to set producer prices and to settle labour problems. Farm equipment

such as milking machines and tractors is usually too expensive and is short-lived due to lack of maintenance and spare parts.

Small family farms, with low capital, input and foreign exchange requirements and which depend mainly on family labour, offer more promise for sustainable dairy development.

Dairy development experiences

There have been many attempts at dairy development in sub-Saharan Africa. This section examines two attempts in sub-Saharan Africa (Kenya and Tanzania) and Operation Flood in India.

Kenya National Dairy Development Project

Kenya is a well-known example of successful smallholder dairy development. The establishment of large-scale dairy farms during the colonial period lead to the creation of a structure of services (e.g. Kenya Cooperative Creameries (KCC), research institutes, milk recording schemes, herdbooks, shops of Kenya Farmers Association etc).

The Kenya Dairy Development Project started in 1980 against a background of good infrastructure and favourable government policies. The main focus of the project was on milk production at the farmer level. A zero-grazing package was introduced to farmers. This package included forage-crop cultivation, construction of cattle sheds, use of improved cattle and improved management practices. The project relied on existing organisational structures (Kenya Farmers Association, crop societies and KCC) to supply inputs and market milk.

By 1988, some 2600 smallholder farmers were registered as project participants. A number of farmers joined farmers' organisations and around 25 zero-grazing clubs of 10 to 60 members were operational.

The factors that lead to the success of the dairy development project in Kenya are:

- the existence of a basic infrastructure for marketing, provision of inputs and services and the availability of dairy cattle

- a government policy favourable to smallholder dairy development and

- the development and availability of a package of improved production practices for smallholder dairying which was introduced to the farmers through an intensive system of guidance, demonstration and extension.

Smallholder dairy development in Tanzania

Initial emphasis in Tanzania was on large-scale parastatal dairying. The cost of production was high in this system and included a large component of foreign exchange. The technical performance of the farms remained below acceptable levels. The parastatal farms sold milk to dairy plants in the city. The main source of milk for these plants was imported milk powder and butter oil. In some areas, mainly on the mountain slopes of Arusha and Kilimanjaro regions, smallholder dairying developed.

In Kagera province a smallholder dairy sector has developed over a period of around 15 years. Prior to 1976, dairy production was virtually unknown in Kagera and a limited supply of fresh milk was brought from Mwanza by ferry to Bukoba (the capital of Kagera province). A programme to produce F_1 crossbred heifers started in 1976. Initially, many F_1 heifers on smallholder farms died due to lack of veterinary supplies and inadequate management. A farmer training centre was eventually established and around 1982 a smallholder extension project was set up to ensure proper management of the animals distributed in the Kagera province and to strengthen the extension service and provide inputs. Zero-grazing was chosen and further developed because of the high tick burden, the tsetse challenge and the high demand for manure to apply to crops.

Milk production in the area increased from 325,000 litres from 113 farms in 1984 to 1.8 million litres produced on 615 farms in 1988. All milk was sold locally, mainly directly from producers to consumers. Locally produced milk first replaced supplies of fresh milk brought from Mwanza and subsequently replaced imported milk powder, which became very expensive when Tanzania severely restricted imports. The local market is now showing signs of saturation and attention needs to be paid to smallholder dairy processing to ensure profitable prices for producers.

The main factors contributing to the success of smallholder dairy development in Kagera are:

- long-term support for step-by-step development through provision of good-quality animals, credit and training, development and extension of an improved production system, and provision of inputs and services and marketing channels and

- an increasing demand for fresh milk due to the decreased availability and high price of milk powder.

Operation Flood, India

Many people are impressed by the results of Operation Flood in India, the best known example of dairy development in the developing world. It is useful to

review briefly Operation Flood and examine its possible replicability in sub-Saharan Africa.

The principal features of this model are:

- a three-tier structure owned by the dairy farmers through their cooperatives, namely village societies (which collect the milk and provide inputs and services), district cooperative unions (which collect milk from the village societies and process and market it) and state federations (which coordinate marketing and promote dairy development)

- a National Dairy Development Board, responsible for project planning and technical advice, and the Indian Dairy Corporation, responsible for financing. These organisations have high-level political support and control the import of dairy products

- donated milk powder and butter oil used to finance infrastructure for milk processing and marketing and not for on-farm investments and

- most dairy equipment produced in country, as a result of the existing level of industrial development and the boost given by Operation Flood.

Various factors helped Operation Flood succeed:

- Milk production was already high (roughly 20 times the average milk production density found in Africa) at the start of Operation Flood, which made it possible to establish a sustainable marketing structure without having to immediately increase production. In India, milk is mainly produced under zero-grazing conditions within the villages and milk collection points are close to the farmers' homesteads, making for easy access to milk collection, provision of concentrates and breeding and veterinary services.

- Operation Flood was specifically designed to link distant milksheds with urban markets. Producers needed a guaranteed outlet for peak milk production and this could be provided by using the milk powder supplies as a buffer stock in the dry season. It should also be emphasised that Operation Flood has not been successful within a radius of about 100 km of big cities, where direct sales to consumers and high producer prices made cooperative marketing and processing unattractive.

- The basis for Operation Flood in the villages is the Village Milk Producers Cooperative, managed and owned by the farmers without any direct government control or supervision. Government control, through the Registrar of Cooperatives, is strong in countries under English law, but in India the cooperative movement was initially facilitated by high-level political support.

- Milk is more important as a traditional source of protein in India than in Africa. Training in dairying started earlier and at a much larger scale in India than in Africa, creating a large corps of professionals to select from.

There are very few areas in Africa where an "Operation Flood" approach to dairy development could be used. Milk volume in most areas is too small to support an elaborate marketing and processing structure. In Africa the initial focus should be on increasing milk production and on improving small-scale processing or trade in fresh milk. Farmers' organisations will have to be promoted and should play a role in the provision of inputs and services as well as small-scale marketing and processing.

Milk collection and marketing options

The principal problems of most collection systems in Africa include the small volumes supplied per producer, the pronounced seasonality of supplies, dispersed and relatively low-income retail markets, high ambient temperatures, poorly developed transportation systems and heavy seasonal rainfall. The main limiting factor for all systems is the time it takes for the milk to reach the consumer or the processing unit.

In Africa there are basically two systems of marketing milk and milk products, informal and formal. Under the informal system, which operates in both rural and urban areas, milk is sold fresh or processed direct to the consumer or to a trader who in turn delivers the milk or milk products to the consumer. In the formal system, milk is delivered direct, or through a system of collecting and chilling centres, to a dairy plant where it is pasteurised and processed. The formal system caters primarily to high-income urban consumers.

Past efforts to increase supplies and improve processing in Africa focused largely on the establishment of large-scale centralised plants to provide liquid milk for urban dwellers. The approach was initially influenced by the emphasis on the supply of pasteurised milk for children (e.g. by UNICEF) and by the availability of cheap (or free) imports of skim-milk powder and butter oil. Because of low production levels, inadequate collection systems and unattractive prices for locally produced milk (relative to subsidised imports), these plants have relied heavily on imported materials.

The advantages of the informal system are:

- low cost, with short marketing channels and potentially good prices for producer and consumer

- possibility for small farmers to participate in milk production and marketing and

- limited competition with imported products.

The disadvantages are:

- no payment for quality and fat content

- possibilities for adulteration

- problems with seasonal fluctuations in production and

- no public health control.

Formal marketing systems are more expensive, are generally less accessible to small farmers and the price paid for milk is influenced directly by the price of imported commodities.

Where farmers cannot take advantage of short, low-cost marketing channels for fresh milk, the alternative of efficient on-farm or village-level processing should be investigated. Depending on the products to be manufactured, plants based on relatively simple equipment can cope with a daily milk intake of up to 3000 kg. The management of such plants is likely to be within the capabilities of local communities.

To recapitulate, the main problems facing milk marketing in sub-Saharan Africa are:

- the small quantities supplied per farmer

- the seasonal fluctuations in milk production and

- the low density of milk production.

The problems are mainly connected with low milk production, and increasing milk production should be the first priority. The economic feasibility of milk marketing will only improve at higher production levels and with lower overhead cost per litre of milk marketed. Area-specific studies are required to provide information on local production systems, on collection/processing/marketing systems and on distribution and consumption patterns.

However, the effect of improvement in milk marketing on local production systems is not known. The effects of a reliable sales channel, better prices and an improved input supply and production support system should be studied. Further research on dairy marketing should provide information on the effects of different marketing systems (e.g. collection of fresh milk, small-scale processing, home processing, farmers' organisations) and production systems (e.g. pastoral, zero-grazing, peri-urban). Systems should be tested over at least two seasonal cycles to determine seasonal fluctuations in supply and demand. Attention should be paid to the socio-economic aspects of milk production and marketing: the participation of small farmers, distribution of responsibility, work

load and income within the family (i.e. gender issues) and the role of formal and informal farmers' organisations.

Reference

Jahnke H E. 1982. *Livestock production systems and livestock development in tropical Africa.* Kieler Wissenschaftsverlag Vauk, Kiel, Germany. 273 pp.

Discussion

Emphasis for further research was on the importance of quantifying production costs, analysing the relative merits of zero grazing and mixed farming systems and using input subsidies under varying conditions. Nell argued that the major potential for increased milk production in sub-Saharan Africa was in mixed-farming systems, mainly because of the adequacy of feed resources and the lower cost of small-scale dairy production in such systems. He stressed the need for applied research on small-scale dairy production and marketing and for investigating the scope for development of low-cost informal dairy marketing systems. Subsidies must be justified case by case and considered in relation to the stage of development in the dairy sector. However, caution should be exercised in establishing a dairy industry which in the long run may prove not to be viable without subsidies.

Dairy marketing and development in Africa

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Abstract

This paper provides an overview of marketing factors that currently influence the development of the dairy sectors of sub- Saharan Africa. The paper is structured around eight hypotheses relating to opportunities for and constraints to dairy development. On balance, the authors are optimistic about the prospects for sustained growth in African dairying, but not without some changes in current marketing, pricing and institutional practices. Changes in the world dairy situation could result in incentives to stimulate domestic milk production to meet increasing demand for dairy products in Africa.

Introduction

Livestock products account for about one quarter of the food produced in Africa and milk accounts for about half of those livestock products, in terms of grain equivalents calculated using domestic price ratios (Jahnke, 1982). A broad overview of African dairy development, including marketing, has recently been completed by the World Bank (1990). This work raises a number of issues that warrant further consideration in this discussion of dairy marketing in Africa. Those issues can be framed as the following general hypotheses:

1. The domestic supply of milk has increased erratically overall and unevenly across countries, but there is substantial opportunity for production gains.

2. Increases in population, urbanisation and income will combine to generate more rapid growth in demand for dairy products than has generally been projected.

3. There is strong and increasing demand in secondary cities that will make dairying profitable in a large number of areas.

4. Farmers have several marketing channels from which to choose and hence they can avoid exploitation by traders and the negative effects of government monopolies.

5. There are significant opportunities to develop small-scale processing plants to serve smaller urban settlements and milksheds.

6. Underutilisation of capacity is a major problem for the dairy processing industry and milk powder may be important in ameliorating it.

7. Imported dairy products can play a valuable role in the development of African dairying, but not in Operation Flood-type programmes.

8. The world dairy situation has changed and there will not be large surpluses available for food aid.

This paper does not attempt to test these hypotheses, but has the more modest objective of reviewing some of the relevant literature and perhaps thereby laying the groundwork for more intensive, location-specific investigations.

Supply of dairy products

Domestic milk production

Milk production in sub-Saharan Africa (SSA) has more than doubled over the past 30 years, with most of the growth occurring since the mid-1970s (Figure 1).[1] Between 1974 and 1989, reported milk production from all species increased by 74%, from 7.1 million tonnes to 12.4 million tonnes. Over that period, the increase in cow milk production was 3.7 million tonnes (81%). Production from other species increased by 1.6 million tonnes (61%).

The magnitude of change in milk production in SSA compares favourably with other countries (Figure 2). Changes in milk production in Africa paralleled world trends in the 1960s; fell below in the early 1970s; and sharply exceeded world trends since the mid-1970s. Growth in SSA countries has increasingly exceeded growth rates for the African continent as a whole.

Measured on a per caput basis, SSA cow milk production has shown very little change since 1961 (Figure 3), ranging from 15 to 17 kg per person. Gains in production have been largely offset by population increases. However, annual

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1. Production and import data shown in the Figures are from United Nations Food and Agricultural Organization (FAO) Production and Trade Yearbooks and Food Aid Yearbooks.

Put Figure 1 here

Figure 2. *Indexes of milk production, all species, 1969-81.*

Index (1977=100)
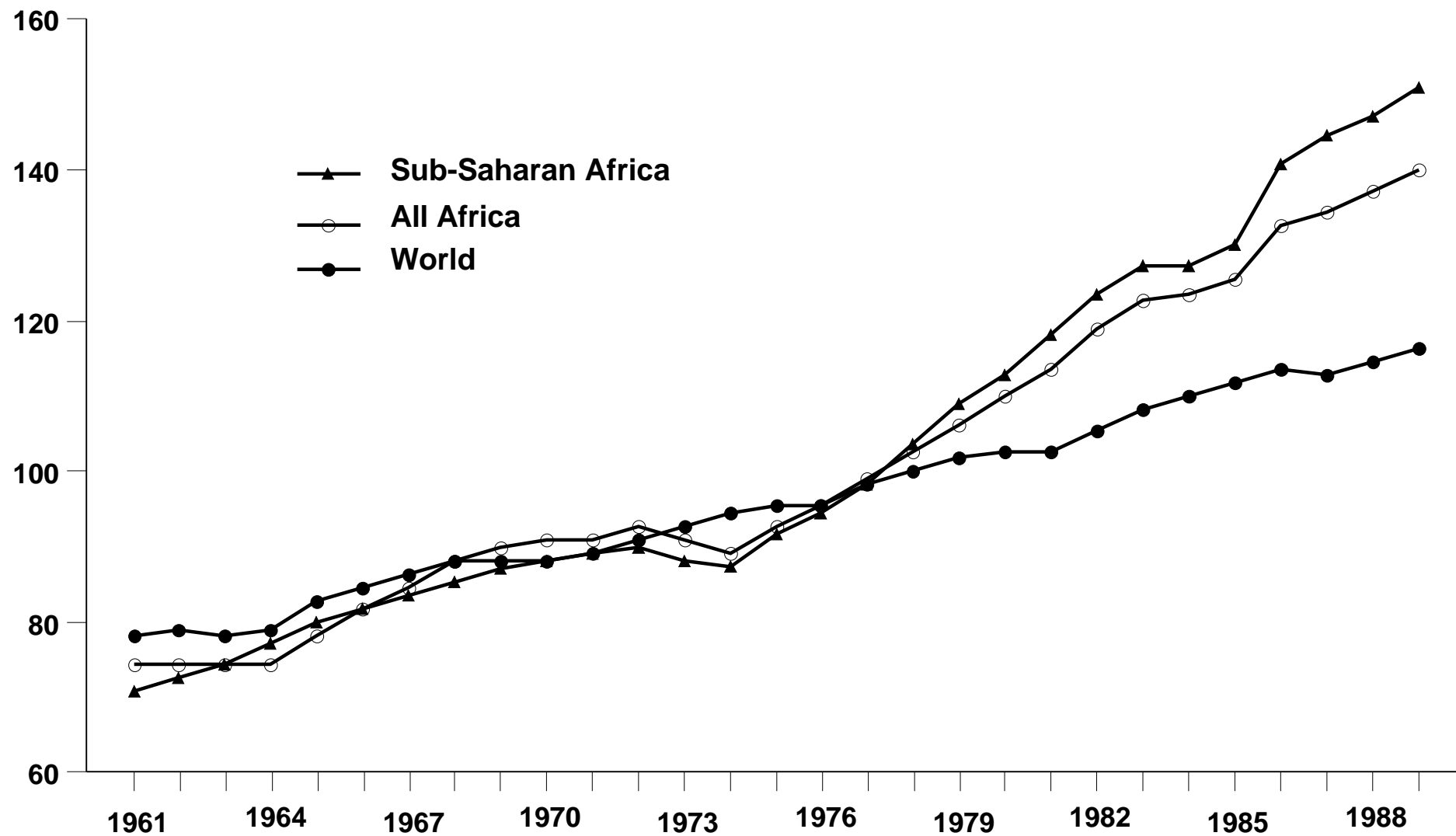
Figure 3. *Milk production indexes for sub-Saharan Africa, 1961-89.*
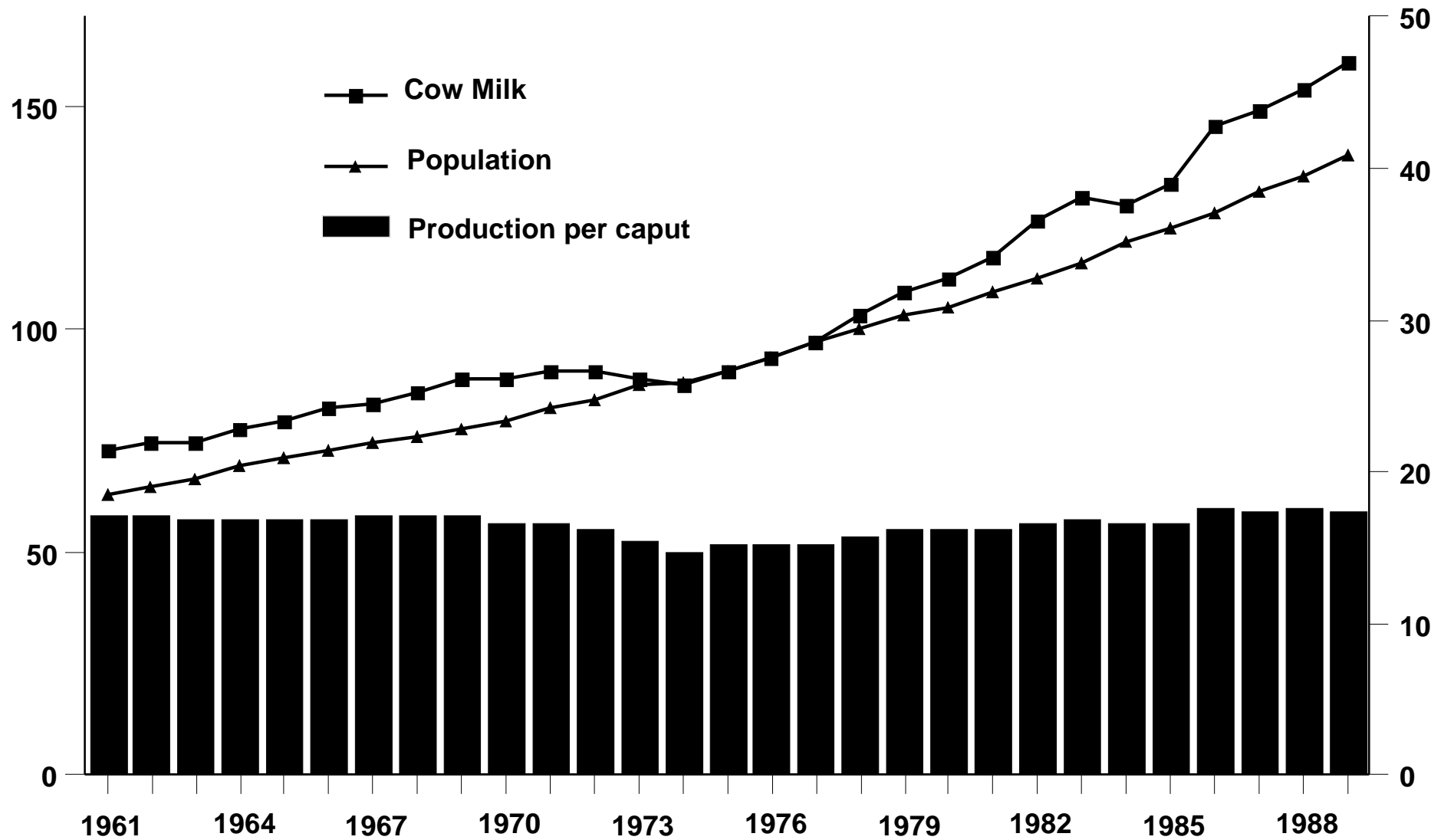
percentage gains in cow milk production since the late 1970s have exceeded population growth, an encouraging trend.

Most of the gain in SSA milk production has come from increasing animal numbers (Table 1). Yield increases have been disappointingly small. Production per cow increased by 2.5% from 1961 to 1974 and by 15.7% from 1974 to 1989. Both the current level of milk yield and the rate of change in SSA compare unfavourably with productivity measures in developed countries and most developing countries.

Table 1. *Milk production statistics, sub-Saharan Africa.*

| | 1961 | 1974 | 1989 | Percentage change | |
				1961–67	1974–78
Number of head ('000)					
Cows	12,586	14,888	23,244	18.3	56.1
Camels	1088	1667	2179	53.2	30.7
Goats	16,034	17,719	25,742	10.5	45.3
Sheep	9650	11,581	23,011	20.0	98.7
Yield/head (kg)					
Cows	298	305	353	2.5	15.7
Camels	479	507	513	5.8	1.2
Goats	68	69	70	0.5	1.9
Sheep	39	40	53	4.0	32.1
Total production ('000 t)					
Cow	3748	4545	8209	21.3	80.6
Camel	522	846	1118	62.1	32.2
Goat	1097	1219	1804	11.1	48.0
Sheep	374	467	1226	24.8	162.6

Source: Derived from FAO data.

Growth in SSA milk production has been very uneven among countries. In 1961, seven countries—Nigeria, Uganda, Tanzania, Somalia, Ethiopia, Sudan and Kenya—accounted for 71% of total SSA cow milk (Figure 4). By 1989, these seven countries had increased production by 144% and their share of total SSA production was 80%. All other SSA countries in total showed a combined increase of 57%. Sudan and Kenya tripled milk production over this period.

Figure 4. *Cow milk production in sub-Saharan Africa, 1961 and 1988.*

Other 1700

Other 1080

Kenya 2295

Kenya 669

Sudan 660

Sudan 1800

Ethiopia 435

Ethiopia 624

Somalia 252

Somalia 605

Tanzania 230

Tanzania 466

Uganda 209

Uganda 370

Nigeria 213

Nigeria 360

1961

1988

Values '000 tonnes
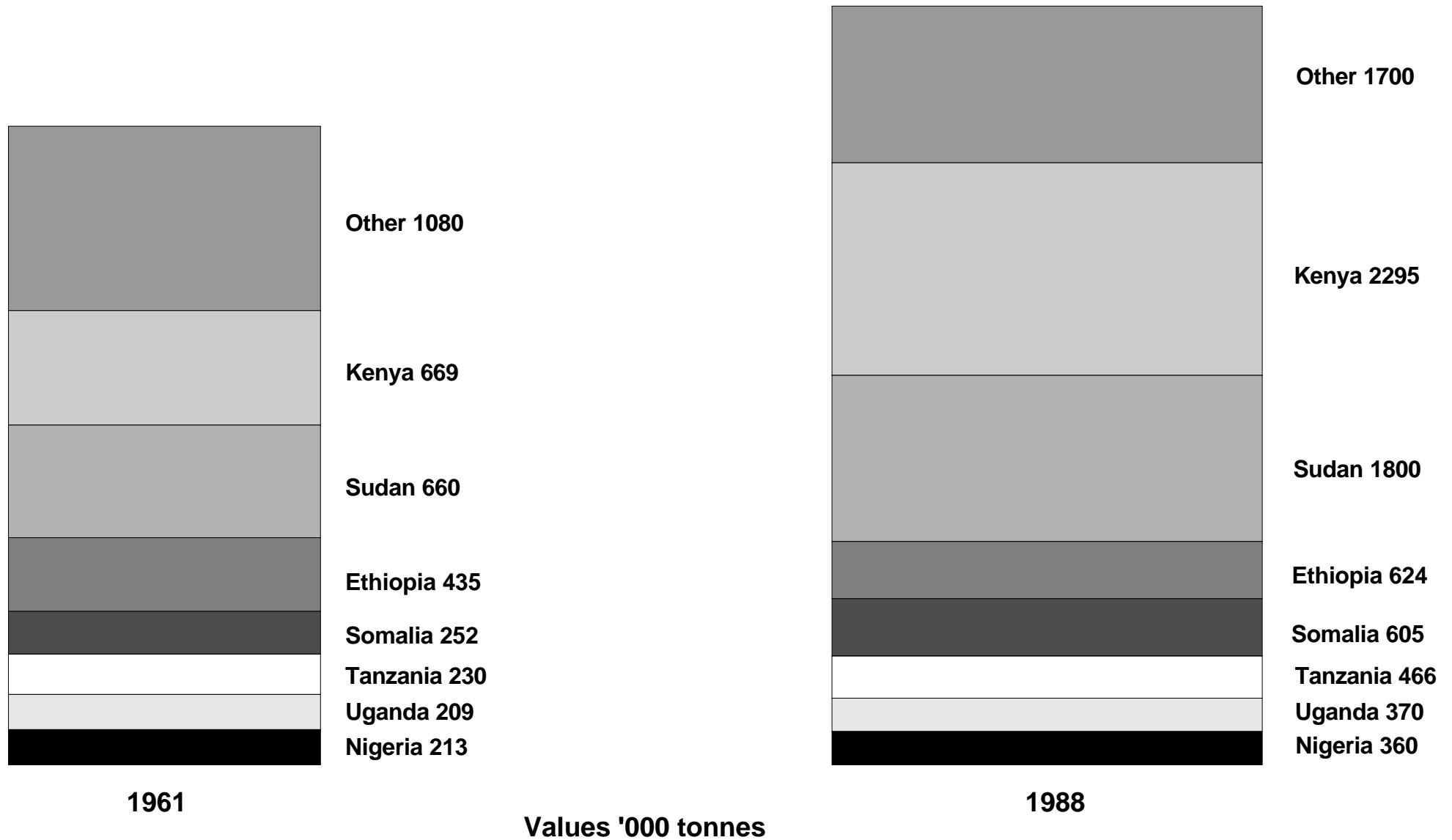
Per caput milk production data emphasise the heterogeneity among SSA countries. In 1988, cow milk production per person ranged from less than one kg in several countries to nearly 100 kg in Kenya (Figure 5). Average per caput cow milk production in SSA was about 17 kg in 1988.

Dairy imports

Sub-Saharan Africa augments its milk production with dairy products imported either commercially or as food-aid donations. Dry milk powder (whole and skim) dominates import volume (Figure 6). Butter and butter oil are also important (Figure 7). Most of the skim-milk powder and butter/butter oil imports are used for producing reconstituted liquid milk. On a liquid-milk-equivalent (LME) basis, dry milk and butter/butter oil imports account for about 80% of total dairy imports (Figure 8).

Other imported dairy products of significant volume include evaporated and condensed milk, cheese and curd and fresh milk. These are mostly commercial imports.

Total SSA dairy imports declined by nearly half from their peak level in 1985 to 1988 (Figure 8). Most of the decline in volume was in the form of dry milk. Commercial dry milk imports and donations were down sharply because of the stronger world markets for skim-milk powder in 1988, which continued through 1989 and much of 1990. Donated dairy products dropped from a total of nearly 1 million tonnes (LME) in 1985 to 315,000 tonnes in 1988 (Figure 9).

Imported dairy products account for a small and decreasing share of the total milk available to SSA residents (Figure 10). As detailed later, the relative share of imports in total dairy product consumption is expected to decline even further because of higher prices and reduced donations. This suggests that domestic milk production in SSA will compete on increasingly favourable terms with imported dairy products and reconstituted liquid milk made from imported butter oil and milk powder.

Neither commercial imports nor dairy donations contribute much to the very skewed distribution of milk availability across SSA countries. Figure 11 shows the relative contribution of various sources of dairy products for a representative range of countries. While imports add substantially to the milk supply of a few countries with very low domestic milk production (e.g. Congo, The Gambia and Gabon), the variation in per caput availability from all sources appears little different from that in per caput cow milk production (Figure 5). In particular, dairy donations have not helped level the availability of dairy products among countries.

Figure 5. *Per caput cow milk production, selected African countries.*
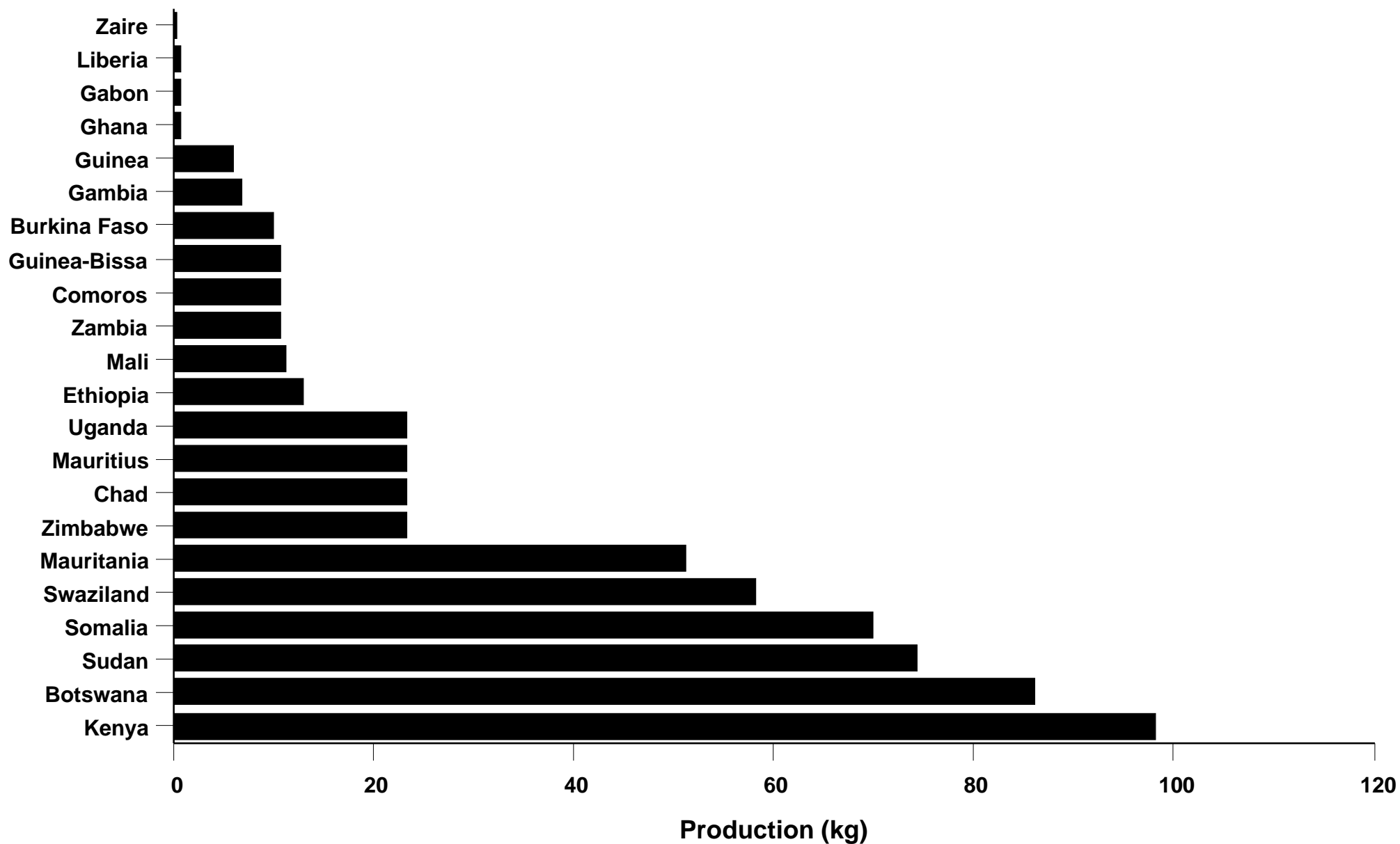
Figure 6. *Dry milk imports into sub-Saharan Africa, 1979-88.*
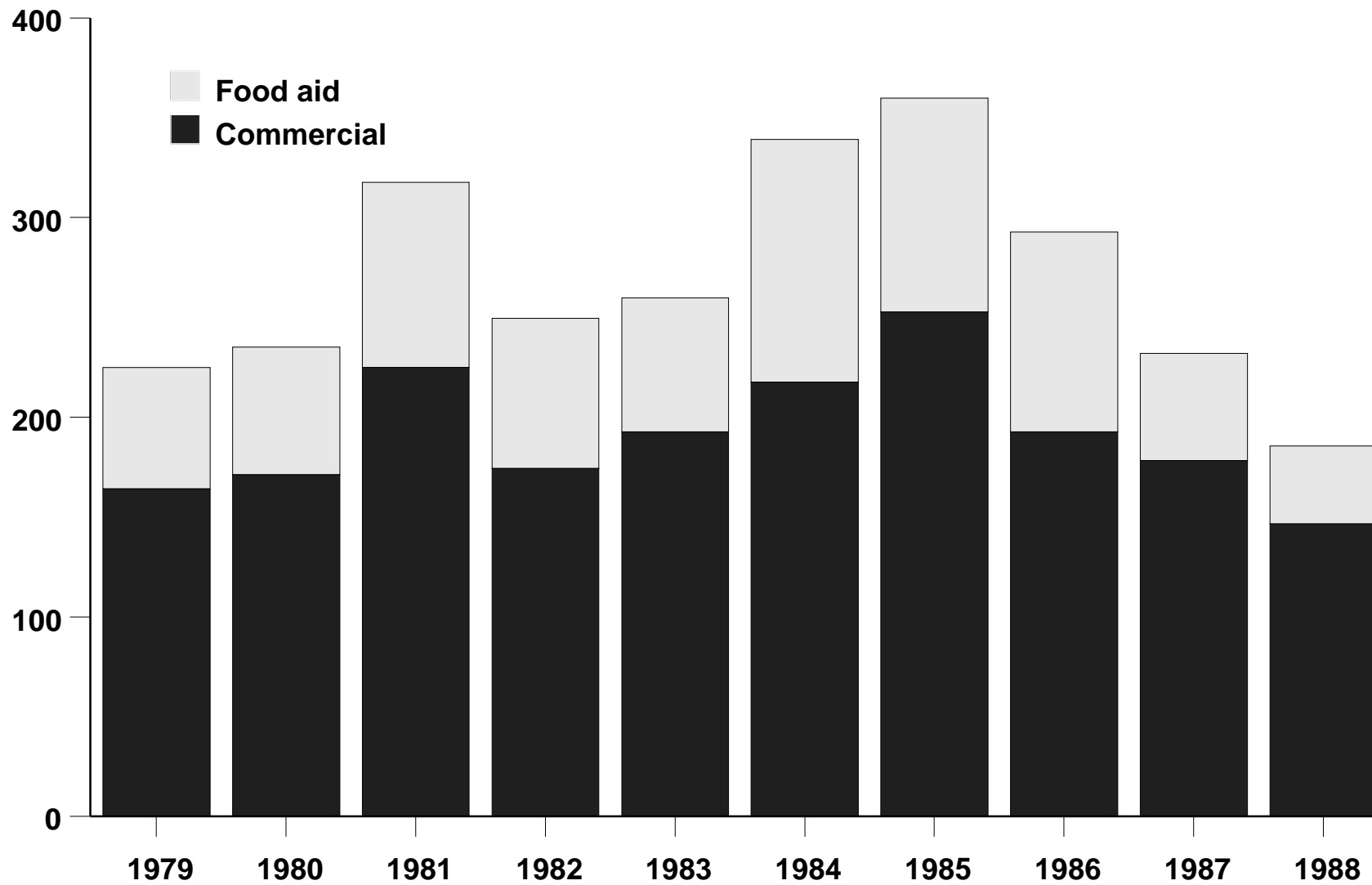
Imports

('000 tonnes)

Figure 7. *Butter imports into sub-Saharan Africa, 1979-88.*
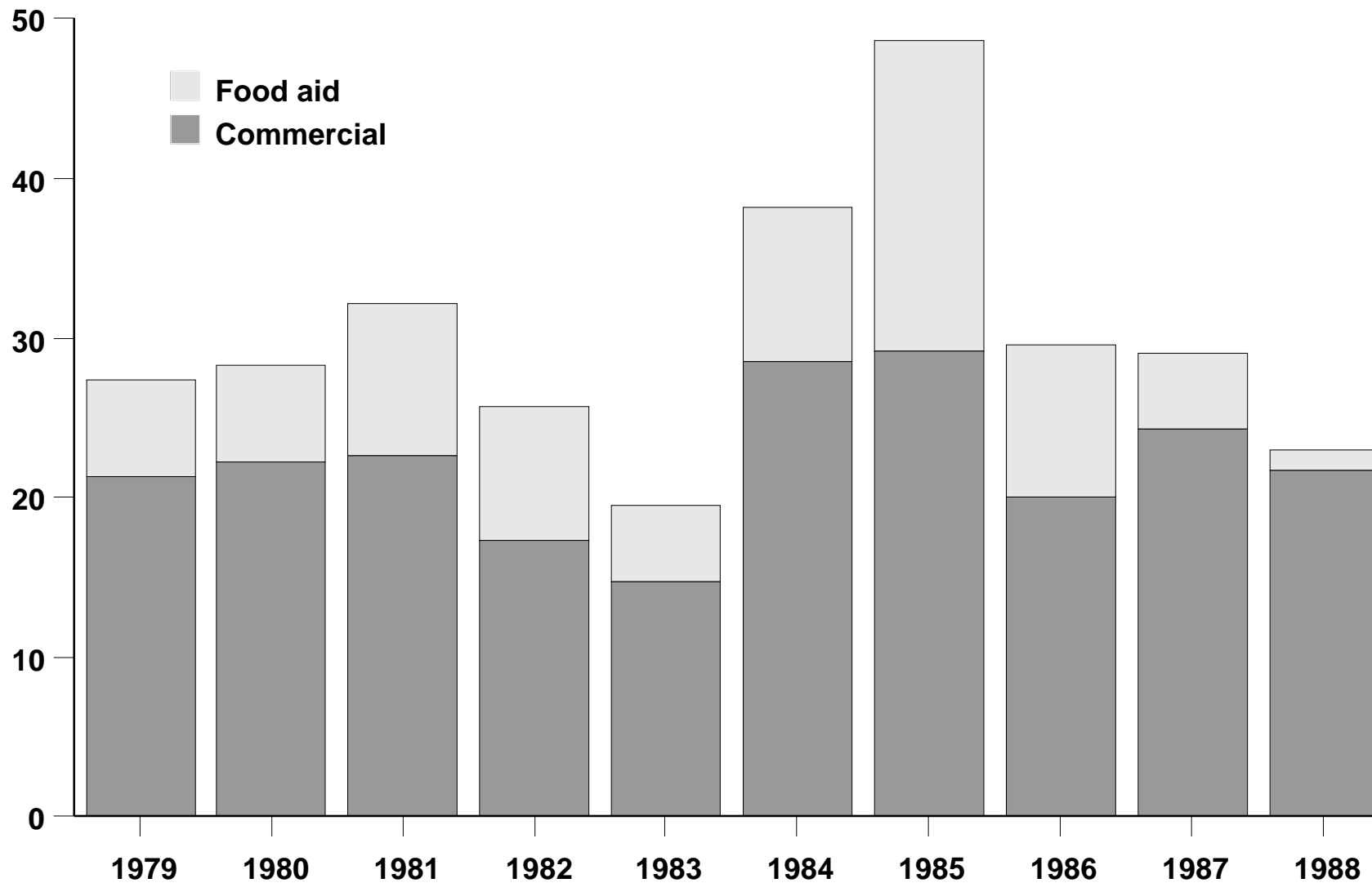
Imports

('000 tonnes)

Figure 8. *Dairy imports (commercial and food aid) into sub-Saharan Africa, by commodity, 1979-88.*

Imports

('000 tonnes LME)
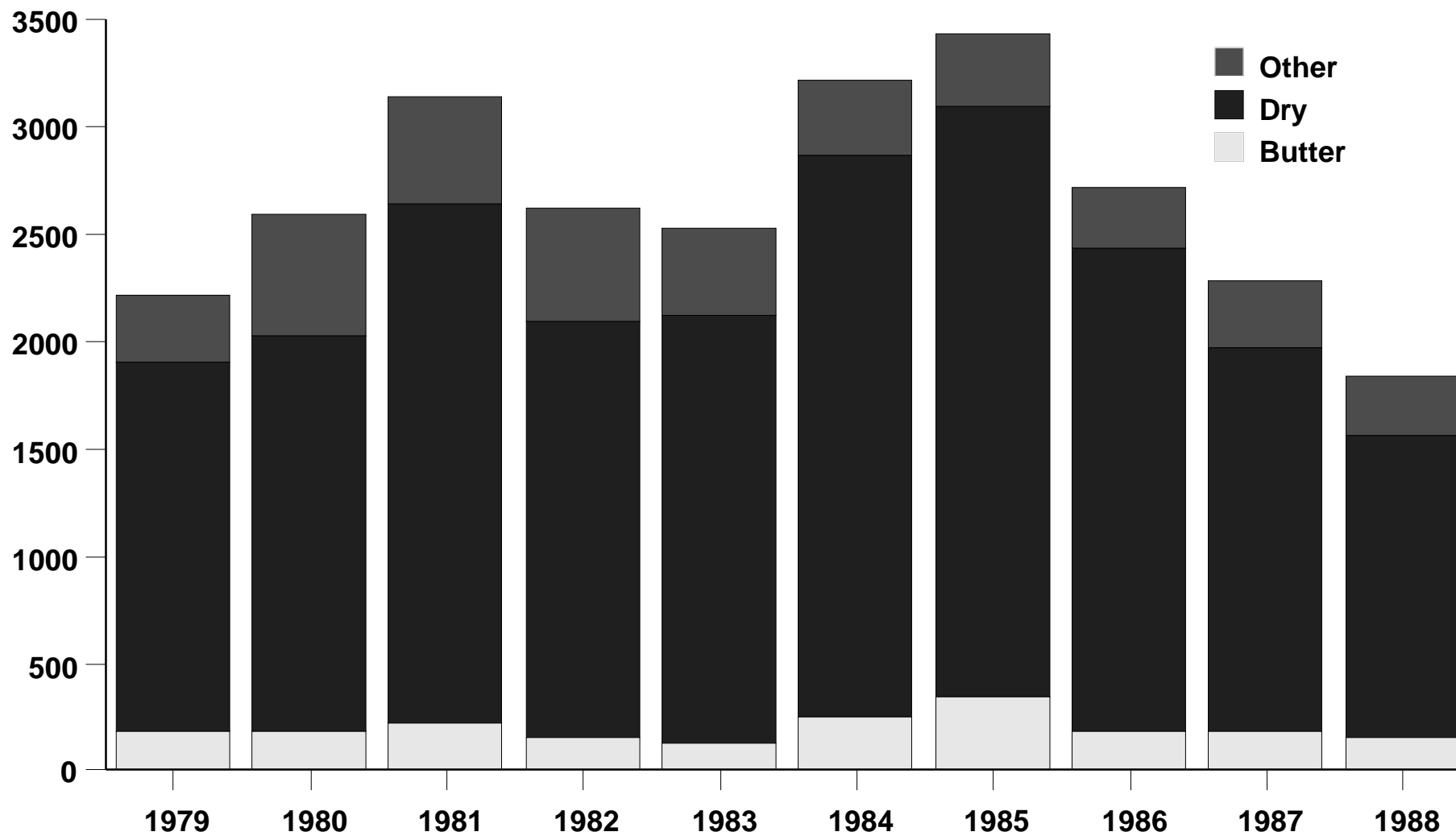
Figure 9. *Dairy imports (all products) into sub-Saharan Africa, by type, 1979-88.*
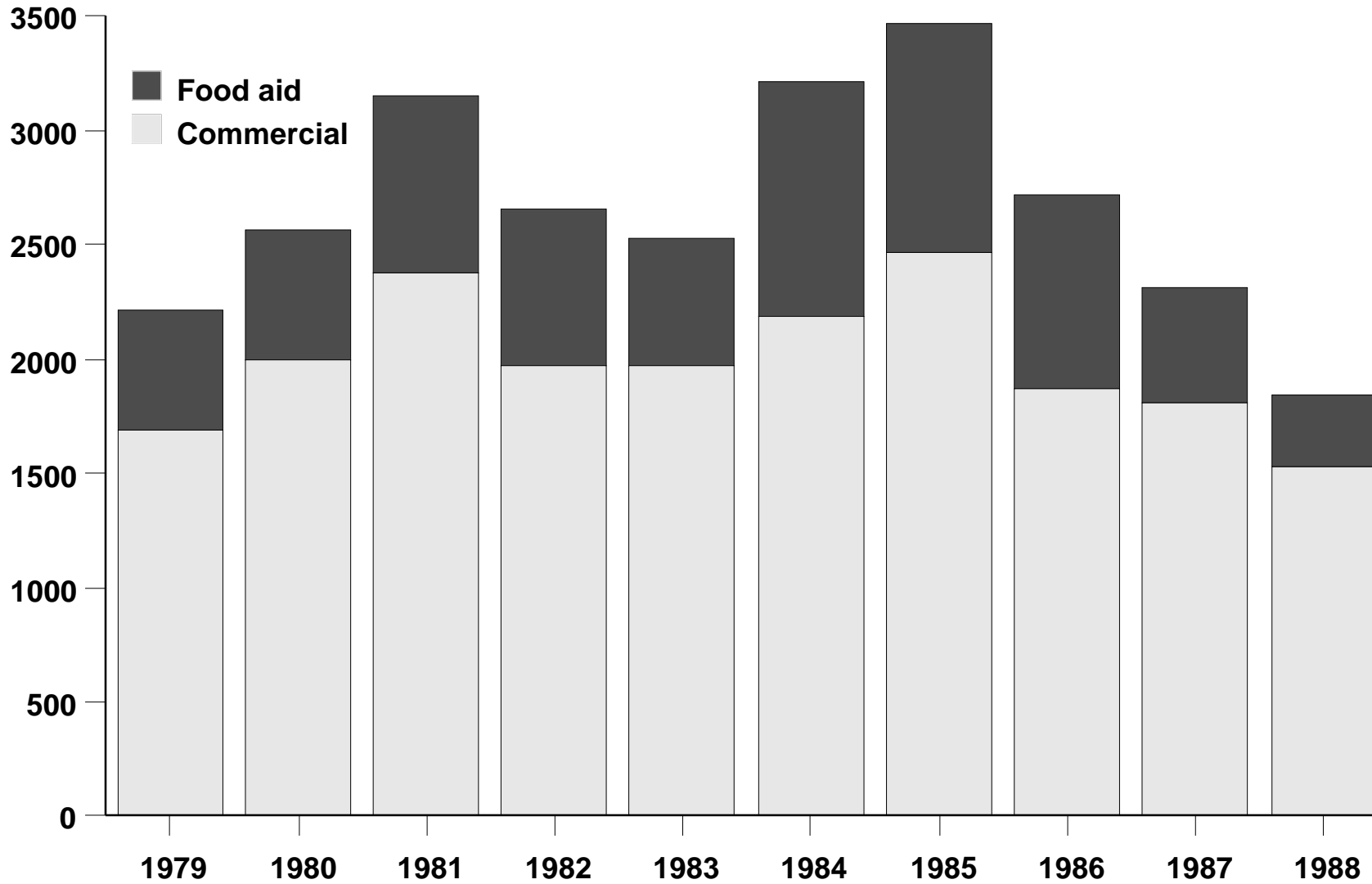
Figure 10. *Per caput milk availability (reported production plus imports), by source, 1979-88.*
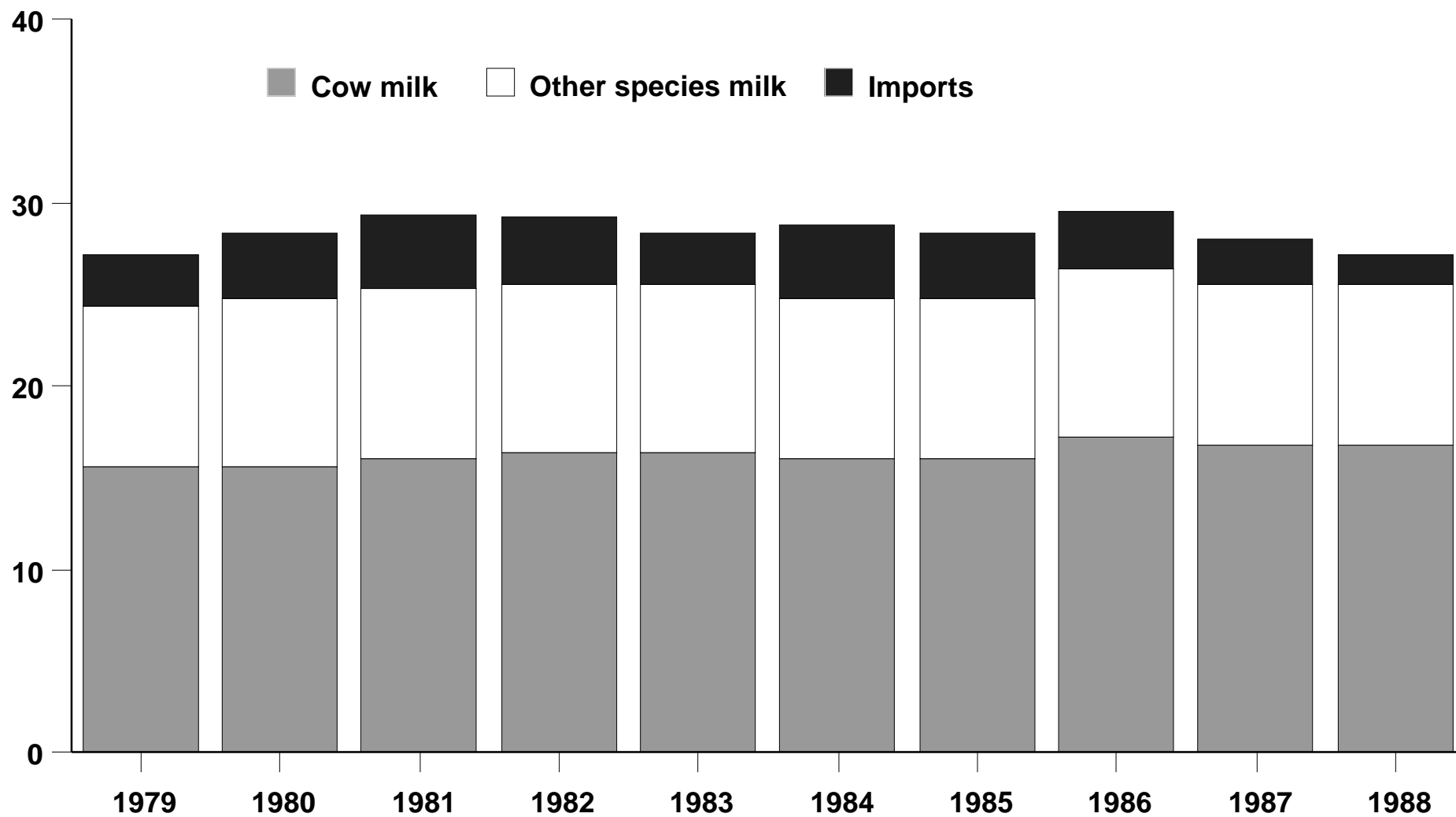
Figure 11. *Total per caput milk availability in selected African countries, 1988.*
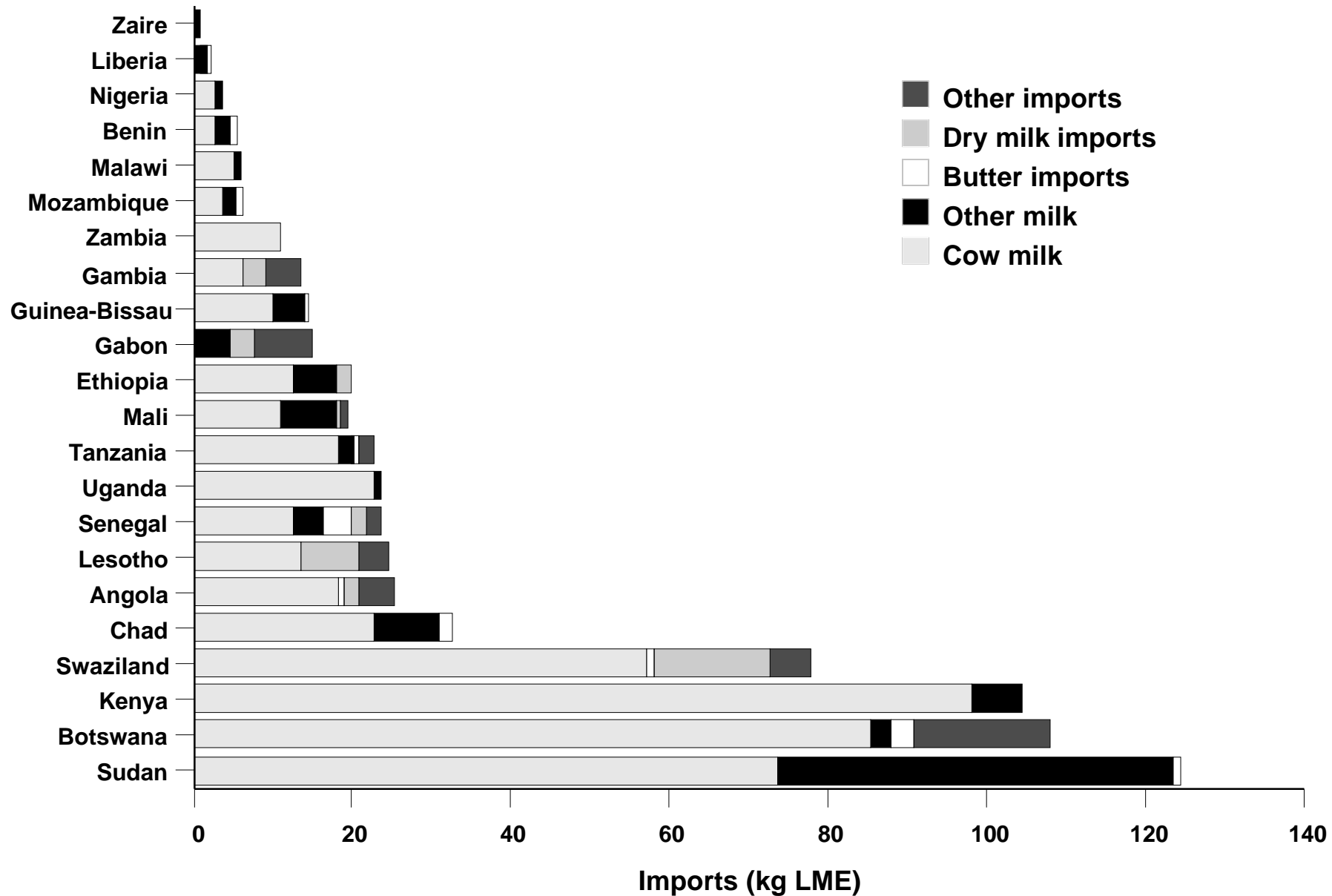
Demand for dairy products

The World Bank (1990) synthesises some of the most commonly cited descriptors of the demand for dairy products in sub-Saharan Africa as follows:

- Consumption per caput — 27 kg LME per caput

- Growth in total demand — 4% per year

- Income elasticity of demand — 0.8.

These are of necessity highly aggregate, rough estimates covering over 40 countries and capturing the experience and projections of several decades. As such, it is important to review the bases for these estimates.

As is true for most aggregate consumption figures, the above are not based on direct observation but rather are inferred from production and trade statistics. FAO Production and Trade Yearbooks provided the basis for the per caput consumption estimate, and also for similar estimates by Mbogoh (1984), Senait Seyoum (1988) and von Massow (1989).

Senait Seyoum (1988) takes the analysis further for West Africa and shows the great variability behind the averages. First, by separating the predominantly arid and semi-arid countries from the humid and subhumid ones, she estimates that in 1983/1985 consumption per caput in the former was 45 kg while in the latter it was only 11 kg. She then disaggregates further by estimating the population of each country in five ecosystems and in rural and urban areas. This is combined with (a) Jahnke's (1982) estimates of cattle population and milk yield in each ecosystem, (b) the assumption that 10% of all milk not taken by the calf is wasted and (c) the assumption that 0%, 10%, 20% and 30% of production in the arid, semi-arid, subhumid and highland areas, respectively, is marketed to urban areas.

Senait, refreshingly, calls the results "guesstimates." They reinforce the picture of great variability, with rural per caput consumption ranging from 6 kg in the West African highlands to 55 kg in the arid zone; and urban per caput consumption ranging from 22 kg in the humid zone to 58 kg in the highlands (Senait Seyoum, 1988).

The reliance on production and trade data by most analysts reflects a dearth of dairy consumption studies in Africa. Senait Seyoum (1988) assembles those available for West Africa, but cannot use them for much, although she does note that they confirm the generally accepted increase in consumption as you move from settled rural to urban to nomadic groups. The assembled studies show extremely large variations.

The lack of consumption surveys is perhaps most troublesome when projecting future demand based on increases in income and urbanisation. Senait Seyoum

(1988) reviews the studies available for urban West Africa and concludes that "the available evidence…does not permit one to arrive at precise conclusions regarding the proportions of expenditure allocated to dairy products by households at successively higher levels of income." She then notes that FAO's projections of milk demand are based on a range of income elasticities from 0.5 to 1.2. However, this contrasts with lower estimates of income elasticities for Nairobi, Mombasa and Kisumu in the 1960s (Ruigu, 1978).

Africa's towns and cities are growing rapidly, but income is expected to grow slowly. Thus it is important to be able to separate the effect of income on dairy demand from that of urbanisation. For example, in the case of grains, Delgado (1987) was able to argue that urbanisation *per se* (as distinct from any income effect) changed West African consumption patterns so that rice was substituted for other grains. We have not seen data that would allow a similar analysis of the relative importance of income and urbanisation in contributing to the relatively high per caput consumption of dairy products in urban areas.

Even without such detailed consumption studies, we know that the combination of urbanisation itself and its association with the higher income of urban dwellers is a powerful stimulus to greater demand for dairy products. Thus prior studies have emphasised the importance of Africa's increasing urbanisation. While the average population growth rate for SSA is estimated at 3.1% per year, the urban population is said to be growing at 6.9% per year. "Over 60% of the population increase over the next decade is expected to be in the towns and cities, where per caput consumption of dairy products is highest" (World Bank, 1990).

Two aspects of future urbanisation call for a bit more scrutiny. The first is straight forward. Most earlier studies have based demand projections just on expected growth of total population and income. However, the urban population is growing much more rapidly than the rural population and per caput consumption of dairy products is much higher in urban areas than in most rural areas. Thus if the urban and rural components of population growth are treated separately, this would add about 1% per year to the estimated impact of population growth on dairy demand. (This is based on the above growth rates, the "guesstimate" that urban dairy consumption per caput is twice as high as consumption in rural areas, as Senait Seyoum (1988) found in West Africa, and the estimate that 27% of the population is urban.) As the number of consumption studies grows, there will be better estimates of rural and urban consumption and hence better projections of the impact of the different growth rates in the two populations.

The second aspect of urbanisation needing more scrutiny is the geographic pattern of urban population growth. In 1980, only 36% of Africa's urban population lived in each country's largest city and only 41% lived in cities of over 500,000 persons (World Bank, 1990). The Bank notes that these estimates are based on different nations' definitions of what is "urban," so international comparisons are hazardous. However, even with that caveat, it is clear that there

are many smaller urban settlements outside the capitals and large port cities. Urban residents living in other than the primary city account for over 17% of all Africans or approximately 80 million people.

The pattern of urban population growth in Kenya shows the importance of these smaller urban areas. The Nairobi area accounted for more than half the urban population in the Kenya Creamery Cooperative (KCC) sales areas in 1969, with Mombasa accounting for an additional 25% and the urban populations in seven other areas adding up to only another 25%. By 1990, the relatively small towns and cities in those seven other areas are projected to have about as many people as Nairobi and more than twice as many as Mombasa (COWIconsult, 1979).

What opportunities do these many smaller urban areas present for broader based dairy development? How does dairying fit into the surrounding agricultural systems? How can dairying contribute to overall economic development in those areas? What are the physical and economic characteristics of the milksheds surrounding these smaller towns and cities? How well are they served by roads and electricity? How competitive are imported products? What kinds of dairy products are demanded? How is milk marketing and processing organised in these areas? Are these areas well suited to low-cost, small-scale processing operations?

Small producers and small milksheds

No single paper can address all the above questions for the great variety of situations in Africa, but a few examples are instructive. The differences between northern Nigeria and the Kenyan highlands offer some insight into the great diversity on the continent, but also may reveal some directions for development. Nwoko (1986) lists only 13 dairy plants in Nigeria, most of them in the north, with capacities ranging from 500 to 35,000 litres a day and operating at 10% to 100% of that capacity. This is obviously a very small non-traditional processing industry for Nigeria. It is thus not surprising that traditional dairy processing and marketing are important in Nigeria.

At one end of the spectrum are the village-based *nono* (fermented milk) and *fura* (a millet or maize dumpling usually consumed immediately after mixing with *nono* or water and sugar) industries near Zaria and Jos described by Simmons (1973) and Waters-Bayer (1988). Village women make these products, often from their own crops and milk, and sell them directly to consumers, not only in the villages but also in small towns and in larger cities like Zaria. Simmons (1973) found that *fura* was perhaps the most common midday meal item in villages around Zaria.

Although operating on a very small scale, these artisanal dairy industries, in aggregate, are quite important. According to a 1981 World Bank estimate, only 3% of Nigeria's national herd was exotic. Most milk is from Fulani-held cattle.

Waters-Bayer (1988) estimates that about 350,000 tonnes of milk from traditionally managed herds are processed by traditional methods and sold annually, compared with an estimate by Nwoko (1986) of 221,200 tonnes for 1983. While this latter figure was dwarfed by imports of almost 800,000 tonnes in 1983 (Nwoko, 1986), traditional production, processing and marketing are nonetheless important, all the more so as imports have shrunk recently.

The literature we have seen contains only the briefest references to how traditional dairy marketing is organised in Nigeria. There may be merit in examining the prospects for non-traditional, small-scale processing that might call forth greater quantities from the traditional herds and make a greater contribution to feeding the population. The response of Kenyan farmers to the Meru dairy plant (although that was not a small-scale operation and the herds included many non-traditional animals) demonstrates the capacity of African farmers to respond to marketing opportunities and is discussed next.

The Meru Dairy Project, which in some ways is at the other end of the spectrum from the northern Nigerian situation, was started in Kenya as an effort to develop dairying in a rural area that is not near a major city. Meru Municipality had only 72,000 people in 1979 (Launonen et al, 1985). According to Korhonen (1987):

> *"the project strategy was designed to improve milk collection and cooling at [the] primary cooperative society level and improve milk processing and marketing at [the] cooperative union level. This approach was aimed at encouraging farmers to produce more and deliver their surplus milk to the existing dairy cooperatives for further transportation to the processing plant."*

The Meru project seems to have succeeded in at least one dimension—getting more farmers involved in commercial dairying. The number of active dairy cooperative societies in Meru increased from 9 in 1983, when the processing plant was opened, to 18 in 1986 and the number of "active" members increased from 4500 to 9000 (Korhonen, 1987). Some of these new members were likely to have been selling milk privately before they joined, but the doubling of active members in just three years probably reflects a combination of new farmers selling milk as well as farmers increasing their sales to the point where active membership was attractive.

The Meru project was aimed at small farms with only a few milking cows and relatively low milk production. For a sample of active members, the mean daily milk production per farm in 1983–84 was 16.2 litres in the wet season and 10.9 litres in the dry season; production per cow was 6.4 and 5.6 litres in the two seasons; and sales were about 55% of production (Launonen et al, 1985). Figures for inactive members were lower, and for non-members were lower still. About one fourth of the herd was grade cattle in 1982 (Launonen et al, 1985).

The comparable figures for the Fulani studied by Waters-Bayer (1988) are even lower. The average daily milk offtake per milk cow was 0.67 and 0.79 litres in two villages; production per household averaged 3.7 litres a day over the year, reaching a high of 5.8 litres a day at the end of the wet season. Household consumption came out of these amounts and the remainder was sold. These figures are even lower than those for non-members in Meru, but, since the Nigerian figures are averages, there presumably are households that have significantly higher production figures.

The point is not that Meru and northern Nigeria are precisely comparable, but that they may have enough in common to indicate that a project to collect milk from small producers may be appropriate in the latter, as it was in the former. In fact, northern Nigeria may have some advantages over Meru and similar areas in Kenya. First, there is a larger urban population. The triangle from Jos to Katsina to Sokoto contains at least seven cities that each has well over 100,000 people, with a combined population far greater than Nairobi's. Second, because this urban population is spread over so many cities, more farming areas are in close proximity to urban markets than if the urban population were concentrated in one city. Third, northern Nigerian milk producers do not face competition from well-developed dairy areas in higher potential zones the way Meru farmers do. Korhonen (1987) noted that the Meru Union faced stiff competition from KCC's pasteurised milk.

Short-distance marketing

Are the marketing systems that serve the smaller cities and milksheds a constraint to dairy development? Generalisations are always risky, but the weight of fragmentary evidence seems to indicate that whatever constraints exist are more likely to be in the physical infrastructure than in the human and policy realms. Throughout Africa there are accounts of farmers and small traders marketing all kinds of farm products, even where government policies discourage it. Milk is no different. In both the northern Nigerian and Meru cases discussed above, farmers were quite active in direct sales to consumers in both urban areas and their local rural neighbourhoods. In northern Nigeria there were a variety of trading relations between Fulani and Hausa women regarding supply of milk and preparation of *nono*, and there were also trading relations between Fulani women in families with many milking animals and those with only a few.

Ruigu (1978) states that most of the milk produced in Kenya in 1975 did not move through formal marketing channels. About 75% was consumed on the farm or sold locally, while only about 25% went through formal channels. In the Meru sample of 300 farms, 12% were selling privately; among those not belonging to the cooperative, the proportion was 20%. The Meru farmers did not see marketing as one of their major problems. When the Meru farmers were asked

about constraints, the five most frequently cited were, in descending order, disease, feeding, land shortage, lack of credit and labour. Marketing was ninth and was cited by only 14%, barely edging out "other" (Launonen et al, 1985).

In Tanzania in 1988, Tanzania Dairies Limited (TDL) and private traders were both listed as the major suppliers of milk in urban areas (Netherlands Economic Institute, 1988). Private trading was quite profitable. Total annual costs, excluding labour, were TSh 10,000 for depreciation and maintenance of a bicycle, buckets and other equipment. Annual revenues were TSh 100,000, based on a marketing margin of TSh 10 per litre (a consumer price of TSh 25 and a farm-gate price of TSh 15), a capacity of 40 litres a day and 250 working days a year. Net revenue per working day was thus TSh 360, which was about seven times the minimum wage (Netherlands Economic Institute, 1988). There are similar accounts for the 1970s. In their study of Tanzania's Mara Region, Chikaka and Foote (1978) state that, in addition to TDL, "another marketing channel involves private vendors who buy milk direct from producers at higher prices than those offered by [government]. The milk is then sold unprocessed to consumers at much higher prices. This channel operates mainly near towns." The Debrah and Berhanu Anteneh (1991) study of dairy marketing in, near and far from Addis Ababa finds a variety of private channels as well as the government's Dairy Development Enterprise (DDE).

Private, small-scale trading may benefit from consumer taste preferences. In Tanzania, consumers found the taste of TDL milk watery or powdery (Netherlands Economic Unit, 1988). In addition, sour milk is desired in many parts of Africa but there are few plants that produce it in quantity. Zalla (1982) found that 57% of the milk protein consumed in northern Tanzania near Mt Kilimanjaro was in the form of fermented milk.

Previous studies of agricultural marketing in Africa have generally found that farmers have a choice of outlets and that traders were reasonably competitive, so that marketing margins reflected costs and not excessive profits. The available literature on dairy marketing does not contradict this, but there have been few systematic dairy marketing studies. The current set of studies sponsored by ILCA will be a major addition to this body of knowledge.

The existing literature is replete with references to marketing constraints in the form of poor roads, insufficient cooling capacity, insufficient and unreliable processing capacity and related problems. These constraints constitute a barrier between urban demand and rural supply. The perishability of milk means that producers who cannot sell raw milk within a few hours of milking must either process it or cool it. When cooling and processing facilities are limited, production is discouraged.

Chikaka and Foote (1978) found that the increase in the number of cooling centres in Mara more than counterbalanced the fall in prices between 1970 and

1974. Although prices fell, sales to TDL rose, at least in part because the number of cooling centres increased. As noted above, the increase in cooling centres seems to have had a similar effect in Meru, Kenya.

In the early development of Uganda's dairy industry, a beef farmers' cooperative opened a cooperative milk shop in 1965 with a milk cooler supplied by USAID (United States Agency for International Development). This stimulated the establishment of farms along the road and the hiring of a local transporter to move the collected milk. When a larger cooler was added two years later, this allowed collection of evening milk (Baker, 1971).

Small-scale processing

Small-scale processing may be important for dealing with the low levels of supply that result from low production per cow and from relatively few cows per farm and per square kilometre. Also, smaller urban settlements may be adequately served by small-scale processing. Finally, small-scale technologies may be advantageous because they do not require high levels of energy, employee skill, maintenance and repair.

The smallest-scale processing is, of course, done by the household. Ephraim Bekele and Tarik Kassaye (1987), for example, described traditional Borana milk processing in southern Ethiopia. The Borana make a soured milk that can be stored for up to three months and ghee that can be stored for up to three years. Batches of about two litres are processed at a time.

At a somewhat larger scale, but still quite small, are the Ethiopian technologies described by O'Mahony (1988). The level of throughput for the fresh milk processing described is from 100 to 500 litres a day. The sour milk technologies are for batches of up to 15 litres. As O'Mahony and Ephraim Bekele (1985) note, one key to dairy profitability is the extent of fat recovery. They reviewed milk separation by traditional hand churning, a wooden paddle agitator and a centrifugal separator. The centrifugal separator gave the best fat recovery, but is too costly for many small farmers. Their economic analysis showed that the centrifugal separator would be profitable for a throughput of more than 12 litres a day all year round (O'Mahony and Ephraim Bekele, 1985). This would be appropriate for some cooperatives and larger farmers.

Bachmann (1987) considered plants with a capacity of 1000 to 3000 litres a day (still relatively small) and argues forcefully that:

> "It is in fact possible to manufacture the highest quality dairy foods with extremely simple tools and means. It is also true that most dairy foods can be made with the help of relatively few basic processes provided that the manufacturer has the necessary skills and experiences. Complicated machinery and sophisticated processing

> methods have not been invented to make better dairy products, but to save labour and nothing else."

As an example, Bachmann (1987) pointed to a plant near a small town in the Northern Indian Hills. It processed 1500 kg of milk a day using simple methods that were mostly hand operated. Its products included pasteurised milk, sweetened condensed milk, fresh butter, ghee, cheeses and cream caramels. He also noted an important advantage of small plants—when the power fails, alternative methods employing manual labour can be used to save the milk. This reduction of risk and waste is a very important consideration.

For Africa, Bachmann (1987) suggests starting with traditional products such as sour milk, ghee and white cheese in brine, for which the local population has the skills and for which there are local markets. The cheese industry in Sudan's White Nile Province seems to be a good example of this. It specialises in making soft white cheese using methods that were introduced in 1908 by a Greek woman (El Tayeb, 1986). In general, one factory serves one village. There were two factories in 1935, 39 in 1963 and 70 in 1975. Most of their output is sold in Khartoum and other cities. There is an average annual flow of about 100,000 kg of fresh milk to a factory. Labour is unskilled, except for the head worker.

Bachmann (1987) further suggested that dairy plants should make use of local fruit juices and vegetable extracts, as they do in Asia. This would include "vegetable milks" to supplement animal milk during the dry season when animal milk is in short supply, a major problem discussed in more detail below. Vegetable oils could be mixed with milk to produce a high-calorie, low-cost food. Tropical fruit juices and bean extracts could be used to flavour and acidify milk to produce a high-protein, high-vitamin food. As Bachmann (1987) concluded, "One can explore a great variety of possibilities as soon as one accepts that milk is not the only raw material that can be processed in a dairy factory."

A small dairy plant may be very appropriate where transport is a constraint. Milk must reach a cooling facility or processing plant within two to five hours of milking, or chemical changes occur that make it unsuitable for processing (Bachmann, 1987; Rochford, 1987). In many parts of Africa, the amount of milk available from farms within two to five hours of any point is not likely to be sufficient for any but small plants. An alternative, as is found in East Africa, is a series of cooling facilities to which farmers deliver and from which milk is then shipped to a larger processing plant. But such arrangements run risks of waste when the cooling facilities fail because of power or mechanical problems, when transport to the plant fails because of vehicle or road problems and when the large plant has problems with machinery, power or such inputs as packing materials. For example, in their review of milk collection in developing countries, the International Dairy Federation (IDF, 1986) notes that in some parts of Kenya, "the amount of milk that can reach commercial factories falls by as much as 20 to 30% during the wet season because of difficulties with roads."

The small-scale processing strategy seems to have worked in Afghanistan, where the IDF (1986) reports:

> "[They have limited] the size of the factory and thereby the collecting radius to a maximum of 2 hours of transport time. This measure helped to collect good quality milk without cooling. It proved to be easier to build and run a second processing centre than to centralize milk processing with the help of expensive and unreliable chilling centres. Transport has been found to be economical by using contractors which bought milk at the farms and brought it to the dairy factory by means of horse-carts and donkeys. The margin paid to the contractors was 15% of the price of the milk. The contractors were responsible for the milk quality. If the fat test or the refractmeter value showed adulteration, the prices were lowered accordingly and the contractor had to bear the consequences."

Cameroon has developed a dairy action programme that calls for large private plants at cities as well as smaller "village milk factories" (Cameroon Ministry of Livestock, Fisheries and Animal Industries, 1989). The feasibility study for the village factory at Tadu is based on expected daily supplies of 1000 litres in the dry season and 2000 litres in the wet season. It would draw on about 140 milk producers in seven villages milking 1300 cows in the dry season and 2100 cows in the wet season. Milk would be brought to the factory by bicycle and head load. An important market target would be the capital of Bui Division (Kumbo Town), just 5 km away.

Small dairy plants may foster local economic development. They may stimulate greater milk production and sales from the local farmers. In addition, employment is provided in the plants themselves, in their marketing operations and in various support services, such as collecting milk from farmers.

Underutilisation of capacity: Seasonality and other problems

Underutilisation of capacity is a serious problem for many African dairy processing plants. One cause of this is the marked seasonality of milk production in Africa. Average production in the rainy season may be more than double that in the dry season, and the rainy-season peak may be 300% higher than the dry-season trough (Launonen et al, 1985; Waters-Bayer, 1988; Cameroon Ministry of Livestock, Fisheries and Animal Industries, 1989).

This marked seasonality has at least three causes—time of calving, availability of feed and water and prices. The seasonal calving pattern tends to result in more cows in milk during the wet season. The shortage of feed and water in the dry season results in lower milk yields per cow. Both these natural phenomena could

be overcome, at least in part, if farmers had sufficient incentive to do so. However, some governments impose uniform milk prices throughout the year. Not only does this not give farmers any incentive to smooth the seasonal pattern of production by, for example, storing feed for the dry season, but it can also exacerbate the seasonal pattern of deliveries to government plants if farmers have private marketing options.

In the dry season the drop in production causes free-market milk prices to rise and thus farmers sell as much to the private market as possible. In the wet season higher production causes free-market prices to fall, so farmers shift relatively more of their sales to the government plants. Therefore, in the dry season the pan-seasonal price policy tends to lower the percentage of milk coming to government plants from the lower total quantity of milk that is produced and sold, while in the wet season the policy tends to increase the percentage the plants get from the larger quantity produced and sold, thereby intensifying the seasonal swings in deliveries.

This does not necessarily mean that the plants actually get a higher percentage of production in the wet season than in the dry season. Other factors work in the opposite direction. The poor condition of roads in the wet season inhibits the movement of milk to plants. Also, the higher levels of production probably lead to greater home consumption. As Chikaka and Foote (1978) showed in Mara Region, Tanzania, such factors tend to moderate the seasonal swings in deliveries, while pan-seasonal pricing tends to exacerbate them.

In addition to seasonality problems, which affect large and small processing plants alike, the generally low levels of production in much of the continent are a problem for many of the larger plants. For example, in 1985 the seven plants in Tanzania processed 112,500 litres of milk, whereas their installed capacity was 309,000 litres (Netherlands Economic Institute, 1988). Some were operating at less than 20% of capacity. Furthermore, the four plants that accounted for 75% of the total processed relied on imported milk powder and butter oil for 65 to 82% of their throughput.

Other causes of underutilised capacity are lack of other inputs, such as packing materials, lack of spare parts to repair machinery, power outages and transport bottlenecks.

The role of food aid

Between 1983 and 1988, the World Food Programme (WFP) of the United Nations donated approximately $134 million worth of dairy food aid to 14 African countries—Angola, Mali, Niger, Senegal, Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Swaziland, Tanzania and Uganda (WFP, 1988). Tanzania was the largest recipient ($35 million), followed by Uganda ($24 million).

An example of the kind of initiative undertaken as part of the WFP effort is Tanzania's Tanga milk plant, built with aid from New Zealand and designed 10 years ago to start production at 10,000 to 12,000 litres a day. The Tanzania Sisal Authority farms were to provide the plant with 3000 litres of fresh milk a day. The rest of the capacity was to be used by recombining World Food Programme milk powder. The plant design was enlarged after Tanzania received a $10 million World Bank credit to expand parastatal dairying. The final installed capacity was 40,000 litres a day (Netherlands Economic Institute, 1988).

The plan for Tanga and other plants was that locally produced fresh milk would eventually replace imported milk powder as the domestic industry developed, helped in part by proceeds from selling milk powder donated by WFP. Not only has this eventuality not materialised, but in Tanzania there was actually an increase between 1976 and 1983 in the share of milk powder in the total amount of milk processed by the four plants with reconstitution capability (Netherlands Economic Institute, 1988).

The best known example of using dairy food aid to develop a local dairy industry is India's Operation Flood. The following discussion reviews briefly the main features of Operation Flood and summarises recent evaluations of its impacts. The relevance to Africa is then considered and the experience in one African country, Mali, is presented.

Operation Flood

Operation Flood used food aid in the form of skim-milk powder and butter oil from the European Economic Community (EEC) channelled through the WFP. The Indian Government sold this food aid to dairy processing plants to help meet demand in urban areas. Thus, the food aid filled unused capacity in diary plants until local production could catch up. In areas where excess demand necessitated new capacity, new plants were built with profits from food aid sales. Much of the new capacity was used in reconstituting food aid milk powder until local production reached the optimum level.

Food-aid milk supplies were also used to keep dairy processing plants operating at uniform levels of capacity during both the low- and peak-production seasons. This allowed plants to be built to handle peak-season milk levels and still operate close to capacity year-round.

Profits from the sale of food aid were used to finance Operation Flood's developmental activities. Operation Flood I received rupees (Rs) 1.5 billion in aid, 80% of which was generated through sales of dairy food aid; a World Bank loan covered most of the rest. This financed the establishment of cooperatives, improvement of research and extension services and development of dairy infrastructure that included processing plants, chilling plants, feed mills and a national dairy grid. The national dairy grid sought to link rural milk producing

areas with potential urban consumers, through improved roads and new milk tankers on railways.

While Operation Flood sought to increase the number of milk producers and their access to markets, it also emphasised increasing the productivity of the Indian dairy herd through improved technology. Food-aid revenues and World Bank loans financed research centres, artificial insemination campaigns and veterinary and extension services. Innovations were to be disseminated through the system of cooperatives. Productivity increases were to come through genetic improvement of the Indian herd, better management techniques and increased use of feed concentrates.

The weight of the literature seems to indicate that Operation Flood's main success has been in marketing rather than production, although questions remain. Doornbos et al (1990), in a major review, concluded that, "success in milk collection ... has been clearly demonstrated by the very large increases in milk procurement which occurred in many states, such as Gujarat." Goldberg and McGinity (1979) noted that the Anand cooperatives paid producers 15% more than did traditional outlets and they sold to consumers at 9% less. Mergos and Slade (1987) showed that, in the state they studied (Madhya Pradesh), the project improved the milk marketing system which increased competition. This resulted in an 8% increase in the average price of milk to producers.

The improvements in milk marketing are attributed to Operation Flood's capital investments in dairy infrastructure and the operations of village-level cooperatives. Higher prices and better marketing opportunities induced farmers to deliver more milk to market.

Some critics have argued that the increase in official milk marketing has merely come at the expense of home consumption or other marketing channels and is not due to any great change in dairying by farmers. Doornbos et al (1988) noted that, "with the exception of some advanced regions, the large increases in milk procurement under Operation Flood seem due mainly to a shift in marketing channels (i.e. farmers switching from sales to ghee traders to cooperatives), rather than any sizeable increase in milk production."

Official Indian statistics show an average annual growth in domestic milk production of about 1% between 1961 and 1974, but 4.9% between 1975 and 1985. Unfortunately, the latter figure is highly questionable. If official estimates of the number of milk animals are to be believed, then the production figures imply annual productivity increases per animal of 8.5%, which is highly unlikely (Doornbos et al, 1990).

In addition to the questions about Operation Flood's impact on production, other issues that warrant examination are dependency on food aid and the impact on farm income and income distribution, other marketing channels, rural nutrition and women. Space does not permit a thorough discussion of these issues here.

Doornbos et al (1990) summarised their own research and the work of others as follows:

1. During part of Operation Flood, food aid was quite important, but recently it has amounted to a very small percentage of total Indian milk supplies.

2. Farm income has increased due to higher milk prices and the opportunity for greater sales through the new marketing channels, but the very poorest farmers and the landless are underrepresented in Operation Flood.

3. There does not seem to have been a significant loss of employment in the informal marketing channels.

4. Although rural milk consumption may have declined, rural nutrition may have improved because higher dairy income allowed greater purchases of other foods.

5. Women may have lost some control over dairy income as men became attracted to the increased possibilities and because cooperatives typically enrolled men as members.

At the start of Operation Flood, India had several advantages that Africa does not now enjoy. The relatively high level of industrial development in India allowed Operation Flood to buy locally produced dairy equipment with local currency generated through food-aid sales. The foreign exchange needs of the project were thereby minimised. There was a relatively large pool of trained manpower to draw on for project implementation and research. In terms of dairy development, India had and continues to have much higher levels of per caput consumption of dairy products than African countries. There existed at the time of the project's start, areas of India that had thriving commercial dairy production by both smallholders and commercial operations. This situation exists in only a few African countries. Even with these advantages, questions remain about the impact of Operation Flood, as indicated above. Similar efforts to use WFP dairy food aid for development of African dairy industries have enjoyed much less success.

Mali's use of dairy food aid

Mali provides an interesting case study. In 1969, Mali was one of the first countries in Africa to receive WFP aid for dairy development, in this case for the development of the milk industry in Bamako. The outcome was not as hoped and WFP cancelled the renewal of the Mali project in 1979. Since 1984, however, the EEC has supplied skim-milk powder and butter oil, much of which is sold by the government to the Union Laitière de Bamako (ULB). The revenues from sales of dairy food aid currently go to a compensation fund for famine victims, whereas

the original WFP project envisioned them going to a research station for dairy development.

ULB reconstitutes milk and sells it to consumers in the capital at subsidised prices. ULB incorporates only negligible amounts of local milk into its product and its retail prices are almost half that of fresh milk. According to von Massow (1989) less than 50% of ULB's pre-tax profit goes to stimulating milk production. In comparison, WFP suggested that, for a similar project in Tanzania, 80% of the funds generated by the project be used in dairy development.

Mali's use of dairy food aid has managed to provide inexpensive milk to consumers in the capital city. Yet it has not helped to promote dairy development. ULB's cheaper product, though inferior, reduces potential demand for local milk in the short run. It has brought milk consumption to a greater portion of the population, stimulating demand for milk without an increase in domestic production. This increases dependence on imports of dairy products, whether food aid or commercial. In other parts of the continent researchers have shown that low consumer prices for milk are detrimental to dairy self-sufficiency (Mbogoh, 1984; Rodriguez, 1987). In Mali the benefits of dairy food aid seem to have gone to urban consumers, the government and ULB, but not to producers.

Dairy food aid is unlikely to play a major role in the development of Africa's dairy industries. Whatever success India achieved is not likely to be replicated in Africa. Conditions in India were very different from those in Africa. Furthermore, the world dairy situation is also very different now. As discussed in the final section of the paper, large dairy surpluses are unlikely to be consistently available for major food-aid programmes in the foreseeable future.

The role of imports

Even if dairy food aid becomes less important to Africa, the world market may still be relevant in relation to dairy imports. Imports can play a role in meeting consumer demand and also in helping processing plants operate closer to capacity. However, imports may also retard development of the domestic industry if they come in at very low prices. The data presented in the first section of the paper show the role of imports in meeting demand. This section discusses the capacity issue and also the issues that must be addressed in formulating import policy. The next section assesses the world market.

Kurwijila (1986) showed how higher levels of capacity utilisation in the Tanzanian reconstitution plants were associated with lower unit costs in 1983. The Musoma and Mbeya plants, which could only process fresh milk, operated at 11 and 20% of capacity and had average unit costs of TSh 4.86 and 3.95 per litre, respectively, for processing and marketing milk, butter, ghee, cheese and cultured milk. In contrast, the Dar es Salaam, Arusha and Tanga plants relied on imported powder

for over 80% of their production; they operated at 52, 55 and 30% of capacity and had average unit costs of TSh 1.05, 1.60 and 1.68 per litre, respectively. (None of these cost figures include the cost of the milk purchased by the plants.)

This large cost difference must be considered when assessing the advantages and disadvantages of future reliance on imported milk powder in Africa. A standard comparative advantage, domestic resource cost analysis that only considers the cost of the raw milk or milk powder is not sufficient. That analysis must be supplemented by consideration of overall savings in processing due to greater use of capacity because of using imported milk powder. Nwoko (1986) and Chikaka and Foote (1978) indicated that commercial imports may have undercut domestic production in Nigeria and Tanzania, respectively, but the world market has since changed sharply.

If commercial imports can be landed in Africa at relatively low prices, there is the possibility that they will create disincentives for expansion of the domestic industry. Thus many observers raise the possibility of restricting imports through tariffs or quotas. The restriction of food imports is often rooted in one or several of the arguments discussed below.

Food security

The argument is that food imports are an unreliable source of something as vital as food. Furthermore, world food surpluses and import prices are a function of policies in major producing countries and hence relying on imports means being at the mercy of those policy makers. The posited dangers of relying on world markets must be balanced against the risks of relying on domestic supplies. The former may represent a form of portfolio diversification that tends to have counterbalancing forces, while the latter is subject to more extreme fluctuations caused by relatively local weather variations. All these considerations are probably more important for food grains than for milk, but they must be considered for milk as well. Another aspect of food security is the question of who consumes the food and who stands to lose if prices go up because of import restrictions. In the case of food grains, the urban and rural poor often stand to lose significantly from import restrictions, but milk may be more of a luxury good.

Stimulating domestic production

If imports are kept out or subjected to high tariffs, then they will offer less competition to domestic milk, which can then earn a higher price and thereby stimulate greater production. This argument calls for analysis of the links between the markets for imported and domestic products and the expected behaviour of domestic producers. It may be that imported dairy products only have a strong impact on prices near large cities with reconstitution plants. Thus import restriction may have minimal impact on many producers. The impact of

restrictions may also be blunted if consumers view the imported and domestic products as quite different, as has been reported in many cases. Fresh domestic milk products sell for a premium over imported products.

If domestic prices did rise, how would farmers react? Is the technology available to permit a significant increase in output? Are the inputs available, especially the feed? Some observers believe that relatively modest changes in management practices can yield large increases in production. The Indian experience does not provide great encouragement in this regard, but the Kenyan experience may. Higher domestic prices may also induce farmers to leave less milk for calves and for consumption by the family. These reallocations would increase milk sales, but only on a one time basis and at a cost to human nutrition and calf development. How sharp are those trade-offs?

Stimulating economic development

If domestic supply responds as argued above, this may increase farm incomes and non-farm rural employment and lead to broad economic development. This scenario calls for investigation of the importance of dairy income in total farm revenues and of the use of dairy earnings. The latter is often related to whether the men or women control the earnings.

Saving foreign exchange

This can be a very complicated issue for food crops when increases in domestic production can only occur if export crop production is decreased. However, it probably is straight-forward for milk since increased domestic production is unlikely to come at the expense of export crop production.

The world milk market

As discussed above, many sub-Saharan African countries have made extensive use of imported or donated skim-milk powder and butter or butter oil to produce reconstituted liquid milk. Reconstituted milk has often been sold to urban consumers in competition with fresh milk produced domestically, often at lower prices. While contributing to the goal of expanding food supplies, this strategy has simultaneously discouraged development of the domestic dairy sector.

Subsidisation of milk consumption through reconstitution of inexpensive and donated ingredients has been made possible by the domestic dairy price support programmes of some developed countries, particularly the EEC and the USA. Both have employed domestic price support policies that have encouraged surplus milk production. Both have attempted to remove surpluses by removing excess butter and non-fat dry milk from commercial markets.

The EEC has used export subsidies to dispose of vast quantities of butter and skim-milk powder on world markets, leading to world market prices during most of the 1970s and 1980s that were a fraction of domestic intervention prices. The EEC has also directed surplus butter and milk powder into food-aid programmes. The USA has not engaged directly in export subsidisation, but it has made its large volumes of skim-milk powder and butter purchases available for international feeding programmes.

We hypothesise that depressed world dairy prices and large dairy donations will not continue because of changes in dairy price support policies. Essentially, it has become too costly for the EEC and the USA to continue their past programmes which encouraged surplus milk production. Consequently, SSA will need to rely increasingly on domestic sources to expand consumption of milk and other dairy products.

Long-term supply–demand outlook

Following is a brief review of dairy supply–demand conditions and policies in major developed countries, focusing on recent efforts to balance milk supply with domestic needs.

EEC. The EEC produces nearly one-quarter of total world cow milk and accounts for almost one-half of world trade in dairy products and has had substantial dairy surpluses for many years. These have been the result of the EEC's pricing and intervention policies. Until recently, target producer prices applied to unlimited milk production. Target prices are maintained through state purchases of butter, skim-milk powder and specified cheeses at intervention prices set at levels that assure manufacturers sufficient revenue to pay dairy farmers the announced target price.

In light of feed costs and returns to farming alternatives, EEC target prices have been above market-clearing prices for milk, creating a mounting surplus problem. Attempts to correct the problem through incentive payments to terminate dairy farming and co-responsibility levies were not successful. Consequently, the EEC instituted a compulsory milk quota programme in 1984. The programme allocates a total community quota among member countries, which, in turn, allocate their country quota nationally, regionally or among processing plants. Milk production in excess of quota is currently taxed at a rate of 100% of the announced target price (superlevy).

Increasingly restrictive quotas have substantially reduced EEC milk surpluses. Changes in EEC production and stocks from 1986 to 1989 are shown in Table 2.

Reduced milk production and smaller stocks of surplus dairy products have reduced the amounts of dairy products available for EEC food-aid programmes.

Table 2. *Cow milk production and stocks of butter, cheese and skim-milk powder in the EEC, 1986 and 1989.*

	1986	1989	Change (%)
Cow milk production ('000 t)	116,569	108,870	-6.6
Ending stocks ('000 t):			
Butter	1583	358	-77.4
Cheese	810	886	9.4
Skim-milk powder	1039	282	-72.9

Source: *World dairy situation*, Foreign Agricultural Service, US Department of Agriculture, Circular Series FD 1-90, May 1990. Includes values for Spain and Portugal in 1986, prior to their joining the EEC. Data for 1989 are preliminary.

Smaller surpluses have also reduced the volume of subsidised exports, strengthening world market prices for butter, skim-milk powder and cheese.

The EEC quota programme was slated to terminate in 1988, but was extended through 1992. Initially opposed to quotas, EEC dairy farmers have come to accept compulsory controls as a reasonable cost to achieve price stability. EEC agricultural policy-makers see quotas as a cost-effective measure. Given their apparent success and general acceptance, quotas are likely to be a permanent fixture of EEC dairy policy. Quotas will be increased only as warranted by expanded domestic consumption or profitable export markets.

Other Western European countries. Major milk-producing countries in this group include Austria, Switzerland, Norway, Sweden and Finland, producing about 3–4% of world cow milk. With the exception of Sweden, these countries employ milk quota systems similar to the EEC programme. Despite quotas, non-EEC Western Europe produces more milk than it consumes, with surplus butter, skim-milk powder and cheeses exported under various export subsidy programmes.

Milk production in non-EEC Western Europe declined in the 1980s, falling almost 8% from 1985 to 1989. As a result, stocks and the availability of subsidised exports have diminished. Quotas will continue to be used to balance milk production with needs in these countries. They are not likely to contribute materially to exports.

Eastern Europe and the USSR. Milk production in Eastern Europe was stable in the 1980s, while increasing in the USSR. This region produces about one-third of total world cow milk. Eastern Europe is a net exporter of dairy products, while the Soviet Union is a large net importer, recently accounting for one-half to two-thirds of world butter imports (excluding intra-EEC trade).

The USSR has embraced a policy of increasing supplies of dairy products by encouraging increased domestic production and augmenting that with imports. In spite of increasing milk production, demand has outpaced supply. That situation is likely to continue, keeping the USSR a major importer of butter to the extent permitted by the availability of hard currency.

The effect of recent political and economic changes in much of Eastern Europe on dairy production and trade is a major unknown factor. Large, efficient collective and cooperative farms in some countries have yielded milk production in excess of domestic consumption, fostering substantial exports. Relaxation of price controls has stifled consumption and increased surpluses. But privatisation of milk production and higher incomes should ultimately lead to a more balanced supply–demand situation.

The USA. The USA produces about 15% of world cow milk. Its exports of dairy products about equal imports. But imports are restricted by import quotas and exports are largely concessionary or in the form of donations.

A system of dairy price supports has been in place in the USA since 1947. An announced support price for milk is maintained through unlimited government purchases of butter, skim-milk powder and specified cheeses at intervention prices linked to the milk support price. Since 1981, the support price could be lowered if government purchases exceeded specified limits. Persistent surpluses have resulted in a reduction of the support price from US$ 0.29/kg in 1981 to US$ 0.22/kg today. Recent legislation freezes the existing support level and requires either a co-responsibility levy or use of a (unspecified) supply management programme if surpluses exceed trigger levels.

Reduced support levels, voluntary supply control measures and increasing per caput cheese consumption have cut US dairy surpluses from 12% of production in 1983 to about 5% in the last two years. The current support price (US$ 0.22/kg) is believed to be less than full production costs for most US dairy farmers. Consequently, supply and demand for milk overall should be in balance. The USA, like the EEC, will continue to produce substantial surpluses of butter because of a structural imbalance between butterfat and non-fat solids in dairy products. Shifts in consumption toward low-fat milk and cheeses with no corresponding change in the butterfat content of milk has resulted in increasing production of butter. The intervention prices for butter and skim-milk powder have been altered to reduce the relative price for butter, but the government continues to be the primary market outlet for butter. Consequently, ample supplies of US butter will likely remain available for food-aid donations and special export programmes in the short run, but there will be little surplus cheese or skim-milk powder for these programmes. In the long run, pricing changes are expected to reduce butter surpluses as well.

New Zealand and Australia. These countries represent distinct exceptions to other developed countries in their export-market-oriented dairy policies. New Zealand currently has no support programme for dairy farmers, either direct or indirect. Australia maintains a market development tax on domestic dairy product sales that will be phased out by 1992. Together, the two countries account for only about 3% of world cow milk but about 25% of world exports of butter, skim-milk powder and cheese.

New Zealand and Australia do not subsidise dairy exports. Low milk production costs have allowed them to export profitably at world market prices that have been much lower than supported prices in the EEC and the USA.

Higher world market prices for dairy products have meant more lucrative export earnings for New Zealand and Australia. While this might be expected to have triggered increased milk production, opportunities for expansion are limited, particularly in New Zealand. These major exporting countries will continue to benefit from efforts to control milk supply in other countries, but they are unlikely to increase substantially their export volume.

Prospects for dairy prices and donations

Domestic price support policies in many developed countries have created chronic surpluses of non-perishable dairy products, especially butter and skim-milk powder. The high cost of maintaining prices above market-clearing levels has spawned a variety of measures to reduce production.

Following considerable experimentation, governments have settled on two diametrically opposite approaches to controlling surpluses. The EEC, most of Western Europe, some Eastern European countries, Canada and other countries now use quotas to manage supplies. The USA, Australia and New Zealand have moved toward deregulation, with New Zealand relying completely on market signals to allocate resources in its dairy sector.

Both approaches have been successful. Stocks of butter and skim-milk powder have fallen dramatically (Figures 12 and 13). Ending stocks of both products in 1990 are projected to be 35% of their 1986 levels. World dairy prices strengthened considerably in response to reduced surpluses. While falling below their peak levels of late 1989, butter, cheese and skim-milk powder prices on world markets remain 50 to 100% higher than 1985–87 (Figure 14).

Food-aid programmes in many countries depend heavily on the availability of government-held stocks. Lower stocks and higher export values have therefore affected dairy donations. Estimated dairy donations from all donors to all recipient countries fell by 35% between 1984 and 1988 (Figure 15). More recent figures will show further declines.

Figure 12. *World year-end stocks of butter, 1985-90.*

Figure 13. *World year-end stocks of skim-milk powder, 1985-90.*

Stocks

('000 tonnes LME)
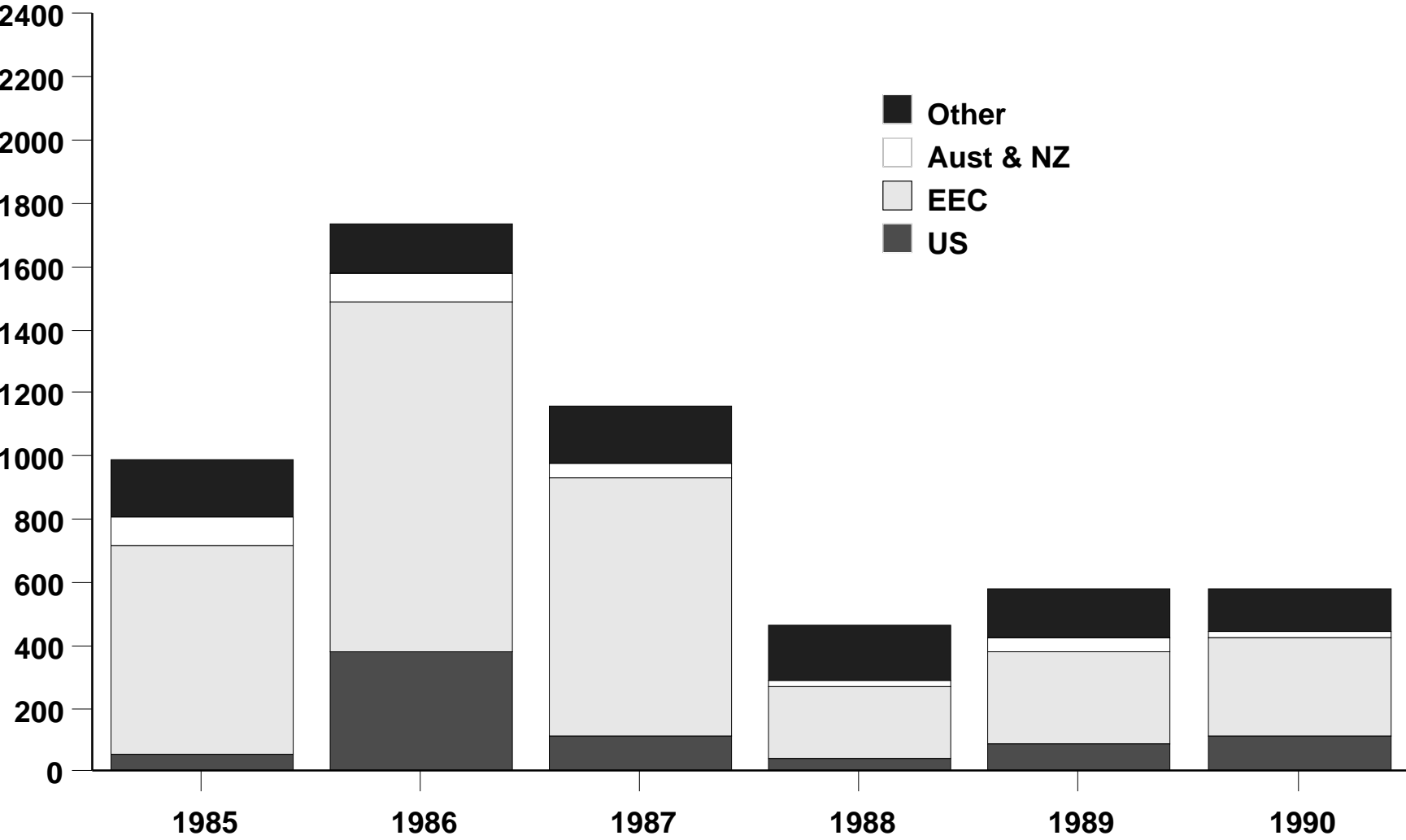
Figure 14. *World prices for dairy products, 1983-90.*
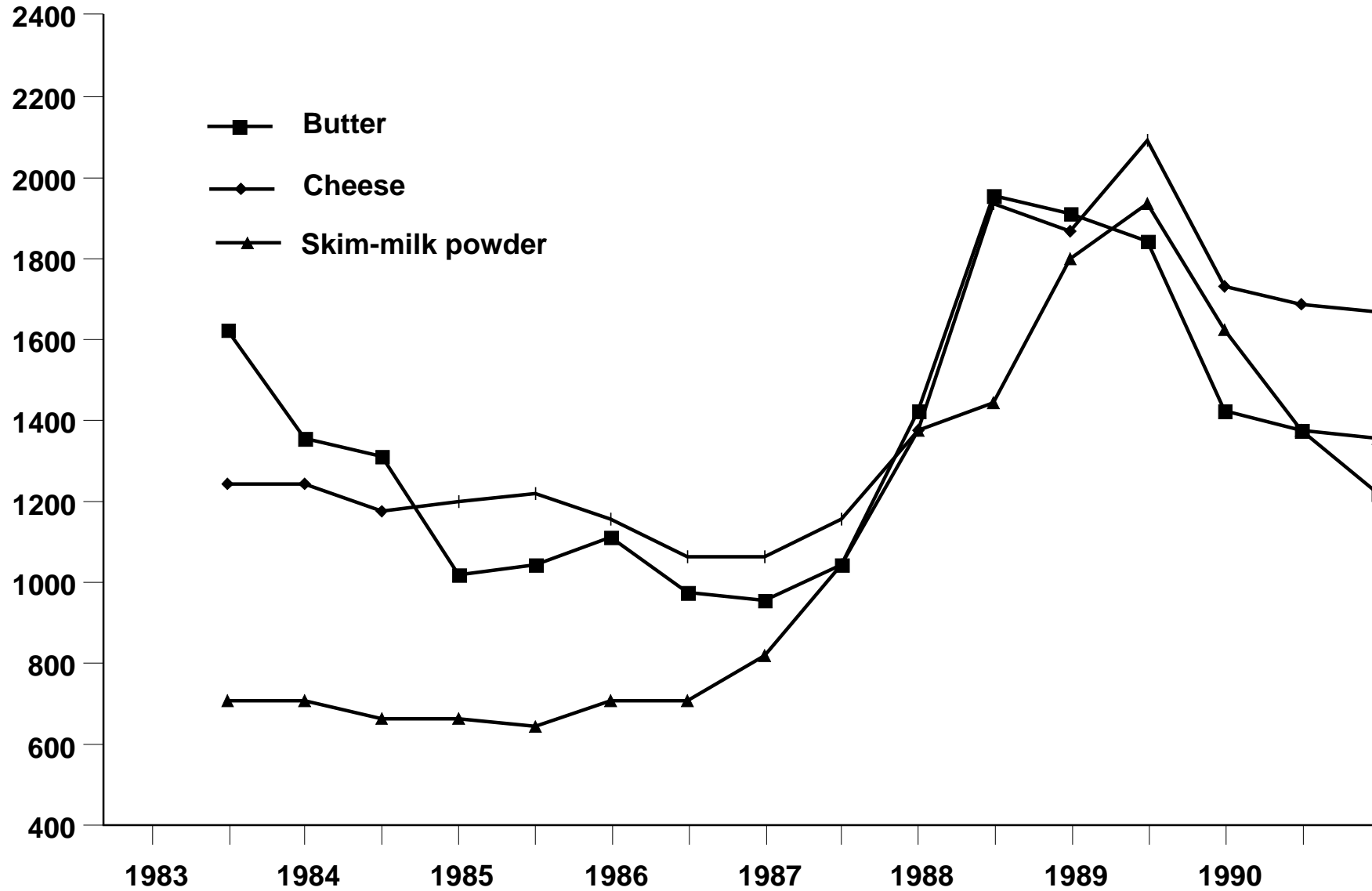
Figure 15. *Total world dairy donations, 1979-88.*

Donations
('000 TONNES LME)
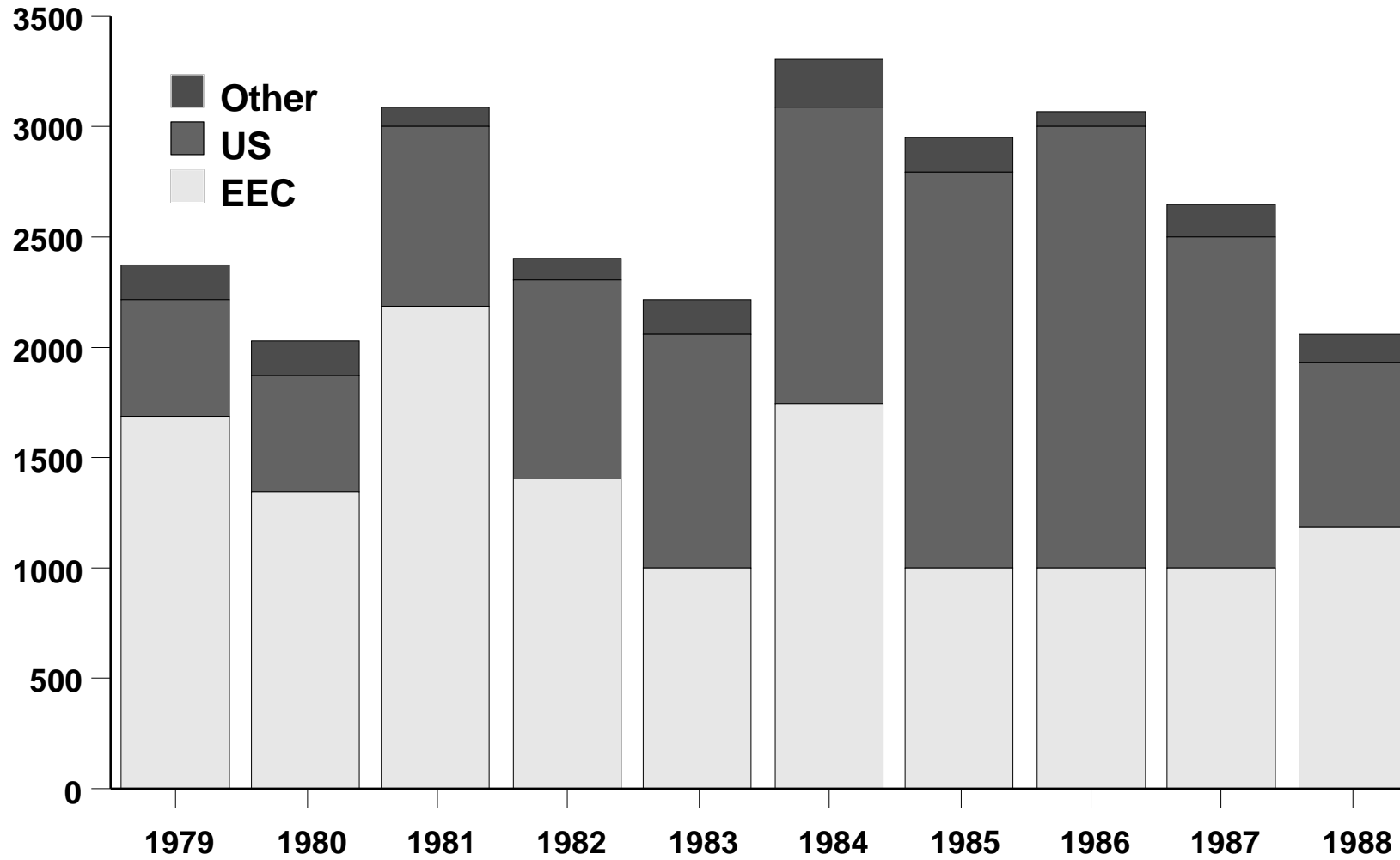
It is very unlikely that dairy policies in developed countries will revert to those that previously generated surpluses. Any build-up in stocks will be met with more restrictive quotas or lower support prices. Consequently, the longer-term prospect is for dairy prices on world markets to remain high relative to levels experienced in the 1970s and 1980s. Smaller surpluses will also generate smaller dairy donations.

This conclusion holds notwithstanding the outcome of the ongoing negotiations under the General Agreement on Tariffs and Trade (GATT). The USA is supporting a GATT agreement that would require elimination of trade-distorting domestic support programmes as well as import barriers and export subsidies. If the USA's position is adopted, then world market prices for dairy products would strengthen for two reasons: (1) milk production in the USA and the EEC would decrease in response to lower domestic prices and (2) the demand for imported dairy products would increase with lower tariffs and fewer import restrictions. Estimates of world price increases from trade liberalisation range from 31 to 95% (Blaney and Fallert, 1990).

Most observers believe that GATT will yield little change in either domestic dairy programmes or trade restraints. With no change from the current situation, world prices will continue to be affected by export subsidies and barriers to entry. But budget-related pressures to minimise dairy surpluses in most developed countries will continue.

Future prospects strongly indicate that relying on imported skim- milk powder to supply low-cost reconstituted liquid milk to urban consumers in sub-Saharan Africa will become an expensive policy. In turn, there will be a premium to providing incentives for expansion of domestic milk production.

References

Bachmann M. 1987. Products and processes, possibilities and limitations of decentralized milk processing. In: Dairy Development in East Africa. *Bulletin of the International Dairy Federation* 221:95–96.

Baker R. 1971. Stages in the development of a dairy industry in Bunyoro, Western Uganda. *Transactions of the Institute of British Geographers* 53:43–54.

Blaney D P and Fallert R. 1990. *The world dairy market— Government intervention and multilateral policy reform.* Staff Report No. AGES 9053, Economic Research Service, US Department of Agriculture, Washington, DC, USA.

Cameroon Ministry of Livestock, Fisheries and Animal Industries. 1989. Feasibility study of Tadu Village Cheese Factory. Cameroon Ministry of Livestock, Fisheries and Animal Industries, Yaoundé, Cameroon.

Chikaka C M B and Foote R J. 1978. *Milk and dairy products: Production, marketing, and consumption in Mara Region, Tanzania.* Rural Economy Research Paper No. 8. Department of Rural Economy, Faculty of Agriculture, Forestry and Veterinary Science, University of Dar es Salaam, Dar es Salaam, Tanzania.

COWIconsult. 1979. *Master plan study for the dairy industry in Kenya.* Vols. I, II, and III. DANIDA (Danish International Development Agency), Copenhagen, Denmark.

Debrah S H and Berhanu Anteneh. 1991. *Dairy marketing in Ethiopia: Markets of first sale and producers' marketing patterns.* ILCA Research Report 19. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 21 pp.

Delgado C. 1987. *Le rôle des prix dans l'augmentation de la consommation de riz et de blé en afrique de l'ouest francophone.* Paper prepared for the conference on ''Dynamique de la consommation et de la production de céréales en afrique de l'ouest'', Dakar, September 1987. IFPRI (International Food Policy Research Institute), Washington, DC, USA.

Doornbos M, Mitra M and van Stuijvenberg P. 1988. Premises and impacts of international dairy aid: The politics of evaluation. *Development and Change* 19:467–504.

Doornbos M, van Dorsten F, Mitra M and Terhal P. 1990. *Dairy aid development: India's Operation Flood.* Sage Publications, New Delhi, India. 336 pp.

El Tayeb G D. 1986. The cheese industry and underdevelopment in the White Nile. In: Davies H R J (ed), *Rural development in White Nile Province, Sudan. A study of interaction between man and natural resources.* United Nations University, Tokyo, Japan. pp. 73–82.

Ephraim Bekele and Tarik Kassaye. 1987. Traditional Borana milk processing—efficient use of subtle factors needs further research work. *ILCA Newsletter* 6(4):4–5. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Goldberg R A and McGinity R C. 1979. *Agribusiness management for developing countries—Southeast Asian corn system and American and Japanese trends affecting it.* Ballinger, Cambridge, Massachusetts, USA.

IDF (International Dairy Federation). 1986. Milk collection in developing countries. *Bulletin of the International Dairy Federation* 205. IDF, Brussels, Belgium. 16 pp.

Jahnke H E. 1982. *Livestock production systems and livestock development in tropical Africa.* Kieler Wissenschaftsverlag, Vauk, Kiel, Germany. 273 pp.

Korhonen H. 1987. The Meru Dairy Project: A case study. *Bulletin of the International Dairy Federation* 221:84–90. IDF (International Dairy Federation), Brussels, Belgium.

Kurwijila R L. 1986. *Flame sterilization and marketing of milk in 20 litre containers.* Thesis, Eidgenossische Technische Hochschule, Zurich, Switzerland. 185 pp.

Launonen R, Karinpaa A, Marangu L and Minae S. 1985. *Rural dairy development in Meru: A socio-economic study of smallholder milk production, consumption and marketing.* Report No. 8/1985/B. Institute of Development Studies, University of Helsinki, Helsinki, Finland. 229 pp.

von Massow V H. 1989. *Dairy imports into sub-Saharan Africa: Problems, policies and prospects.* ILCA Research Report 17. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 46 pp.

Mbogoh S G. 1984. Dairy development and dairy marketing in sub-Saharan Africa: Some preliminary indicators of policy impacts. *ILCA Bulletin* 19:8–16. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Mergos G and Slade R. 1987. *Dairy development and milk cooperatives: The effects of a dairy project in India.* World Bank, Washington, DC, USA. 140 pp.

Netherlands Economic Institute. 1988. *The livestock sector in Tanzania.* Netherlands Economic Institute, Rotterdam, The Netherlands.

Nwoko S G. 1986. *The development of dairy imports in Nigeria.* LPU Working Paper 10. LPU (Livestock Policy Unit), ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 70 pp.

O'Mahony F. 1988. *Rural dairy technology: Experiences in Ethiopia.* ILCA Manual 4. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 64 pp.

O'Mahony F and Ephraim Bekele. 1985. Traditional butter making in Ethiopia and possible improvements. *ILCA Bulletin* 22:9–14. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Rochford N. 1987. Milk preservation by refrigeration. *Bulletin of the International Dairy Federation* 221:55–56.

Rodriguez G, Jr. 1987. The impacts of the milk pricing policy in Zimbabwe. *ILCA Bulletin* 26:2–7. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Ruigu G M. 1978. *An economic analysis of the Kenya milk subsystem.* PhD thesis, Michigan State University, East Lansing, Michigan, USA.

Senait Seyoum. 1988. *Patterns of consumption of dairy products in West Africa.* LED Working Document 11. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 52 pp.

Simmons E B. 1973. The economics of consumer-oriented food processing technology in northern Nigeria. *Samaru Agricultural Newsletter* 15(2):56–72. Zaria, Nigeria.

Waters-Bayer A. 1988. *Dairying by settled Fulani agropastoralists in central Nigeria: The role of women and implications for dairy development.* Farming Systems and Resource Economics in the Tropics 4. Kieler Wissenschaftsverlag Vauk, Kiel, Germany. 328 pp.

World Bank. 1990. *Dairy development in sub-Saharan Africa: A study of issues and options.* World Bank, Washington, DC, USA.

WFP (World Food Programme). 1988. "Food Aid and Dairy Development." Committee on Food Aid Policies and Programmes, 25th session, Rome, 30 May–10 June, 1988. WFP, Rome, Italy. WFP/CFA: 25/P/8.

Zalla T M. 1982. *Economic and technical aspects of smallholder milk production in northern Tanzania.* PhD thesis, Michigan State University, East Lansing, Michigan, USA.

Discussion

The authors' suggestion to concentrate on the development of small milksheds around smaller urban markets was generally well received. Some concern was, however, expressed about the need for discussing the issue of supporting dairy technologies. Specific comments on the paper revolved around the choice of domestic and international prices to value dairy products and the use of FAO production data and LME conversion factors, which often provide a misleading picture of the importance of dairying relative to other livestock activities; the effects of imports on domestic production; and sources of production growth (resulting from changes in herd size, proportion of cows in milk and yield per cow).

A number of research issues arose and the priorities to be given to these in resource allocation were discussed. With respect to market research it was felt that, continentally, it was more important to measure the influence of non-income factors like ethnicity, urbanisation and

population growth on aggregate demand rather than estimating income elasticities. As regards the economic efficiency of milk marketing systems, it was argued that the commonly used structure performance approach was unsatisfactory in the African context and the need for an improved theoretical paradigm going beyond the structure aspect was acknowledged.

A third area of concern related to research on matching production and marketing systems. Economists' lack of attention to non-price incentives such as risk and inconvenience in handling dairy products was perceived as a problem in stimulating increased milk supply. Dependence on imports, especially in situations where there were foreign exchange constraints, was seen as a risky venture. Given an assessment of the domestic resource costs of dairying relative to imports, demand for local milk could be expanded through education, exposure and exploiting the efficiency of traditional marketing systems in SSA.

Dairy imports in sub-Saharan Africa

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Abstract

In sub-Saharan Africa, concern over nutritional deterioration and growing food-import dependency has increased during the last decade. Population growth, urbanisation, and government policies promoting improvements in diets, have changed consumption patterns in these countries. Between 1961 and 1986, sub-Saharan Africa's dairy imports increased sixfold, growing at an annual rate of 8%. This paper examines 39 sub-Saharan countries, and evaluates factors affecting dairy imports. The results indicate that government policies encouraged import growth in most of the countries. The welfare effects of import policies, such as direct import or consumer price subsidies, exchange rate overvaluation, and distribution of food-aid imports, are reviewed in addition to the policies of exporting countries.

Dairy imports in sub-Saharan Africa

In sub-Saharan Africa, concern over nutritional deterioration and growing food-import dependency has increased during the last decade. Most studies have focused on the availability of grains because of their importance in the diet and the availability of data and information on them. Far less attention has been paid to the livestock and dairy sectors. Population growth, rising incomes, urbanisation, and government policies promoting improvements in diets, have changed consumption patterns in sub-Saharan African countries. With slow domestic production growth, import dependency for commodities such as dairy products has increased significantly. Between 1961 and 1986, sub-Saharan Africa's dairy imports increased sixfold, growing at an annual rate of 8%. This trend is a cause for concern as high import growth may be difficult to sustain financially.

This paper examines 39 sub-Saharan countries in three regions: West Africa (Benin, Burkina Faso, Cameroon, Cape Verde, Chad, Cote d'Ivoire, Gabon, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo), East Africa (Burundi, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania, Uganda and Zaire), and southern Africa (Angola, Botswana, Comoros, Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Zambia and Zimbabwe).

This paper evaluates factors affecting dairy imports such as income, population, production and domestic policies, in order to determine the impact of policies on import growth. The results indicate that government policies encouraged import growth in most of the countries included in the study. The welfare effects of import policies, such as direct import or consumer price subsidies, exchange rate overvaluations and distribution of food-aid imports are reviewed in addition to the policies of exporting countries. The period covered in the study is 1961 to 1986, with a particular attention to the years 1977–86, years for which food-aid data were available.

Overview of the international dairy market

Total world cow milk production neared 470 million tonnes in the late 1980s. The recent production growth of about 1 to 1.5% annually was less than the historical 2% annual growth rate of the 1970s and the mid-1980s (Blayney and Fallert, 1990). Europe, the Soviet Union and North America (the USA and Canada) account for about 80% of world production.

Most dairy products are highly processed and are traded largely among higher income countries. An exception is non-fat dry milk which is imported by lower income countries. Only about 5% of the world's milk production is traded. Storable products, mainly cheese, non-fat dry milk, butter and protein components such as casein, dominate dairy trade.

Government policies play a significant role in international dairy trade. The major industrialised dairy producing nations, except New Zealand and Australia, operate domestic dairy programmes that provide relatively high levels of assistance to their dairy sectors. In order to maintain domestic supply and demand balances, many countries have used the international market as an outlet for surplus dairy production.

Most milk is consumed where it is produced either as fresh milk or processed dairy products. The share of traded dairy products has remained stable through time, but the absolute traded quantities have increased with production. Developed countries are large net exporters, while developing countries are large net importers. The European Community (EC), New Zealand and Australia are the most active traders, with the EC and New Zealand clearly dominating. Other

industrialised countries, such as the United States and Canada, participate in selected product markets. The Soviet Union is the largest importer of dairy products, importing half of the world's traded butter. The main importers within the developing countries group are oil exporters such as Mexico, Venezuela, Algeria, Iran, Saudi Arabia and Malaysia. These countries have recently increased their imports as prices of dairy products have fallen and oil prices have risen. Imports of most developing countries, however, are constrained by limited foreign exchange availability. This has lowered demand and contributed to the excess supply on the world market, spurring the decline in prices (FAO, 1990).

Dairy imports in sub-Saharan Africa

Dairy imports by sub-Saharan countries are small relative to total world trade, but dairy consumption in some countries is almost totally dependent on imports. The data for the last 25 years showed a sixfold increase in imports into sub-Saharan Africa, with an annual growth rate of about 8% (Figure 1). Most of the import growth occurred during 1961–76 (11% per year) and has lessened since then to about 3% per year. The earlier high rate of import growth most likely stemmed from slow domestic production growth (1.8% annually), which was not keeping pace with the 3% population growth for the region (Figure 2), and the availability of the foreign exchange to import.

During 1977–86, production performance improved, growing 2.7% annually, while import growth slowed to 3%. This resulted in little change in the self-sufficiency ratio, but a slight decline in average per caput consumption levels. The average dairy self-sufficiency ratio, which was about 95% in the early 1960s, fell to 82% during 1977–86.

On the subregional level, the rate of import growth during 1977– 86 was the highest in East Africa (8%), followed by southern Africa (6%) and West Africa (-0.7%). The import dependency ratio showed a contrasting pattern, with East Africa being the least import-dependent subregion (7% average), followed by southern Africa (36%) and West Africa (42%).

Individual country import growth rates varied significantly (Table 1). Of the 39 countries studied, two (Kenya and Zimbabwe) were net exporters of dairy products until the early 1980s. The range of annual import growth for the remaining 37 countries was from -22 to 27%. Five countries registered import growth of more than 20% per year (Chad, Niger, Ethiopia, Rwanda, and Mozambique). For some of these countries, this high rate of import growth is due to the low level of imports in the base period, so that even with the high import growth, their import dependencies remained low (less than 20% in Chad, Niger and Ethiopia, and 32% in Rwanda and 48% in Mozambique in 1984–86).

Figure 1. *Imports of dairy products into sub-Saharan Africa, 1961-85.*

Index (1961 = 100)
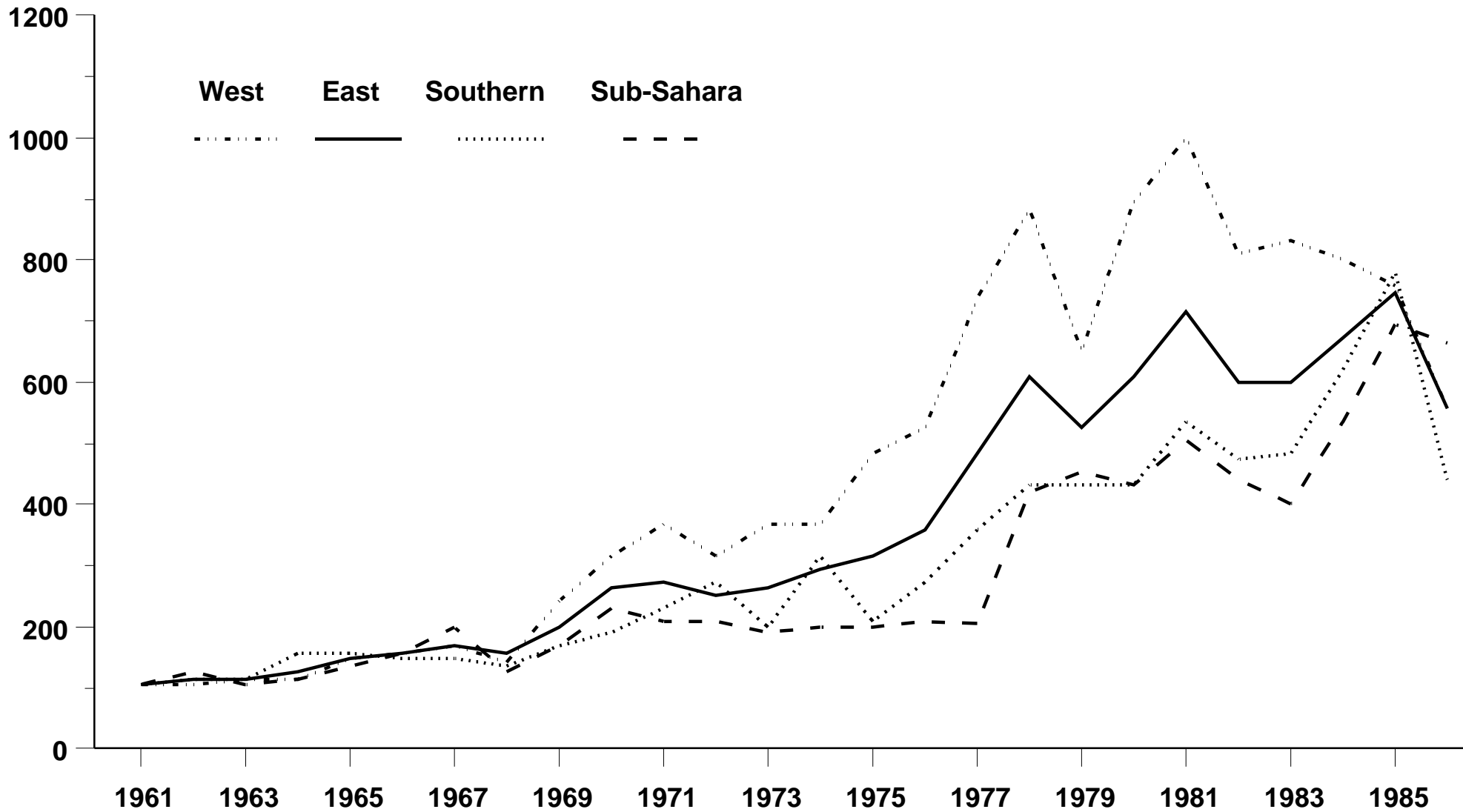
Figure 2. *Per caput milk production, sub-Saharan Africa, 1966-86.*

Index (1966 = 100)
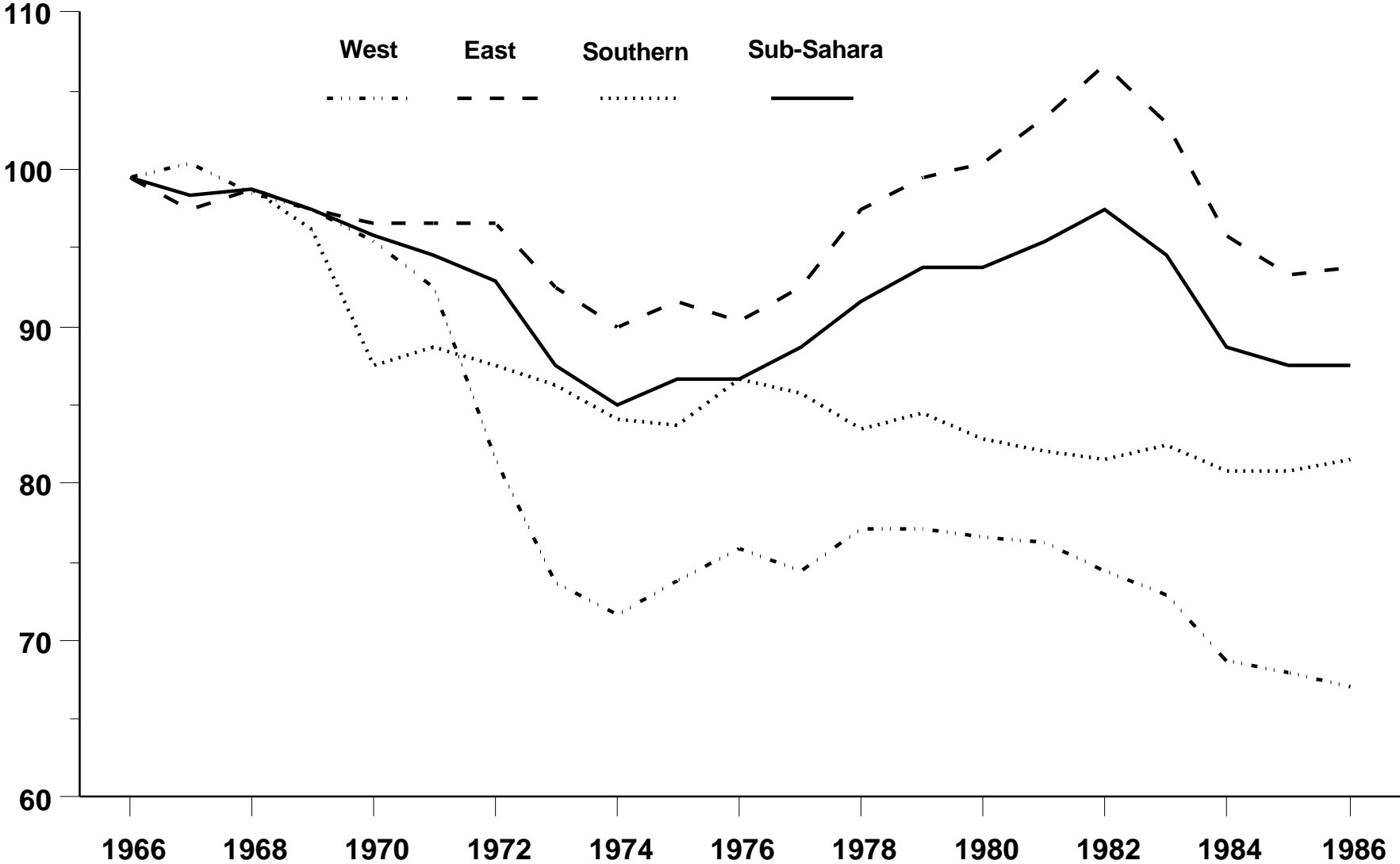
Table 1. *Dairy supply and utilisation growth in sub-Saharan Africa*

Country	Production	Imports	Food aid	Commercial imports	Consumption
WEST					
Benin	4.01	10.57	NA	17.76	5.40
Burkina Faso	1.85	0.55	0.08	3.18	1.34
Cameroon	2.20	4.32	NA	4.32	3.12
Cape Verde	-1.10	-2.63	3.70	-30.89	-2.44
Chad	0.25	27.43	28.51	14.03	1.93
Côte d'Ivoire	-5.00	8.00	NA	8.00	4.50
Gabon	13.83	2.40	NA	2.40	2.57
Gambia	-0.21	17.55	16.63	18.67	10.32
Ghana	5.67	-2.64	6.86	-20.53	-1.28
Guinea	1.54	7.63	-0.25	12.32	2.51
Guinea-Bissau	2.37	-6.46	-7.39	-3.22	0.04
Liberia	3.24	8.51	11.75	-3.54	5.62
Mali	-0.28	5.37	8.96	0.50	0.44
Mauritania	2.09	17.05	26.45	10.42	5.78
Niger	1.46	21.35	24.70	18.37	3.39
Nigeria	0.79	-10.79	NA	-10.79	-5.28
Senegal	-1.21	5.10	14.15	1.81	2.31
Sierra Leone	-0.12	-2.04	18.57	-49.79	-0.89
Togo	0.96	18.94	27.54	-13.37	10.33
EAST					
Burundi	-7.10	14.45	12.14	20.40	-2.31
Ethiopia	0.66	23.70	24.58	-4.27	2.89
Kenya 2/	-2.07	NA	32.67	NA	-1.35
Rwanda	6.13	20.61	18.42	43.90	9.36
Somalia	0.12	-7.72	9.56	-35.83	-0.87
Sudan	6.91	8.55	-0.11	45.50	6.96
Tanzania	2.72	-10.45	-4.14	-30.14	1.43
Uganda	0.70	10.95	10.50	11.98	1.14
Zaire	1.88	3.99	-32.96	14.64	3.79

Annual growth (%)[1]

1. Calculated from 1977–79 (average) to 1984–86 (average).

NA = not applicable.

Table 1. *Dairy supply and utilisation growth in sub-Saharan Africa* (cont.).

Country	Production	Imports	Food aid	Commercial imports	Consump-tion
SOUTH					
Angola	0.42	9.23	16.05	8.04	4.95
Botswana	1.95	14.10	NA	14.10	4.26
Comoros	2.93	15.12	NA	15.12	8.48
Congo	1.57	14.21	NA	14.21	11.90
Lesotho	2.64	8.51	11.75	-6.54	5.62
Madagascar	3.08	8.51	15.12	-3.17	4.71
Malawi	2.76	2.78	-18.93	10.69	2.77
Mauritius	0.25	1.46	-12.86	3.36	1.15
Mozambique	1.20	21.35	24.70	18.37	3.39
Zambia	3.24	-21.67	-5.97	-33.92	-1.87
Zimbabwe[2]	5.07	NA	NA	NA	5.94

(columns grouped under: Annual growth (%)[1])

1. Calculated from 1977–79 (average) to 1984–86 (average).

2. Kenya and Zimbabwe were exporters of dairy products until 1980.

NA = not applicable.

Source: FAO data.

In countries with declining imports, the annual rate of decline ranged from -3 to -22%. These include Cape Verde, Ghana, Guinea-Bissau, Nigeria, Sierra Leone, Somalia, Tanzania and Zambia. In all, with the exception of Cape Verde, Ghana, and Sierra Leone, the lower imports significantly reduced import dependency.

The most dairy-import-dependent countries were Cape Verde, Cote d'Ivoire, Gabon, Liberia, Zaire and Congo, with imports contributing more than 80% of consumption in 1984–86. The countries with the lowest import dependencies, less than 10% included Kenya, Somalia, Sudan, Tanzania, Uganda, Zambia and Zimbabwe (Table 2).

Commercial and food-aid imports

During 1977–86 (the period for which food-aid data were available), the food-aid share of total dairy imports increased from 21% in 1977 to 57% in 1986. Of the 39 countries studied, seven did not receive any dairy aid during the study period: Cameroon, Cote d'Ivoire, Gabon, Nigeria, Botswana, The Comoros and Congo. Benin and Liberia were food-aid recipients in earlier years, but were not during 1984–86. The reverse was true in Zimbabwe, which received dairy aid only since the early 1980s. In Zimbabwe, the share of dairy imports in total consumption

Table 2. *Dairy import dependency and food aid share of total imports.*

Country	Total imports/ consumption		Commercial imports/ consumption		Share of food aid of total imports	
	1977–79	1984–86	1977–79	1984–86	1977–79	1984–86
	———————————— Per cent ————————————					
WEST						
Benin	17.4	24.7	10.6	24.7	39.9	0.0
Burkina Faso	38.9	38.1	6.3	7.9	85.9	80.0
Cameroon	41.7	45.3	41.7	45.3	0.0	0.0
Cape Verde	85.1	87.1	31.0	5.1	63.9	94.1
Chad	2.2	11.4	0.3	0.5	79.5	69.1
Côte d'Ivoire	70.3	90.1	70.3	90.1	0.0	0.0
Gabon	98.9	97.7	98.9	97.7	0.0	0.0
Gambia	43.8	72.3	19.4	31.3	53.9	57.7
Ghana	86.1	78.6	42.7	14.5	51.9	80.9
Guinea	13.2	18.7	6.9	13.8	47.2	21.0
Guinea-Bissau	32.7	19.8	6.4	4.7	80.1	80.6
Liberia	82.2	87.0	63.3	87.0	23.2	0.0
Mali	10.6	14.8	5.3	5.2	55.6	64.0
Mauritania	15.8	34.4	11.4	15.0	27.0	59.9
Niger	4.8	16.7	2.8	8.0	37.2	51.5
Nigeria	62.0	41.6	62.0	41.6	0.0	0.0
Senegal	49.7	60.2	40.2	39.0	19.8	34.9
Sierra Leone	40.8	36.9	32.0	1.0	19.8	97.0
Togo	34.0	66.3	13.8	3.3	71.6	95.0
EAST						
Burundi	11.3	35.7	2.6	12.9	75.3	58.9
Ethiopia	4.1	17.3	0.3	0.2	94.8	98.8
Kenya	0.0	4.8	0.0	0.1	NA	79.1
Rwanda	13.6	31.8	0.5	5.4	94.2	83.1
Somalia	15.4	9.7	11.2	1.0	34.0	90.3
Sudan	3.3	3.7	0.1	1.7	95.9	56.4
Tanzania	14.3	6.2	6.0	0.7	60.1	87.0
Uganda	3.0	5.9	0.9	1.9	69.6	65.6
Zaire	88.8	91.0	46.2	86.8	46.5	4.6

NA = not applicable.

Table 2. *Dairy import dependency and food aid share of total imports* (cont.).

Country	Total imports/ consumption		Commercial imports/ consumption		Share of food aid of total imports	
	1977–79	1984–86	1977–79	1984–86	1977–79	1984–86
	Per cent					
SOUTH						
Angola	43.1	56.0	37.7	43.8	13.9	24.0
Botswana	12.7	25.7	12.7	25.7	0.0	0.0
Comoros	35.0	55.2	35.0	55.2	0.0	0.0
Congo	74.6	87.6	74.6	87.6	0.0	0.0
Lesotho	45.6	55.1	14.1	6.4	69.3	89.6
Madagascar	26.0	34.0	13.7	7.7	47.2	77.7
Malawi	32.9	32.2	16.5	28.7	52.0	10.9
Mauritius	73.9	75.5	60.3	70.5	18.4	6.6
Mozambique	37.5	47.8	23.5	27.1	41.5	41.4
Zambia	36.0	8.9	27.6	2.9	25.8	68.3
Zimbabwe	0.0	4.7	0.0	0.0	0.0	100.0

Source: FAO data.

grew to 5% in 1984–86, while commercial imports accounted for 1–2% throughout the period.

Overall, the growing food-aid dependency of these countries is of great concern. From 1977–79 to 1984–86, the aid share of total dairy imports increased in 18 countries. During 1984–86, dairy aid contributed more than 50% of total dairy imports in 23 countries and in 12 this share exceeded 80% (Table 2). This high rate of aid dependency in countries with low self-sufficiency ratios, such as Ghana, Togo and Madagascar, means establishing consumer habits that may be difficult to support financially in the long term. The current level of food aid, if not reduced, is not expected to grow much, particularly if the current GATT negotiations lead to a decline in surplus commodities. Consequently, given growing import dependency in most countries and a history of commitment to consumers, governments may be forced to import commercially, thereby further straining their limited financial resources.

Factors affecting imports

The key factors shaping imports are market demand and supply, and policies. Both domestic and international policies are expected to influence import levels.

Demand pressure

Total consumption of dairy products is derived by adding the local production to net imports. Changes in stocks are not included because of the lack of data and the short shelf-life of most dairy products. Average annual consumption growth for the region during 1977–86 was 2.8%, less than the average population growth of 3%.

Income was not a major factor in increasing demand for dairy products (Table 3). From 1977 to 1986, per caput income grew only by 1.2% per year. When Nigeria is excluded, the growth rate decreases to 0.06%. In fact, positive income growth occurred only during the late 1970s. Since then (1980–86) the per caput income trend was negative (-4.2%); without Nigeria the rate of decline slows to -2.8%.

During 1977–86, per caput income declined in 14 countries, and remained stagnant in three more. Few countries performed well. Cameroon, Burundi and Botswana had the highest annual per caput income growth, ranging from 7 to 9% per year.

In addition to income, changes in commodity prices are the key determinants of consumption. Lack of price data, however, leaves a major gap in demand analysis for dairy products. Given the recent declining trends in international dairy prices, and the consumer-oriented policies of these governments, changes in prices are expected to have a limited impact on dairy consumption in these countries. Hence, population growth remains the principal force behind consumption growth. As a result, maintenance of constant per caput consumption levels translates into a 3% annual increase in future demand.

Production performance

Output of the dairy sector is difficult to assess because of the quality of the data. According to FAO production estimates, from 1961 to 1977, total milk production in the region grew about 30%, an annual growth rate of less than 2%. From 1977 to 1986, it was almost 2.7% per year. The region's share of world production is very low, about 1%, while its population share is about 12%.

Subregional milk production growth and the share of total sub-Saharan production has varied considerably. West Africa, with the largest population, showed the lowest production growth and held only a 17% share of production in 1986. East Africa had the highest annual rate of production growth, at 2.8%, and the highest share of total production, 73%. Southern Africa, which accounted for 10% of total production in 1986, achieved annual production growth of about 2%. In per caput terms, output was highest in East Africa (39 kg) followed by southern Africa (14 kg) and West Africa (8 kg).

Table 3. *The effects of policy and other factors on import growth (averages for 1977–79 and 1984–86).*

Country	Per caput income growth	Population growth	Commercial import growth	Residual of import growth
	————————— Per cent change per year —————————			
WEST				
Benin	2.70	3.2	17.76	4.6
Burkina Faso	1.00	2.6	3.18	1.2
Cameroon	8.20	3.2	4.32	1.7
Cape Verde	4.50	2.2	-30.89	-5.4
Chad	-1.20	2.3	14.03	0.8
Côte d'Ivoire	-3.20	4.2	8.00	1.2
Gabon	0.06	4.3	2.40	0.0
Gambia	-4.40	3.3	18.67	6.1
Ghana	1.20	3.4	-20.53	-2.9
Guinea	0.08	2.4	12.32	2.0
Guinea-Bissau	1.80	1.7	-3.22	-0.5
Liberia	-2.10	3.3	-3.54	0.2
Mali	-1.40	2.4	0.50	0.2
Mauritania	1.60	2.7	10.42	3.6
Niger	-2.80	3.0	18.37	2.3
Nigeria	1.65	3.4	-10.79	-2.4
Senegal	-0.06	2.9	1.81	0.9
Sierra Leone	4.90	2.4	-49.79	-9.8
Togo	-3.70	3.4	-13.37	3.7
EAST				
Burundi	6.60	2.8	20.40	-4.7
Ethiopia	2.20	2.4	-4.27	1.5
Kenya	0.01	4.1	NA	NA
Rwanda	5.30	3.3	43.90	7.8
Somalia	0.03	2.9	-35.83	-3.1
Sudan	-2.50	3.1	45.50	6.7
Tanzania	3.90	3.5	-30.14	0.1
Uganda	-3.20	3.1	11.98	1.0
Zaire	-10.10	3.1	14.64	-3.8

NA = not applicable.

Table 3. *The effects of policy and other factors on import growth (averages for 1977–79 and 1984–86)* (cont.).

Country	Per caput income growth	Population growth	Commercial import growth	Residual of import growth
	————————— Per cent change per year —————————			
SOUTH				
Angola	2.00	2.5	8.04	2.6
Botswana	8.70	3.4	14.10	3.0
Comoros	4.70	3.6	15.12	4.6
Congo	9.30	3.3	14.21	2.8
Lesotho	3.90	2.7	-6.54	3.6
Madagascar	-0.09	3.3	-3.17	3.2
Malawi	1.30	3.8	10.69	0.4
Mauritius	1.20	1.0	3.36	0.1
Mozambique	-6.50	2.7	18.37	6.5
Zambia	-4.90	3.6	-33.92	-5.6
Zimbabwe	2.50	3.7	NA	NA

NA = not applicable.

Source: USDA data.

In sub-Saharan Africa, most dairy output is produced by nomads with traditional objectives of subsistence and survival over long periods of drought and regeneration. Each family requires a basic stock of animals for survival. However, as families expand, this stock is expanded. Consequently, overstocking and overgrazing deteriorate the range land. Milk yields of these producers are low. For example, in Ethiopia, a livestock exporting country, cows do not reach maturity for three to four years, calve every two years, and produce only about 250 kg of milk per lactation. This is a very low yield, even in comparison with neighbouring countries. In Egypt, for example, the average estimated milk yield of a native cow is about 578 to 756 kg per lactation (Soliman and Fitch, 1982).

The commercial dairy sector, with a small share of production, is operated both by the government and private sector. Large parastatal farms are using specialised management skills, which minimise input supply and transportation problems, and have substantial economies of scale. However, in most cases they are faced with high production costs and require subsidies to be able to operate. The high costs stem from high labour costs, poor management, the use of highly capital-intensive technologies and reliance on purchased feed rather than pastures.

The smaller commercial units within the private sector are more efficient and could increase their production significantly if sufficient production incentives were in place. The limited available information about the performance of small

dairy producers in the region provides encouraging signs for future production growth. One example of a successful smallholder dairy programme is in Kenya (World Bank, 1990a). The Kenyan dairy development programme includes a marketing system based on a cooperative structure, the provision of technical services, reform of the pricing policy, a national artificial insemination service, the presence of large high-grade herds, and a relatively well developed agricultural infrastructure. Here, parastatals were more successful, not in their production role, but in their work as service centres providing artificial insemination and female stock for distribution. Increased production has led to increased per caput dairy consumption, which stands at 52 kg compared with 25 kg for sub-Saharan Africa as a whole. About 75% of the output is accounted for by smallholder farms (World Bank, 1990a).

In most countries, poor animal health, leading to a large number of losses, remains the major problem for the dairy industry. Up-graded animals are more vulnerable to disease than the local breeds. The shortages and high cost of veterinary services remain a major concern. In some countries, limited resources are the bottleneck to production growth. In Somalia, for example, where the livestock sector is the major component of GNP, the World Bank estimates that the capacity of the range to sustain animals was at or near its limit (World Bank, 1988). There are also limits to increasing feed supply on the range. Land degradation, resulting from large human and livestock population growth and increased agricultural activities in the areas with marginally higher rainfall and better soils, means that maintaining current production levels will be difficult.

Domestic policies

The impacts of different domestic policies, although not always quantifiable, are expected to have a significant influence on the growth of dairy imports in the region. Two sets of domestic policies affect commodity imports: (1) general economic and trade policies (indirect effect) and (2) specific commodity policies (direct effect) (von Massow, 1989).

The general economic policies of African countries during the last two decades focused on protecting the industrial sectors. Import-substitution policies were employed to stimulate domestic production.

Industrialisation was believed to be the engine of growth and hence the key to transforming traditional economies. Agriculture was perceived as playing a secondary role, as provider of raw materials for agro-industry, and as a source of tax revenue to support other development activities. Regulations to control prices, restrict trade and allocate foreign exchange were put in place. The low priority given to the agricultural sector encouraged labour and capital to flow into the urban areas. In order to satisfy growing urban demands, government intervention in the food sector increased.

Although the degree of intervention has varied by commodity and country, producer prices for most basic foodstuffs have been under government control. The major criteria used for the determination of producer prices include the following, often conflicting, basic elements: cost of production, fair return to producers, fair price to consumers, import–export parity price, crop profitability, food security and political acceptability. The relative weight accorded these criteria by the governments has varied, but fair price to consumers and political acceptability has been given major consideration in most countries.

Government policies in milk-deficit countries were frequently oriented toward maintaining low milk prices for consumers, thereby discouraging domestic production and encouraging reliance on imports. In countries where a commercial food subsector exists, such as Zimbabwe, farmers who market their commodity commercially are most affected by government-set prices and regulations on production and marketing.

The impact of government policies on traditional farmers, who account for most dairy producers, is less because such farmers market most of their output through informal channels. Therefore, the effective price at which they sell can vary from the government-set price. Current research in this field puts more emphasis on non-price factors such as the efficiency of the marketing system and the effectiveness of government-sponsored research and extension and credit in improving the productivity of the traditional producers.

Due to the generally small and highly variable amount of milk sold by traditional producers, dairy imports have become a major source of supply. Import-dependent milk processing plants have received government support through price subsidies and investment. Overvaluation of exchange rates in most countries has subsidised imports. The middle- and upper-income urban population, who are primary consumers of imported dairy products, were influential in promoting government policies supporting dairy imports.

Domestic policies were not the only reason for the sharp rise in dairy imports. Protection and subsidies at the international level also influenced import demand (von Massow, 1989). Given the excess supply of dairy products, these imports have been relatively cheap.

Contribution of selected factors to import growth

In assessing the forces influencing dairy import growth, an analysis of the impact of factors affecting dairy supply and demand is essential. Among the factors affecting supply are input prices, producer prices, prices of competing commodities, choice of technology and weather. Factors shaping demand include population, income, commodity prices and prices of substitute products. The analysis of dairy market behaviour is difficult not only because of inadequate

data but also because dairy products are not homogeneous. Another complication is the subsistence nature of the dairy market in sub-Saharan Africa. The response of this type of market to economic signals is expected to be different from that of commercial markets, but there is little evidence available to support this expectation.

To measure the contribution of supply and demand growth and the impact of consumer policies on import growth, we used a commodity balance identity similar to von Massow's (1989) approach. The only difference is that food aid is added as a separate source of supply, on the assumption that in a given time period commercial imports are the residual of demand, domestic supply, food aid and stock changes. This yields the following relationship:

$$M_t = C_t + S_t - Q_t - FA_t - S_{t-1} \qquad (1)$$

where M_t is net commercial imports, Q_t is domestic production, FA_t is food aid, S_{t-1} is beginning stocks, C_t is consumption and S_t is ending stocks. Changes in stocks are assumed to be small because of the short shelf-life of dairy products. The simple period changes in the variables, weighted by total consumption in the base year, are derived as follows:

$$M/C * dM/M = dC/C - Q/C * dQ/Q - FA/C * dFA/FA \qquad (2)$$

Equation 2 indicates that the relative change in imports between two periods is equal to the relative change in total consumption, minus the relative change in production and the relative change in food aid.

The change in total consumption (C) is specified as a function of population growth (P), per caput income growth (Y) and all other policies affecting consumption (z). Substituting these factors for consumption growth, equation 2 can be written as follows:

$$dM/M = C/M (dP/P + e * dY/Y + z - Q/C * dQ/Q - FA/C * dFA/FA) \qquad (3)$$

where e is the income elasticity of demand for dairy products. The population elasticity is assumed to be one. The sign of z could be positive or negative depending upon government consumption policies. Reorganising equation 3 in terms of z and substituting commercial import share for M/C, yields the following equation:

$$z = (M/C * dM/M) - dP/P - (e * dY/Y) + (Q/C * dQ/Q) + (FA/C * dFA/FA) \qquad (4)$$

From equation 4, the residual proportion of import growth that cannot be explained by growth in population, income, production and food aid can be derived as follows:

$$z^* = C/M * z \qquad (5)$$

Table 3 summarises the residual import growth rates, z^* and growth rates of other variables for the period 1977–86. All calculations are based on average annual changes between the average for 1977–79 and the average for 1984–86. To measure the impact of income growth on demand, an income elasticity of 0.68 (FAO estimate of income elasticity for dairy products for the region in the mid-1970s) was used for all countries. The actual income elasticity for individual countries is expected to vary from this average, but the range is probably small because of the narrow range of per caput income variations. A positive value of z^* indicates that factors other than growth in population, income, production and food aid, e.g. government policies, were responsible for encouraging dairy imports.

The results suggest that most countries in the region actively encouraged commercial dairy imports, with z^* being positive in 28 of the 39 countries. Kenya and Zimbabwe were excluded as they became importers of dairy products after 1980 and most of their imports were supplied through aid.

In nine countries, z^* was negative. One possible explanation for this is limited availability of foreign exchange in these countries. Most of these countries have been faced with severe financial difficulties since the early 1980s.

In seven of the nine countries for which z^* was negative, dairy-product consumption declined between 1977 and 1986. Annual consumption declines ranged from -0.5% in Guinea-Bissau to -9.8% in Sierra Leone.

Expected welfare effect of dairy import policies

The concept of consumer and producer surplus is used to evaluate the domestic welfare effect of import policies. Consumer surplus is based on the assumption that there is a demand for a commodity in the market which responds negatively to a price increase. The notion of producer surplus follows from neo-classical production theory. A producer's short-run supply function is its marginal cost curve, above the minimum average variable cost. Assuming no input price effects, the horizontal sum of individual producers is the market supply function. The area under the industry's marginal cost, or supply, is the total variable cost. The area above the supply function and below the price is producer surplus or rent (producers will receive the same price for all previous units). With a positive supply function, increases in prices lead to increases in producer surplus and vice versa. The producer surplus takes into account the extra costs to the producers associated with responding to higher prices.

The consumer and producer welfare effects of dairy imports depend on the magnitude of price changes, price elasticities of demand and supply and government policies. Decisions on policies are, in general, made at the national

level but nations are connected internationally by trade. Therefore, to measure the impact of imports on the domestic economy, an analysis of policies of both importing and exporting countries is crucial. The evaluation of overall food policies in most African countries indicates that the policies adopted were aimed at protecting consumers. The import policies aimed at maintaining low consumer prices fall into the following categories: (1) direct dairy import or consumer price subsidy; (2) overvaluation of the exchange rate; and (3) food-aid imports. In the international market, the export policies of exporting countries have a direct impact on world prices and hence the import levels of the importing countries.

Import and consumer-price subsidy

Import subsidies result in domestic consumer and producer prices that are lower than world prices. As a result, domestic production declines, domestic consumption increases and imports increase. The government uses funds to reduce the price of dairy imports and this increases the consumer surplus. In the short term, assuming all other factors remain constant, producers lose when consumers gain, because production, sales and profits fall. In effect, producers transfer income to consumers.

In Africa, urban consumers are the primary beneficiary of the subsidy policies (Christensen, 1987). With a substantial portion of dairy products directed to the urban areas, a new pattern of dairy consumption, especially among the middle and higher income groups has been promoted. It has been argued that consumer subsidy policies were the impetus behind the increasing rate of migration to the urban areas (Shapouri et al, 1986). In sub-Saharan Africa, the proportion of the population living in urban areas nearly doubled over 20 years, from 14% in 1967 to 27% in 1987. The annual rural migration rate is about 7%. This means that a subsidisation policy aimed at the urban population will result in soaring budget costs in the future. In the case of African dairy policies, consumer subsidisation policies have often led to subsidisation of the dairy processing industry. These processing plants rely heavily on imported milk because of the high variation in the amount of milk available on the domestic market.

On the producer side, the long-term consumer subsidisation and low producer prices have slowed commercialisation of the dairy sector; and commercialisation of the subsistence agricultural sector is the corner-stone of development. Commercialisation is expected to improve the distribution of incentives and benefits by providing growth linkages with other sectors of the economy. In Africa, the economic gains from commercialisation are expected to improve the welfare of a large portion of the rural population.

Exchange-rate policy

The impact of overvaluation of the national currency is similar to that of import subsidy. An overvalued currency reduces the domestic price of imported commodities. Overvaluation does not have a direct impact on budget expenditures for government but the rest of the economy pays the costs. Currency overvaluation is the primary cause of trade imbalance and poor agricultural performance of the region. With the exception of the countries of the CFA franc zone, official exchange rates were fixed at the nominal level until the early 1980s. Governments relied on import restrictions rather than devaluation to conserve foreign exchange. Import priority was given to essential commodities such as food, raw material, and capital goods. Overvaluation, when combined with direct consumer subsidisation policies has markedly reduced producers' incentives and welfare.

Food aid

The impact of food aid varies depending on government policies. If food aid is sold at less than the import price, its impact on consumer and producer welfare is similar to that of import subsidisation. It leads to consumer gains and producer losses, with no change in the government budget. The extent to which food aid supplements commercial imports is not clear and varies depending upon the policies of the recipients. Most studies of individual countries found that non-emergency food aid displaces commercial imports at rates ranging from 30 to 90%.

If food aid replaces commercial imports and is sold at the world price, there is no change in consumer or producer welfare. The country's financial gain is equal to the value of food aid at the international market price. The local currency generated by setting the food aid can be invested in the local dairy industry. In 1989, under the US Title I and III food-aid programme, 25 agreements that mandated the use of local currency generated by sales of food aid for improving production and marketing of food products were reached with developing countries (Ferguson, 1990).

The impact of targeted food aid, where food aid is distributed among special groups of consumers who normally do not consume dairy products, is a gain to consumers, but does not change producer welfare. The benefit of targeting food aid is that it reduces food insecurity without removing producers' incentives, at least in the short term. A discussion of the limitations of these types of programme is beyond the scope of this study, but one point which can be made is that providing subsidised dairy products for lower-income groups encourages consumption patterns that entail long-term import dependency. One option that would encourage local employment is "cash for work" which is financed by sales of food aid. This type of programme could be used to support public projects,

especially in the areas of road construction. Markets for livestock and dairy products are generally constrained by the lack of infrastructure. Any improvement in market infrastructure has both the potential to improve marketing channels and promote food security.

International market interventions

Governments of dairy exporting countries have extensive programmes to support their producers. These interventions tend to alter conditions on the world market. The impact of commodity support policies on world prices are shown in Figure 3. Without price support, the price established in the international market is P, consumption in country A is OC_a and production is OQ_a. Country B imports are Q_cQ_d. Suppose country A establishes a price support programme at P', above P. At P', the export quantity is C_bQ_b. The excess export quantity will reduce the world price to P" and the unit export subsidy is P'P". The support and export subsidy programmes in country A raise the domestic price, reduce domestic consumption and increase exports. The effects in country B of lower international prices are reduced production and increased consumption and imports (assuming no market intervention by country B).

The major exporting countries have employed a variety of policies to protect their industries. These policies include direct producer subsidies, direct income payments, border measures to influence exports and imports, and supply management.

Any movement toward liberalisation of the dairy market will have significant implications for trade because only 5% of total dairy production enters the international market. The countries that will be most affected by dairy trade liberalisation are Australia, Canada, Japan, New Zealand, USA, countries in the European Community and other European countries. Most of the trade in dairy products is concentrated among the industrialised countries, with developing countries being major importers of only non-fat dry milk. Estimates of the impact of trade liberalisation on dairy prices vary, depending upon the structure of the model used and the time frame considered. The estimated range of price increases is from 30 to 95% (Blayney and Fallert, 1990). The increase in world prices is much less than the subsidies paid to producers in the exporting countries and thus milk production in these countries would be likely to fall. The effect that trade liberalisation would be likely to have on the volume of trade is not clear. While some studies show increases in international traded volume, they fail to address the impact of removing high export subsidies which have shaped historical trade patterns (Blayney and Fallert, 1990). Removing export subsidies, direct subsidies and dairy aid, if not replaced by increases in commercial trade at international prices, will lead to a decline in traded volume.

Figure 3. *Impacts of an export subsidy on exports and imports.*
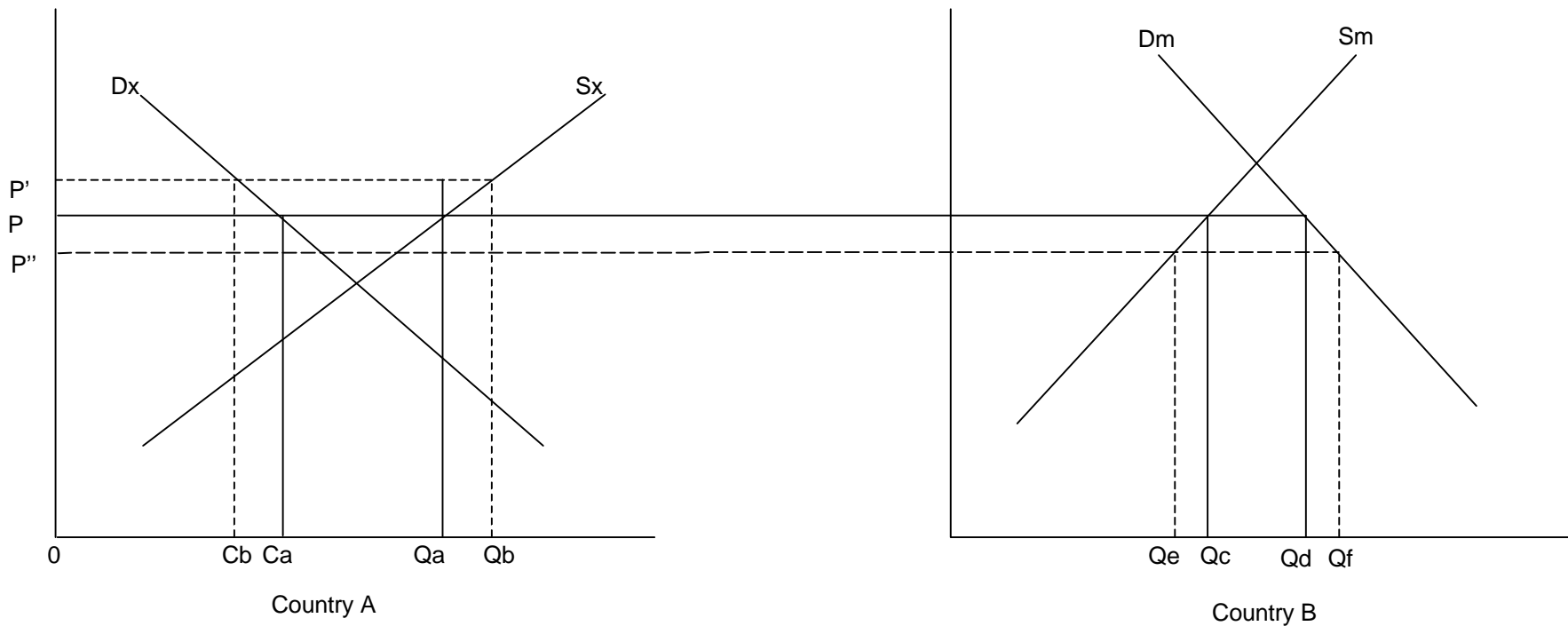
The current GATT (General Agreement on Tariffs and Trade) negotiations may reach their final stage in the early 1990s and the outcome is uncertain. Among various proposals considered, a group of net-food-importing LDCs (least developed countries) suggested that concessional sales and financial grants could be used to offset the impact of higher world food prices. The proposal by the USA recognises the need to continue food-aid programme to help developing countries and suggests establishing a committee to periodically review the required level of food aid. The proposal also gives an expanded role to multilateral and private voluntary organisations for distribution of food aid.

As for African countries, with their growing import dependencies, higher international dairy prices mean a reduction in the volume of commercial imports and probably higher import costs. The changes in food-aid distribution policies, however, could be beneficial for the region. If the political considerations of food-aid distribution policies are reduced in favour of a "needs" criteria, sub-Saharan Africa's share might increase.

Welfare implications for the consumer are expected to vary by country depending upon the level of price increases, food-aid volume and domestic production performance. In any event, increases in international dairy prices, if transferred to the domestic market (assuming food aid is used to shift domestic demand), mean a reduction in consumer surplus. On the other hand, if an increase in international prices is passed on to the producers, incentives for production will increase and, for some countries, export earnings will rise.

Conclusions

During the 1980s, in addition to slow economic activity, providing adequate food supplies became increasingly difficult. Sub-Saharan Africa has been characterised by declining average per caput production and high year-to-year variability. Although food-import dependency has increased, per caput consumption has stagnated or declined.

Between 1961 and 1986, sub-Saharan Africa's dairy imports increased sixfold, growing at an annual rate of 8%. Import growth has slowed since the mid-1970s as production performance improved. Import dependency (imports as a percentage of consumption) averaged near 20% during 1977–86.

The growth in food imports, and the consequent costs, is disturbing for most policy makers. The need to conserve foreign exchange is given as the main reason for adopting food self-sufficiency policies and curbing imports. Although restricting imports saves foreign exchange in the short term, the costs are expected to increase in the long term. If a country does not have a comparative advantage in dairy production, it can earn more foreign exchange by diverting resources from dairy production to areas in which it has a comparative

advantage. Recent adjustments in the dairy programme in the USA are a good example of long-term budgetary pressure and growing costs forcing a reduction in subsidies.

A stronger argument in support of a self-sufficiency policy is the desire to become self-sufficient in critical commodities. Given growth in income and population, particularly urban, demand for dairy products is expected to grow and dairy products are likely to become an important part of the diet, thus placing them in the category of critical commodities. Based on the historical trend in population and expected income growth (per caput income growth in the range of 1 to 2%), along with the average income elasticity for dairy products; dairy demand is expected to grow by 4 to 5% a year until the year 2000.

Satisfying this increase in demand will be difficult. Even with a considerable increase in public investment, production growth will be slight in most countries, particularly if they are dependent on imported feed. The average annual growth in gross investment for the region was -7.3% during 1980–88 compared with -2.1% for all low-income countries—excluding India and China (IMF, 1990). Short-term strategies such as increasing the size of herds will not necessarily increase production because of feed shortages. Long-term increases in production require increased investment and improvements in the collection of information on the size and system of dairy operations in these countries.

To summarise, given the growing demand and limited availability of resources, achieving self-sufficiency in dairy products is an almost impossible task for most countries, at least in the short term. Judging from recent policies, falling imports and shortages of foreign exchange, there will be pressure to limit growth of commercial imports. Given these conditions, dairy self-sufficiency will be achieved only if countries are willing to accept continued low levels of dairy consumption.

The nutritional status of sub-Saharan African countries is poor on average; energy intake is 15% less than the average for low-income developing countries. Dairy products account for less than 5% of total energy intake in the region (Table 4). Because of the low level of energy intake, any decline in the availability of essential food items, such as dairy products, can be detrimental.

Food aid, if it is used effectively, can improve nutritional levels, as well as the financial conditions of these countries without having substantial negative impact on production. The food aid share of total imports increased from 21% in 1977 to 57% in 1986. Monetisation of dairy aid through sales in the recipient countries will not interfere with the functioning of local markets. The funds generated from sales could be used for projects to improve market infrastructure and productivity of the sector. The surplus dairy production of the largest exporting countries is expected to continue, and therefore food aid will continue to be available. Therefore, it is the responsibility of the recipient countries to use food aid

Table 4. *Per caput consumption growth, role of dairy products in the diet and nutritional status in sub-Saharan Africa.*

Country	Per caput consumption growth 1977–86	Contribution of dairy products in the diet	Calorie intake as per cent of LIC's[1]
	———————— Per cent ————————		
WEST			
Benin	2.20	0.46	0.86
Burkina Faso	-1.26	1.37	0.87
Cameroon	-0.08	0.65	0.82
Cape Verde	-4.64	2.51	1.10
Chad	-0.37	2.67	0.70
Côte d'Ivoire	0.30	1.88	1.04
Gabon	-1.73	NA	1.02
Gambia	7.02	1.64	0.91
Ghana	-4.68	0.28	0.71
Guinea	0.11	0.85	0.72
Guinea-Bissau	-1.66	NA	NA
Liberia	2.32	0.70	0.97
Mali	-1.96	2.27	0.84
Mauritania	3.08	15.86	0.94
Niger	0.39	2.85	0.99
Nigeria	-8.68	0.88	0.87
Senegal	-0.59	2.13	0.95
Sierra Leone	-3.29	1.03	0.75
Togo	6.93	0.24	0.90
EAST			
Burundi	-5.11	1.23	0.95
Ethiopia	0.49	1.96	0.71
Kenya	-5.45	5.12	0.84
Rwanda	6.06	0.79	0.74
Somalia	-3.77	16.72	0.87
Sudan	3.86	5.62	0.90
Tanzania	-2.07	2.15	0.89
Uganda	-1.96	2.52	0.95
Zaire	0.69	0.14	0.88

1. Low-income countries. The average calorie consumption for the low income countries was 2463 in 1986 (World Bank, 1990b).

NA = not available.

continued

Table 4. *Per caput consumption growth, role of dairy products in the diet and nutritional status in sub-Saharan Africa* (cont.).

Country	Per caput consumption growth 1977–86	Contribution of dairy products in the diet	Calorie intake as per cent of LIC's[1]
	———————————— Per cent ————————————		
SOUTH			
Angola	2.45	1.91	0.76
Botswana	0.86	8.89	0.89
Comoros	4.88	0.99	0.90
Congo	8.60	0.78	0.99
Lesotho	2.92	2.19	0.94
Madagascar	1.41	0.36	0.99
Malawi	-1.03	0.59	0.94
Mauritius	0.15	6.18	1.12
Mozambique	0.69	0.74	0.65
Zambia	-5.47	0.89	0.87
Zimbabwe	2.24	1.55	0.87

1. Low-income countries. The average calorie consumption for the low income countries was 2463 in 1986 (World Bank, 1990b).

NA = not available.

effectively as an investment tool and in support of long-term improvements in food security.

References

Blayney D P and Fallert R F. 1990. *The world dairy market—Government intervention and multilateral policy reform.* United States Department of Agriculture, Washington, DC, USA. 64 pp.

Christensen C. 1987. *Pursuing food security in sub-Saharan Africa.* Lynne Rienner Publishers Inc., Boulder, Colorado, USA.

FAO (Food and Agriculture Organization of the United Nations). 1990. *Food outlook.* FAO, Rome, Italy.

Ferguson D. 1990. *Summary of PL480 self-help measures fiscal year 1989 agreements and amendments.* United States Department of Agriculture, Washington, DC, USA.

IMF (International Monetary Fund). 1990. *World economic outlook.* IMF, Washington, DC, USA.

von Massow V H. 1989. *Dairy imports into sub-Saharan Africa: Problems, policies and prospects.* ILCA Research Report 17. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 46 pp.

Shapouri S, Dommem A and Rosen S. 1986. *Food aid and the African food crisis.* FAER–221. Economic Research Service, United States Department of Agriculture, Washington, DC, USA.

Soliman I and Fitch J. 1982. *The role of livestock production on the Egyptian farm.* Working Paper 85. Agricultural Development Systems Project, Giza, Egypt. 35 pp.

World Bank. 1988. *Staff appraisal report, Somalia.* World Bank, Washington, DC, USA.

World Bank. 1989. *Sub-Saharan Africa: From crisis to sustainable growth.* World Bank, Washington, DC, USA.

World Bank. 1990a. *Staff appraisal report, Kenya.* World Bank, Washington, DC, USA.

World Bank. 1990b. *World development report.* World Bank, Washington, DC, USA.

Discussion

The discussant, Dr Storey, described the work as an important contribution to the analysis of the impact over time of dairy imports in SSA. He indicated, however, that he would have liked a more extended discussion of the sources and quality of data used in the paper, of producer and consumer prices, and of the theoretical implications of policies (relating for example to food aid and commercial imports, subsidisation etc) for consumer and producer welfare. Shapouri mentioned USDA, FAO and the UN as major sources of data and agreed that it was important to consider welfare and distributional effects. However, lack of information on production and consumption structure and prices in SSA pose serious obstacles to such an analysis.

Questions from the floor focused on the need for considering the accessibility of milk to the majority of consumers in SSA before dealing with the issue of increasing production to reduce import dependency; the authors' advocacy of the comparative advantage concept in the face of current world dairy market and policy conditions and their contention that food aid (the acquisition of which is associated with certain costs) was a free resource. Shapouri noted that developed countries pursued dumping policies but indicated that, given the limited options available to SSA countries at present, cheap food aid could be used and that sound policies based on the comparative advantage of milk production could be adopted. She also acknowledged failure to adjust foreign exchange as an important factor in increasing import dependency.

Dairy imports and their influence on domestic dairy marketing, with particular reference to Tanzania

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Abstract

Tanzania is an agricultural country with a vast dairy potential that is not yet fully developed. This paper describes three categories of milk production system found in the country. Large-scale and smallholder dairy farms have been identified as having the most potential as sources of marketable milk. Local milk production does not satisfy demand at present. To help meet demand, Tanzania has been importing milk and milk products, mostly as food aid.

Tanzania Dairies Limited (TDL) has the role of organising, collecting, processing and selling milk in Tanzania. Most of the fresh milk supplied to TDL comes from the commercial sector, which comprises mostly large-scale farms. TDL has been facing a number of problems that have affected its performance. The ready availability of materials from which to reconstitute liquid milk has been identified as a major reason for TDL's laxity on the collection of fresh milk from farmers.

Most smallholder farmers sell milk directly to consumers because they get higher prices than those offered by TDL. Consumers prefer the whole milk supplied by smallholders to the standardised milk from the dairy plants. It is very likely that smallholder farmers, especially those around centres of consumption, will continue selling their milk direct to consumers. The survival of TDL rests on its ability to collect milk from farmers away from consumption centres and also on strengthening and expanding its distribution channels. Formation of a national dairy board has been recommended to ensure future development of the domestic dairy marketing system.

Introduction

Tanzania in brief

Tanzania has an area of about 886,000 km^2. Altitude ranges from sea level to over 5000 metres above sea level.

The human population of 22.5 million (1988) is growing at 3.24% a year. Over 80% of the population live in rural areas and depend on agriculture. Agriculture contributes about 40% of the Gross National Product (GNP) while the livestock sector accounts for 7% of GNP. GNP per caput was estimated to be US$150 in 1988.

The livestock sector

Tanzania has a large animal base, comprising about 13 million cattle, 6 million goats and 4 million sheep in 1984. Most of the cattle are of indigenous types, but there are some 200,000 improved dairy cattle and 120,000 improved beef cattle. Indigenous-type cattle account for over 75% of the milk produced in Tanzania, most of which is consumed by the rural population (Kurwijila, 1988). Improved dairy cattle are kept mainly by commercial dairy farmers using improved technology and inputs to produce milk for the urban market. Smallholder dairy farmers who normally keep one to four cows supplement the commercial sector.

Government policy on agriculture

Tanzania has a vast agricultural potential. The general policy of the Government has been to stimulate agricultural development with a view to attaining self-sufficiency in food production, increasing per caput income of the rural people and increasing the national income as a whole.

Great emphasis has been placed on livestock development and efforts have been directed towards increasing stock numbers and performance per head. Particular emphasis has been given to the development of the dairy industry as a means of improving the nutritional status of people in both rural and urban areas, and reducing the country's need to import dairy products.

Structure of the dairy industry

Modern dairy development was introduced to Tanzania during the colonial period. Exotic cattle were imported from Europe and Kenya. During the 1950s and 1960s European dairy farmers were concentrated in the highlands and around colonial settlements.

After independence in 1961 milk production declined substantially. In 1965, the Government passed the Dairy Industry Act which among other things required the formation of the National Dairy Board to coordinate between producers, processors, sellers and consumers. However, the Board did not work as expected. Nevertheless, in 1970s Tanzania embarked on several dairy development programmes based on introducing more exotic cattle, farm machinery, better feeding and other management practices on large-scale farms. Most of the dairy farms are now owned by parastatal bodies such as the Dairy Farming Company (DAFCO), the National Food and Agriculture Cooperation (NAFCO), the Kilimanjaro Coffee Cooperative Union (KNCU), the Mkonge Livestock Company (MLICO) and a few other government institutions.

Noting that the performance of parastatal farms was not encouraging, the Government in 1979 proposed a dairy development programme based on strategies that would encourage not only the large parastatal farms but also the development of smallholder dairy farming.

Thus, three different categories of farmer are involved in milk production in Tanzania: large-scale dairy farms, smallholder dairy farmers and traditional cattle keepers. The large-scale dairy farms are modern dairy farms owned by parastatals. They are commercially oriented and supply milk to processing plants in Dar es Salaam, Arusha, Tanga, Mbeya and Utegi.

The smallholder dairy farmers keep up to 10 cows, either pure-bred or grade dairy cattle. Most farmers use the zero-grazing system and hence use substantial quantities of feeds and veterinary medicines. Most of these farmers sell milk direct to consumers. These farmers are concentrated mainly in the high-potential areas of Kilimanjaro, Arusha, Tanga, Iringa, Mbeya and Kagera regions and around urban centres.

Traditional cattle owners keep the local Tanzanian Zebu. Milk in excess of calves' requirement is consumed by the family. Any surplus is sold to nearby consumers or milk plants where such facilities exist.

Milk production and demand

There are no accurate figures from the traditional cattle keepers. However, about 75% of the estimated annual production of 472 million litres comes from the traditional sector, much of which is consumed within the sector itself.

Kurwijila (1988) estimated average per caput consumption of milk to be 15 litres a year. The 1984 National Food Strategy anticipated per caput consumption rising to 30 litres a year by the year 2000.

Assuming a consumption rate of a quarter of a litre per person per day for the whole year and a population of 24 million people would indicate demand for 2.2

billion litres of milk a year, nearly five times current production. However, effective demand, which is largely determined by income, may be much lower than this estimate suggests.

Milk imports

Since demand for milk exceeds supply, Tanzania has depended to some extent on imports of milk and milk products. Most of the milk products imported between 1961 and 1973 were either evaporated condensed milk or powdered milk (including infant milk).

In the mid-1970s Tanzania started experiencing acute shortage of foreign exchange, and thus could not import milk and milk products commercially. From 1976 to date Tanzania has been receiving dairy food aid from the World Food Programme (WFP), the European Economic Community (EEC) and the Japanese Government. So far WFP has donated a total of 17,064 tonnes of dried skim milk (DSM) and 233 tonnes of butter oil, the EEC has donated 21,300 tonnes of DSM and 4181 tonnes of butter oil and Japan has donated 806 tonnes of DSM. Between 1977 and 1989 total commercial imports were 1785 tonnes of DSM and 646 tonnes of butter oil.

The donor agencies (WFP and EEC) require that proceeds from sales of food aid be used for the development of agricultural projects in the country. WFP is more specific—it stipulates that the funds generated are to be used for dairy development projects only. An agreement that governs the use of the generated funds has been jointly signed by WFP and the Government of Tanzania.

The price structure of food aid

To avoid dependency on food aid and its disincentive for local milk producers, a formula that takes into account the world market price and the local producer price is used to determine the selling price of food aid: nine kilograms of dried skim milk plus four kilograms of butter oil is equal to the value of 100 kilograms of locally produced milk of 4% butterfat contents, delivered to a dairy plant.

The changes in prices of locally produced milk, dried skim milk, butter oil and recombined milk between 1983 and 1990 are shown in Table 1.

Equating the price of reconstituted milk to that of locally produced milk has made sure that the former is not looked upon as a cheap alternative product.

Table 1. *Prices of locally produced milk, dried skim milk (DSM), butter oil and recombined milk, Tanzania, 1983–90.*

Period	Factory-gate price per litre (TSh)	Price of DSM per kg (TSh)	Price of butter oil per kg (TSh)	Recombined milk cost per litre (TSh)
1983 – 07/07/85	7.90	39.15	108.20	6.20
08/7/85 – 31/12/86	10.00	44.20	143.75	7.75
01/1/87 – 22/07/87	16.56	79.50	222.60	12.75
23/8/87 – 31/12/88	25.50	122.80	343.90	19.70
01/1/89 – 31/05/90	30.00	146.90	411.20	23.20
01/6/90 – to date	60.00	395.00	569.60	50.90

NB: The cost of recombined milk per litre has been rounded up.

Milk marketing

Tanzania Dairies Limited (TDL) is the only parastatal organisation that has the role of organising, collecting and processing milk in Tanzania. Table 2 shows TDL processing plants and their capacities.

Each plant has several milk collection and distribution points and also sells to retail shops using delivery vehicles. The amount of fresh milk processed by TDL declined from over 14 million litres in 1979 to less than 5 million litres in 1989. This was related to several factors, including breakdowns of collection centres and vehicles, poor infrastructure and late payments to farmers.

Table 2. *TDL milk processing plants and their capacities.*

Plant	Installed capacity (litres/day)	Current rating capacity (litres/day)	Capacity utilisation (%)
Dar es Salaam[1]	90 000	60 000	66.7
Arusha[1]	70,000	16,000	22.6
Musoma	45,000	2500	5.6
Utegi	45,000	1500	3.3
Tanga[1]	40,000	8000	20.0
Mbeya	16,000	3500	21.9
Tabora[2]	5000	1000	20.0

1. Plants equipped with recombining facilities.

2. Undertakes some recombining activities.

Milk pricing policy

Producer and consumer prices for milk and milk products are controlled by the Government and are reviewed annually. Pan-territorial prices were in force from October 1975 until zonal prices were instituted in July 1987. Under the regional price scheme regional authorities are empowered to set producer prices based on local cost of production. However, application has been lax and prices have tended to be determined by market forces.

In setting dairy prices the Government has tended to protect the consumer. This is one of the reasons why most smallholder farmers sell their milk on the free market where prices are higher. Government-controlled prices lag behind the market prices although they are reviewed fairly regularly (Table 3).

Table 3.   *Government-controlled price for fresh milk, Tanzania, 1983–90.*

Period	Farm-gate price per litre (TSh)	Annual price change (%)
1983 – 07/07/85	7.20	
08/7/85 – 03/12/86	9.30	29
01/1/87 – 22/07/87	15.00	61
23/7/87 – 31/12/88	23.00	53
01/1/89 – 31/05/90	27.00	17
01/6/90 –	55.00	104

Domestic dairy marketing development

The decline in the amount of milk collected by TDL between 1979 and 1989 was not caused by a decline in smallholder milk production. The number of smallholder dairy farmers is growing quite fast, especially around major towns, but these farmers are selling directly to consumers, not to TDL. The reasons for this are that the farmers receive a higher price, and that consumers prefer the whole milk delivered by farmers to the standardised (2% butterfat) milk sold by TDL.

The situation whereby farmers sell milk directly to consumers is likely to continue for some time. The situation might change when consumers become more aware of the hazards of raw milk, or if the Government enforced the Dairy Act of 1965, which forbids consumers to buy milk directly from farmers.

There will come a time though when smallholder dairy farmers, especially those around towns, will not be able to keep more animals within their premises because of land limitations thereby becoming unable to produce more milk to

satisfy the demand of the growing urban population. This means TDL milk will only be filling the unsatisfied demand.

Since TDL is unlikely to collect substantial amounts of milk from smallholders around towns in the the near future, the only source of fresh milk supply open to it will be those farmers located away from the consumption centres. Therefore, future survival of TDL will depend on two factors: first, on its ability to strengthen its collection channels to reach farmers away from the consumption centres; and secondly on its success in strengthening and expanding its distribution channels, particularly in the urban areas. TDL's failure to reach distant farmers will discourage increased commercial dairying in outlying areas.

Conclusions

Although dairy imports seem not to have had a very serious effect on the domestic dairy marketing system, it is apparent that TDL's failure to reach distant farmers will hamper development of the domestic dairy sector. In order to make TDL more active in fulfilling its market functions, it is strongly recommended that the 1965 Dairy Industry Act be enforced. The Act requires the formation of the National Dairy Board with the objectives and functions of coordinating producers, processors, sellers and consumers of milk and milk products. Improvement of marketing functions, particularly the collection aspect, is likely to reduce the need for imports in the future.

Reference

Kurwijila R L. 1988. Some reflections on milk supply and consumption statistics in Tanzania with particular reference to the role of traditional cattle herds. In: *Proceedings of the 15th Scientific Conference of the Tanzania Society of Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 216–242.

Discussion

In view of the problems facing the parastatal TDL, the author's optimism about the success of another parastatal, i.e. a National Dairy Board (NDB), was questioned. Ngigwana explained that smallholders had to supply milk to TDL at very low prices because the informal market was saturated in some areas. He conceived of NDB as a cooperative of smallholders who will organise milk collection and processing themselves. Ngigwana stated the need for qualified personnel in order for TDL to take advantage of the existing incentive structure. His argument that encouraging people to consume more milk was desirable was questioned on grounds that milk was not necessarily a cheap source of

nutrients and that it could be more important as a source of income to the farmer. As regards the author's assessment of the impact of food aid on local production and his treatment of the subsidy issue, it was suggested that he introduce more precision and rigour in his analysis by using multivariate regression on aggregate import figures or on figures of price elasticities collected from various studies, and by identifying occasions when subsidies were desirable. Concern was expressed over the existence of processing plants operating at less than 10% of capacity and Ngigwana explained that these were government-subsidised plants which, for political considerations, were kept running against the advice of technicians that they be closed.

Rural smallholder milk production and utilisation and the future for dairy development in Ethiopia

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Introduction

The typical Ethiopian highland smallholder produces a small surplus of milk for sale. There are basically two marketing systems: (1) the formal system in which the milk is collected at the roadside (milk collection and chilling centres) and taken to a central processing plant; and (2) the informal system where the smallholder sells his surplus supplies to neighbours or in the local market, either as liquid milk or in the form of butter or a cottage-type cheese called *ayib*.

The dairy industry includes the production, processing and marketing of milk and milk products. There are several constraints to its development, e.g. lack of infrastructure and finance, poor education, seasonality of supplies and the lack of market and marketing structure and facilities. Because of the lack of cooling facilities or even suitable equipment or utensils for milking and storing milk, milk deteriorates rapidly.

In the vicinity of cities or larger towns the milk producer has a ready outlet for his liquid milk. However, in rural areas outlets for liquid milk are limited due to the fact that most smallholders have their own milk supplies and the nearest market is beyond the limit of product durability.

As there are a large number of interrelated factors in the development of the dairy industry in any country or part of a country, uncoordinated efforts, i.e. tackling one aspect of the industry in isolation are generally unsuccessful.

Large processing plants have been established in developing countries, some operating relatively successfully but generally they are inefficient due to poor management and lack of local raw materials. These plants, which rely heavily on imported skim-milk powder and anhydrous milk fat, have often been responsible for discouraging local smallholder milk production because of the price

differential between the reconstituted milk they produce and locally produced milk.

The development of the dairy industry can only succeed if the component parts are tackled and developed in a coordinated way and with parallel programmes dealing with milk production, processing and marketing.

The present system whereby the smallholders process and market their surplus milk supplies individually is inefficient because of the time involved and the methods of processing used. Because of the seasonality of supplies there can be large fluctuations in the price of products. Storage facilities are not available and such questions as financing storage costs and product quality and durability must be carefully addressed when efforts are made to balance supply with demand.

The dairy industry has been developed successfully in several countries under circumstances not unlike those pertaining in many parts of Africa today. With greater attention being paid to the specific problems, e.g. environmental and associated problems of animal diseases, milk quality and preservation, the dairy industry can contribute significantly to the alleviation of poverty and hunger in Africa.

Smallholder milk processing

In the highlands of Ethiopia, milk produced by smallholders is used for family consumption and the production of butter and a cottage-type cheese. For butter-making, milk is collected over a period of three or four days in a clay pot. When the milk has soured and sufficient milk has been collected, the clay pot is shaken back and forth until butter granules are formed. This method of butter manufacture may take from two to three hours, depending on such factors as temperature, the fat content of the milk, the acidity of the milk and the amount of milk in the clay pot. The time taken to make the butter together with the time involved in taking this butter to the market place is a considerable drain on the already limited time of the smallholder, or specifically on that of his wife and family. To reduce the time for processing the milk into butter and to improve the efficiency of the process ILCA has developed and modified a wooden internal agitator that can be fitted to the usual clay pot used by the smallholder. The use of this internal agitator has been shown to reduce churning time from an average of 139 minutes to an average of 57 minutes (59 churnings) while reducing the fat content of the buttermilk from an average of 1.1% to an average of 0.36% (O'Mahony and Ephraim Bekele, 1985; O'Connor, 1990).

The buttermilk remaining after the butter has been separated from the whole milk is used to produce a cottage-type cheese (*ayib*) by heating the buttermilk and separating the coagulated fat and protein from the whey. The price of *ayib* is

about one-seventh that of butter so the monetary advantage of extracting the maximum amount of fat from the milk and converting it into butter is apparent.

Utilisation of milk by smallholders

In their studies on dairy marketing in Ethiopia, Debrah and Berhanu Anteneh (1991), found that milk-producing households within Addis Ababa sold about 15.8 litres of fresh milk per household per day. Butter and cheese were not sold by intra-urban producers. In the same study it was found that rural dairy producing households sold, on average, 1 litre of fresh milk, 127 g of cooking butter and 258 g of cheese per household per day.

Figure 1 represents the various options and outlets for milk and milk products available to rural smallholder milk producers. There is constant competition between calves and members of the family for liquid milk and to a lesser extent there is competition between family requirements for liquid milk and liquid milk to be processed into butter and cheese for sale. The receipts from butter and cheese sales are used to purchase household requirements, e.g. clothing and grain.

ILCA's Dairy Technology Unit is based in Debre Zeit, about 50 km south-east of Addis Ababa. One of its objectives is to help smallholders and agropastoralists process their milk supplies, i.e. to introduce more processing options and more efficient processing methods, thereby improving their social and economic well-being.

In order to ascertain production and utilisation patterns of milk by smallholders, 160 smallholders within a radius of about 55 km of Debre Zeit (but excluding Addis Ababa and its suburbs) were surveyed.

This survey (O'Connor and Zenash Zewdie, 1990), which was conducted over a three-month period in 1989, indicates, *inter alia*, the effect of market accessibility on the utilisation pattern of liquid milk.

The number of cows per smallholder ranged from one to five, with an average of 2.3. Although smallholders prefer to have crossbred cows because of their greater milk production, only three had a crossbred cow. Easier management and less risk of disease were reasons cited for keeping local (zebu-type) cows. The average daily yield of local cows was about two litres, compared with about six litres for crossbred cows. Distance from the market place weighed heavily against the sale of fresh milk due to the combined factors of poor initial milk quality, high ambient temperatures and time taken to reach the market place. Because of the availability of fresh milk in the majority of rural households only 2% of the smallholders interviewed sold fresh milk. Butter is used in rural areas for cosmetic and cooking purposes and almost 67% of the smallholders sold

Figure 1. *Smallholder milk utilisation.*
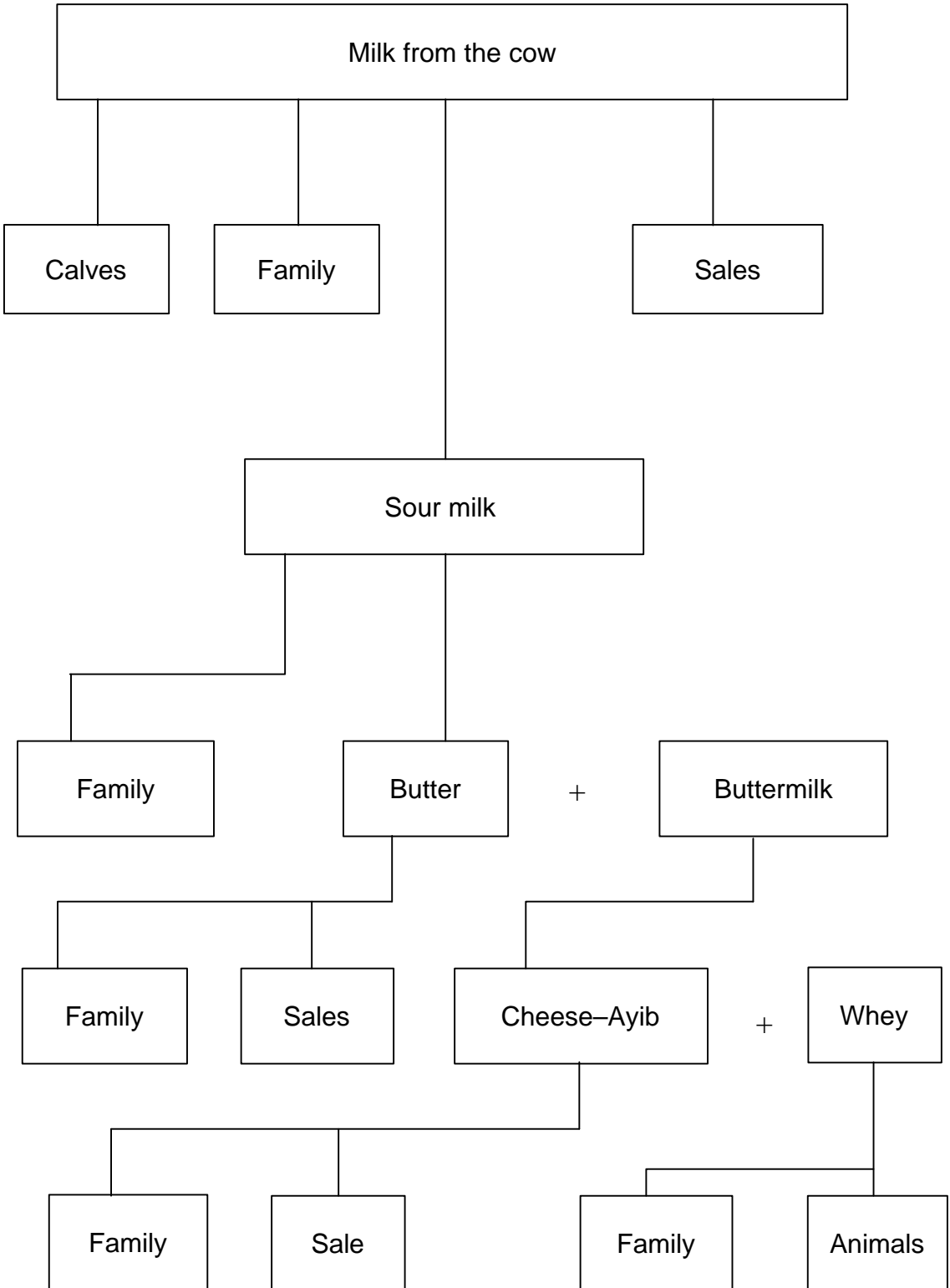
some butter. About 64% of the smallholders consumed all of the cheese they produced, the remaining 36% consuming and selling cheese to different extents.

As is the case throughout rural Africa, women and children are responsible for milk processing. Storage stability problems of dairy products exacerbated by high ambient temperatures and distances from the market place make it necessary for smallholders to seek products with a better shelf-life or to modify the process of existing products. Ghee has a considerably longer shelf-life than butter, but consumers prefer to purchase butter and make their own ghee. Spices may also be added to butter to improve its shelf-life but this method is usually confined to butter for use by the smallholder.

One of the main reasons for the survey was to highlight areas where interventions are required and where improvements could be made. Processing problems included hygiene and quality of milk and products, long churning times, seasonality of milk supplies and temperature fluctuations of the milk prior to and during churning. The need for better extension services was highlighted by the fact that only 1% of the smallholders had received any kind of instruction on milk processing. The need for better processing techniques was referred to by the smallholders; and while the ILCA-developed and modified internal agitator fitted to the clay pot has been shown to be more efficient in butterfat recovery and takes less time than the traditional method of churning, only one smallholder had heard about the internal agitator while none of the 160 smallholders interviewed used the wooden agitator.

All of the smallholders would like to increase their milk production and suggested that they would have little difficulty in utilising the extra milk either through increased domestic consumption or sales of dairy products. Over 70% of the smallholders said that any extra milk they might produce would not be sold to DDE (the state owned Dairy Development Enterprise). The reasons for not selling to DDE included a preference by smallholders to process their own milk supplies along with the fact that they considered milk collection by the DDE to be unreliable in their area in addition to the low price (about Ethiopian Birr 0.50 per litre) paid by the DDE.

Dairy development: The future

In recent years much has been written on the food requirements and shortages and government policies (or lack or them) in relation to dairy development and marketing in sub-Saharan Africa. Governments on the one hand aim to provide cheap food to the growing urban population while on the other hand they wish to promote local production through better prices to the producer (Mbogoh, 1984). Dairy product surpluses in the European Community have declined considerably in recent years resulting in higher prices and less dairy products being made available as food aid. Ironically, these shortages in dairy product

supplies could provide the opportunity for serious attempts to develop the dairy industry in developing countries.

There is no shortage of theoretical answers as to what **should** be done to develop the dairy industry but the identification of what **can** be done and the drawing up and implementation of appropriate programmes is the key to the sustained development of dairying. The parallel development of programmes for production, processing and marketing of milk and milk products is required. Individual national programmes on animal health and improved breeding and feeding strategies are to be commended but it appears that scant attention is given to the processing and marketing of the increased meat and milk supplies resulting from such programmes.

Building large and expensive processing plants is not the answer, especially when it is known from the outset that local milk supplies can only meet about 20–30% of the plant's processing capacity. Such plants are clearly inefficient and uneconomical. In addition these plants, working below capacity and depending on imported milk powder and anhydrous milk fat, often produce products that are inappropriate or required by only a small section of the community.

We return to the questions, what can be done and what should be done to develop the dairy industry? It is suggested that there have been enough feasibility studies and surveys carried out to enable the correct decisions to be made. The large processing plants referred to above have been constructed based on such studies, but emphasis appears to have been placed on plant type and capacities and financing, to the exclusion of consideration of local milk supplies, markets and market requirements. It has been the experience in countries with a developed dairy industry that the development of the dairy industry should start at the producer level rather than having solutions imposed from the top.

The primary producer, i.e. the producer of the raw material on which the industry is and always will be based, must be advised, educated and encouraged as to the most efficient and economical way his and his neighbours' milk supplies can be produced, processed and marketed. The primary producer must be led and guided, not driven, because without his commitment to the efficient production, processing and distribution of milk and milk products, efforts to organise and develop the dairy industry will fail.

We at ILCA have adopted a number of approaches to the development of the initial stages of an organised dairy industry. We organise formal and informal training courses for people in training institutes as well as provide the opportunity for smallholders to visit our Dairy Technology Unit to see new developments either in techniques or equipment which are appropriate to their particular set of circumstances. In addition, new or modified equipment and technologies are investigated at farm level, thereby obtaining information at a very practical level. These investigations or on-farm trials provide a very subtle way of introducing

new techniques, product and processes to smallholders, who will adopt these systems if they find them appropriate and profitable.

Inhabitants of different rural areas may have different attitudes toward the processing and sale of milk and may differ even in the importance they attach to milk as a source of cash income or as food. Where dairy herds are larger than the small (1 to 3 cows) herds of most rural smallholders, production, processing and marketing requirements are considerably more immediate and important. Large surpluses of milk become available either for sale as liquid milk or as dairy products. Larger capacity processing equipment and facilities for cooling and storing milk and milk products are required. It is known that in some rural areas during periods of maximum production, surplus milk is wasted due to lack of knowledge of and/or interest in its preservation. It is the smallholder (peasant association) level that offers the best opportunity for developing the dairy industry in Ethiopia.

By pooling their resources, i.e. milk, money, expertise and time and energy, the smallholders can benefit economically and socially through greater efficiencies at the processing level in addition to saving considerable time by collective marketing.

In summary, therefore, it is suggested that the way forward in the development of the dairy industry in Ethiopia is to realise the importance of its components—production, processing, markets and marketing—and to encourage, lead and advise smallholders to pool and manage their resources to achieve greater economies, particularly in the areas of processing and product distribution. As the seed of cooperative development is sown and germinates more and more emphasis will be placed on raw milk quality, product quality and durability (to overcome seasonal surpluses) and product diversification appropriate to the needs of the market place.

References

Debrah S H and Berhanu Anteneh. 1991. *Dairy marketing in Ethiopia: Markets of first sale and producers' marketing patterns.* ILCA Research Report 19. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 21 pp.

Mbogoh S G. 1984. Dairy development and dairy marketing in sub-Saharan Africa: Some preliminary indicators of policy impacts. *ILCA Bulletin* 19:8–16. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

O'Connor C B. 1990. On-farm churning efficiency of a traditional clay pot fitted with an internal agitator. In: *Brief communications and abstracts of posters of the 23rd International Dairy Congress, Montreal, 8–12 October 1990.* International Dairy Federation, Brussels, Belgium. Vol 1, p. 12.

O'Connor C B and Zenash Zewdie. 1990. The production and utilisation of milk and milk products by smallholders in the eastern region of Shewa, Ethiopia. In: *Brief communications and abstracts of posters of the 23rd International Dairy Congress,*

Montreal, 8–12 October 1990. International Dairy Federation, Brussels, Belgium. Vol 1, p. 12.

O'Mahony F and Ephraim Bekele. 1985. Traditional butter making in Ethiopia and possible improvements. *ILCA Bulletin* 22:9–14. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Discussion

Concern was expressed about the transfer of the dairy processing technology package developed by ILCA in the absence of an effective extension service. O'Connor indicated that peasant associations in the area have been approached and encouraged to adopt the technology. Asked whether farmers would sell fresh milk if collection centres were established, O'Connor responded that sample members in his survey had expressed their intention to continue processing fresh milk into butter and cheese even if collection centres were set up.

Dairy technology appropriate to rural smallholder production: The Tanzanian experience

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Abstract

Data presented show that the ability of centralised dairy plants in Tanzania to collect, process and market local milk supplies has been declining over the last two decades. While producer prices for milk vary widely (40–100 TSh/litre) depending on distance from major urban areas, retail prices for products such as butter and cheese are more uniform in urban centres across the country. Against this background, a few small-scale milk processing projects have been started by individual farmers and groups of smallholders working together. Analysis of data from some of the pilot projects show that under prices prevailing in Tanzania, small-scale milk processing is profitable in remote areas where prices for raw milk are relatively low and if correct choices are made as to product type/quality, processes, equipment and organisational set-up. Some benefits realised in the pilot projects are outlined. Lack of critical inputs such as rennets and starter culture continue to hinder small-scale milk processing. It is suggested that local solutions to some of these problems be sought if smallholder dairying is to succeed and develop.

Introduction

In Tanzania, smallholder dairying is concentrated in the highland areas of Kilimanjaro, Arusha, Iringa and Mbeya regions because climatic conditions in these areas are good for grade dairy cattle. More than 70% of the estimated grade cattle present in the country are found in these regions (Kurwijila, 1988). The majority of these cattle are owned by smallholder farmers.

Although smallholder farmers own only up to six milking cows, milk production per milking cow is often high enough (7 litres/day) to enable them produce marketable surpluses (Urio et al, 1984; Mchau et al, 1985).

Most smallholder farmers have no access to the formal milk marketing channels operated by the Tanzania Dairies Limited (TDL) through its milk processing plants in Arusha, Mbeya, Dar es Salaam, Tanga, Musoma and Tabora. This is especially true during the rainy season when roads become impassable or when milk cooling centres and milk trucks break down. On the other hand, even when farmers have had access to formal TDL milk markets, the disparity in producer milk prices between the informal and the formal sectors has been so wide that farmers find it more profitable and/or convenient to sell their milk to private middlemen or directly to consumers, especially if they are near to urban centres.

As a result, although local milk production has increased, local milk intake has dropped from 14.3 million litres in 1979 to 5.5 million litres in 1987 (Lohay, 1988). This is a clear indication that, in Tanzania, centralised milk marketing and processing systems have not served the smallholder dairy farmer adequately.

In recent years, strong arguments have been put forward advocating the use of decentralised, rural-based milk processing where smallholder milk production is thinly scattered and far from urban markets (Bachmann, 1979; 1983; Kurwijila, 1984; Kurwijila, 1986; Kurwijila, 1987). When correctly applied, small-scale milk processing can contribute to the development of smallholder dairy production and marketing. However, development of this subsector has been slow because of such problems as lack of appropriate processing equipment, inputs and processes (Kurwijila, 1987) or poor marketing organisation and control (Enemark, 1989).

Nevertheless, FAO has taken the lead in implementing the concept of decentralised milk processing by publishing manuals on village milk processing (FAO, 1988; FAO-RDDTT, 1989) and in Tanzania, by assisting three women's groups in Moshi to start village-based milk collection/processing units (Enemark, 1989; Phelan, 1990).

While this option is yet to stand the test of time, it is pertinent at this time to examine in detail the progress made so far and to examine, in countries with a developing dairy industry such as Tanzania, whether decentralised milk processing using appropriate technologies can complement the role played by centralised milk marketing systems.

Arguments for decentralised milk processing

Decentralised milk processing may involve a group of smallholder farmers or a large-scale dairy farm. A milk marketing system will only be appropriate and acceptable if it results in:

- maximum economic returns to the smallholder farmer or dairy farm;

- consumers paying a fair price for good quality, safe milk and milk products without costly government subsidies; and

- minimum loss of milk and milk products through spoilage during the entire milk marketing channel from producer to consumer.

In the case of Tanzania, the following arguments may justifiably be made for decentralised, rural-based milk processing as a milk marketing option for locally produced milk.

Inefficient centralised milk marketing/processing system

The Tanzania Dairies Ltd (TDL) was created as a parastatal organisation in 1969 to take over the Northern Dairies in Arusha, the Coastal Dairies in Dar es Salaam and the Nyamwezi Creameries in Tabora (Lohay, 1977). Additional plants have since been erected at Utegi and Musoma in Mara Region and more recently at Tanga and Mbeya (Lohay, 1977; 1988). The performance of these high-technology dairy plants has been characterised by operation below capacity (Table 1) and declining local milk intakes (Table 2).

Various reasons have been advanced to account for this state of affairs (Lohay, 1988) but among them the most relevant to our discussion may be:

- dependence on imports for milk solids, packaging materials, replacement parts and vehicles, for which the foreign currency needed has not been readily available and

- poor pricing policy, which kept producer milk prices low in an attempt to make milk available cheaply to the poor majority in urban areas (MALD, 1983; Lohay, 1988).

Use of simple, appropriate technologies

For any small-scale milk processing to succeed, equipment used must be as simple as possible. In view of the chronic lack of foreign currency, it is preferable that equipment be made within the country. To this end, several attempts have been made to develop milk processing equipment that can be manufactured in developing countries (Bachmann, 1979; Bachmann, 1983; FAO, 1988; FAO-RDDTT, 1989). Table 3 shows various processes generally required in any milk processing industry and their potential for small-scale application. It is obvious that, for technical and economic reasons, technologies involved in processing liquid milk (refrigeration, steam generation, pasteurisation, sterilisation/aseptic packaging etc) are not immediately accessible to the small-scale milk processor.

Table 1. *Underutilisation of installed plant capacity by dairy factories belonging to Tanzania Dairies Limited, Tanzania, 1976–87.*

Year	Total installed plant capacity ('000 litres/day)[1]	Total processed yearly (litres x 10^6)[a]	Milk processed/day ('000 litres)	Plant capacity utilisation (%)
1976[b]	217		104.5	48.1
1977	NA	NA	NA	NA
1978	NA	NA	NA	NA
1979	303	40.151	110.0	36.3
1980	303	40.314	110.5	36.5
1981	303	36.867	101.0	33.3
1982	303	41.752	114.4	37.8
1983	303	42.318	116.0	38.3
1984	303	36.272	99.4	32.8
1985	303	34.170	93.6	30.9
1986	303	32.676	89.5	29.5
1987	303	25.771	70.6	23.3
1988	303	2.886	NA	

1. Musoma 45,000 litres/day; Utegi 45,000 litres/day; Mbeya 20,000 litres/day; Dar es Salaam 90,000 litres/day; Arusha 60,000 litres/day; Tabora 3000 litres/day; and Tanga 40,000 litres/day (Kurwijila, 1984; Kurwijila, 1986).

a. Lohay (1988).

b. Lohay (1977).

NA = not available.

Table 4 shows the suitability of various products to small-scale processing. Table 5 shows the relative merits of some cheese varieties and sour-milk products.

Products that have been introduced in small-scale milk-processing projects in Tanzania and elsewhere in East Africa include: sour milk, cheese, butter and ghee.

Disadvantages of small-scale milk processing

Small-scale milk processing has a number of disadvantages, some of which are outlined below.

Table 2. *Volumes of milk processed in Tanzania Dairies Limited factories, Tanzania, 1976–87 (million litres).*

Year	From local supply	Recombined milk	Total	Fresh milk as % of total
1976[a]	9.217	28.920	38.130	48.10
1977	NA	NA	NA	NA
1978	NA	NA	NA	NA
1979	14.308	25.843	40.151	35.64
1980	11.346	28.968	40.314	28.14
1981	8.307	28.559	36.867	22.53
1982	7.359	34.393	41.752	17.63
1983	7.570	34.748	42.318	17.89
1984	7.468	28.804	36.272	20.59
1985	7.954	26.215	34.170	23.28
1986	6.775	25.901	32.676	20.73
1987	5.457	20.314	25.771	21.17

Source: Adapted from Lohay (1988).

a. Lohay (1977).

NA = not available.

Diseconomies of small scale: Plants processing less than 2000 litres of milk a day are not likely to be viable because of high overheads per litre of milk processed.

Poor product quality: It is difficult to make high-quality dairy products under the conditions prevailing in rural areas in developing countries. Product quality is likely to vary widely within and between processing plants.

Inappropriate products: Cheese-making is often cited as being inappropriate because Africans do not eat cheese.

Experiences with small-scale milk processing in Tanzania

Where small-scale milk processing has been introduced and tested, a number of advantages have been realised by the smallholder farmers, including:

- reduction in women's workload in milk marketing

- creation of rural employment and new skill

- improvement in animal husbandry through dairy technology units (DTU) serving as centres for essential inputs and services

Table 3. *Possibilities for applying conventional dairy technology unit processes in rural dairy processing.*

Unit process	Rural dairy processing	
	Current	Potential
1. Cooling/ refrigeration	Natural air cooling	- in-can cooling with running water (highlands) - solar refrigeration - surface coolers (highlands) - non-existent in hot/humid areas
2. Heating	Boiling	- batch pasteurisation - in-container sterilisation - in-plastic sachet pasteurisation - solar heaters
3. Separation	Gravitational	- hand-operated cream separator
4. Churning	Traditional vessels	- ILCA's internally agitated clay pots - wooden churns - milk-can churns
5. Fermentation	Natural fermentation	- controlled fermentation using own culture; lyophilised culture
6. Coagulation	Natural acidification	- organic acids, e.g. lemon juice
	Plant lattice	- bovine pepsin, porcine pepsin
7. Drying	Sun-drying	- atmospheric drum drier?
8. Air conditioning	Altitude dependent	- highland areas - evaporative cooling charcoal coolers?
9. Chemical preservation	Smoking?	- LP system?

- more self-confidence in the smallholder farmers as they take control of both production and marketing of their farm produce and

- increased and regular income to smallholder dairy farmers.

Factors influencing profitability of small-scale milk processing in Tanzania

Small-scale milk processing will only be profitable where, among other factors, there is a reasonable difference between the farm-gate price for raw milk and the prices of processed dairy products. The following factors influence price relationships.

Table 4. *Determination of the relative suitability of various dairy products for small-scale processing.*

Products	Pasteurised milk	UHT-sterilised milk	Cultured milks Yoghurt	Butter milk/ sour milk	Butter	Ghee	Cheese White cheese	Soft cheese	Ripened cheese
Energy requirement	+	+ + + +	+ + +	+	+	+ + +	+	+	+
Refrigeration	+ + +	-	+	-/+	+	-	-	+	+
Shelf-life (25–35°C)	-	+ + +	+	+	+	+ + + +	+ + +	-	+
Proximity to market	+ + +	-	+	+	+	-	-	+	-/+
Forex in investment cost	+	+ + + +	-/+	-	+	+	+	-/+	-/+
Forex in packaging	+	+ + + +	-/+	-/+	-/+	-	-	-	-
Possibility of solar energy use	+	-	-	-	-	-	+	+	+
Possibility of biogas use	+	-/+ [*]	-/+	-/+	+	+	+	+	+
Adaptability to small scale	+	-/+ [*]	+	+ + +	+	+ + + +	+ + + +	+	+
Availability of simple processing devices/methods	+	-/+ [*]	-/+	+ + +	+	+	+	+	+
Overall suitability to small scale processing	-	-/+	-	+ + +	+	+ + + +	+ + + +	-	+

Note: + + + + = very high; + + + = high; + + = moderately high; + Fair/low;
- = absent/not necessary; -/+ = optional/occasional; -/+ [*] refers to
possibility of in-can flame sterilisation.
Source: Kurwijila (1986).

Table 5. *Requirements and input availability for various milk products made under rural dairy processing conditions.*

	Level of technology	Shelf-life	Energy consumption	Yield (%)	Transport saving (%)
Fresh milk	+	1 day	-	100	0
Fermented milk	+	1 week	-	100	0
Butter	+	2 weeks	-	5	95
Ghee		2 months	+ + + +	4	95
Cheeses					
White pickled[1]	+	6 months	+	12–14	80
Pasta filata[2]	+ + +	2 months	+ + +	8–10	90
Mould[3]	+ + + + +	1 month	+	8–10	90
Whey[4]	+	1 week	+ + + +	2	
Cottage	+ + +	1 week	+	15–20	80
Semi-hard[5]	+ + + + +	2 months	+	9–11	90
Hard[6]	+ + + + +	1 year	+ + + +	7	90

Notes: Level of technology: + simple to + + + + + advanced.

Energy consumption: - no energy consumption to + + + + + high energy consumption.

Yield is estimated in per cent of milk input.

Transport saving is related to weight of remaining product and storage material.

1. Feta, Domiati, Gybna Beyda.

2. Provolone, Mozzarella.

3. Roquefort, Gorgonzola, Brie, Camembert.

4. Ricotta, Myseost.

5. Gouda, Tilsiter, Cheddar.

6. Grana, Emmental, Gruyere.

Distance from urban markets

While the price of locally processed dairy products is nearly uniform in most urban centres in Tanzania, farm-gate milk prices vary widely depending on the distance from urban areas. Milk is cheapest in areas far from urban markets. Where milk cannot be brought to the market within five hours of milking, farmers are forced to accept low milk prices. Table 6 shows how distance from market influences the marketing margins for various dairy products.

Type of dairy product

In Tanzania milk is marketed by smallholders as uncooled or cooled raw milk (Phelan, 1990) or is transformed into cheese, butter and ghee (Enemark, 1989; Phelan, 1990). Marketing margins per kg of milk are highest for sour milk (Table 6). However, sour milk is bulky and has a shelf-life of less than four days, hence transportation costs may be too high if the processing is done far in remote areas. However, in urban and peri-urban areas it may not pay to go into, for example, small-scale cheese-making if milk can be marketed as sour milk or buttermilk and butter or ghee.

Quality of dairy products

Since trade liberalisation five years ago, locally produced dairy products such as butter, ghee and cheese have been facing competition from imported products of high quality. Although imported dairy products such as cheese retail at prices that are 30–50% higher than local products, consumers of butter or cheese are those in the high-income bracket who tend to be very quality conscious, and ready to pay higher prices if the quality warrants it.

Constraints to small-scale or on-farm milk processing

Small-scale milk processors in Tanzania continue to require foreign currency to acquire some critical inputs such as rennets and starter cultures. Local solutions are needed to such problems. Work has started at the Sokoine University of Agriculture to extract bovine pepsin from abomasa of adult cattle. Results obtained so far are encouraging. Use of deep-freezing techniques in the preservation of lactic cultures can extend the usefulness of limited supplies of lactic cultures considerably (Kurwijila, 1983; Kamanu, 1989) and should be adopted wherever possible.

Table 6. *Effect of distance from market and dairy product type on possible marketing margins per kg of milk processed at small-scale dairy plants in Tanzania (1990 prices).*

Distance from urban market (km/hrs)	Average farm-gate raw milk prices (TSh/litre)	Minimum ratios: product retail price/kg to farm-gate price of the quantity of raw milk utilised in making product				
		Fresh milk	Sour milk	Ripened cheese	Butter	Ghee
0–10 (2)	100	1.0	2.5	1.4[a]	1.7[b]	1.8[c]
10–40 (4)	60	1.7	4.2	2.3	2.9	3.0
40–100 (6)	50	2.0	5.0	2.8	3.4	3.6
100 (6)	40	2.5	6.2	3.5	4.3	4.5

US $1 = 195 TSh (October 1990).

Retail prices: Sour milk 250 TSh/litre; cheese 1400 TSh/kg; butter 600 TSh/kg; ghee 750 TSh/kg.

a. Assume 1 kg of ripe cheese requires 10 litres of milk.

b. Assume 21 kg milk yield 1 kg of butter and 20 kg of milk marketed as low-fat fermented skim milk/buttermilk for a total retail value 3600 TSh.

c. Assume 26 kg milk yield 1 kg of ghee and 25 kg of milk marketed as low-fat fermented skim milk/buttermilk for a total retail value 4500 TSh.

Summary and conclusions

Milk processing and marketing in Tanzania is characterised by the existence of large-scale, centralised milk processing plants whose ability to collect and process local fresh milk supplies has been declining over the last two decades. In the informal sector, milk is marketed as raw, uncooled milk. Some large-scale dairy farms convert milk into dairy products such as butter and cheese. In recent years, with assistance from international donor organisations such as FAO, GATE etc, some small-scale (60–500 litres/day) milk processing has been organised in the Arusha/Moshi smallholder milk corridor with encouraging results. Small-scale milk processing is profitable in Tanzania if it is done in remote areas where raw milk prices are relatively low and correct choices are made as to product type, processes, equipment and organisational set-up. Some of the benefits that have been realised in the pilot projects are outlined. Lack of critical inputs such as rennets, cheese cover and starter culture continue to limit the smooth operation of small-scale milk processing. Local solutions to these problems are required if smallholder dairying is to succeed and develop.

References

Bachmann M R. 1979. Adapted techniques for collection, processing and marketing of milk in developing countries. 2: Milk collection and processing techniques. *Milchwissenschaft* 34(9):538–541.

Bachmann M R. 1983. Milk processing in rural areas to support dairying in developing countries. *Journal of Dairy Science* 68:2134–2139.

Enemark L. 1989. Assistance to women groups in Kenya and Tanzania. In: *Proceedings of the 16th Scientific Conference of the Tanzania Society of Animal Production*. Tanzania Society of Animal Production, Morogoro, Tanzania.

FAO (Food and Agriculture Organization of the United Nations). 1988. *Village milk processing.* FAO Animal Production and Health Paper 69. FAO, Rome, Italy.

FAO–RDDTT (Food and Agriculture Organization of the United Nations–Rural Dairy Development Training Team). 1989. *Rural milk processing: A practical guide to small-scale cheesemaking in East Africa.* FAO–RDDTT, Naivasha, Kenya.

Kamanu N. 1989. *Possibilities of marketing concentrated starter culture for mala production by small scale manufacturers in Kenya.* MSc thesis, University of Nairobi, Nairobi, Kenya.

Kurwijila R L. 1983. Maintenance of reactivated, lyophilised mixed type lactic cultures by subculturing and by cold storage. *Indian Journal of Dairy Science* 36(4):338–343.

Kurwijila R L. 1984. A review of research and development of the dairy industry in Tanzania: Milk processing and marketing. In: *Proceedings of the 11th Scientific Conference of the Tanzania Society of Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 100–113.

Kurwijila R L. 1986. Flame sterilisation and marketing of milk in 20 litre containers. PhD thesis, Eidgenosische Technische Hochschule Zurich (ETH-Zurich), Zurich, Switzerland. Dissertation No. 8037.

Kurwijila R L. 1987. Possibilities and limitations of application of research and development in small-scale dairy processing in developing countries. *Bulletin of the*

International Dairy Federation 221:106–109. IDF (International Dairy Federation), Brussels, Belgium.

Kurwijila R L. 1988. Some reflections on milk supply and consumption statistics in Tanzania with particular reference to the role of the traditional cattle herds. In: *Proceedings of the 15th Scientific Conference of the Tanzania Society of Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 216–242.

Lohay A B. 1977. Dairy production and processing in Tanzania. In: *Proceedings of the 4th Scientific Conference of the Tanzania Society of Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 271–309.

Lohay A B. 1988. Contribution of the milk processing industry towards the national nutritional demand in Tanzania. In: *Proceedings of the 15th Scientific Conference of the Tanzania Society of Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 243–256.

MALD (Ministry of Agriculture and Livestock Development). 1983. *The Tanzania Livestock Policy.* Government Printer, Dar es Salaam, Tanzania.

Mchau K W, Ibbe S N, Lenggenhager M and Kifaro G C. 1985. Some preliminary results from Mbeya region small-scale dairy recording scheme. In: *Proceedings of the 12th Scientific Conference of the Tanzania Society Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 78–97.

Phelan J A. 1990. Support to rural dairy processing in Tanzania. In: *Proceedings of the 23rd International Dairy Congress, Montreal, Canada, Oct. 7–12th 1990.* International Dairy Federation, Brussels, Belgium.

Urio N A, Mlay G I and Nyakalo S J. 1984. Dairy feeding systems research experiences from Hai District. In: *Proceedings of the 11th Scientific Conference of the Tanzania Society of Animal Production.* Tanzania Society of Animal Production, Morogoro, Tanzania. pp. 264–284.

Discussion

Kurwijila's argument that conventional dairy processing technologies are not appropriate to smallholder dairy producers was generally well received. His view that organisation into cooperatives was a good idea but difficult in terms of management was followed by queries about alternatives, e.g. private operation. Kurwijila explained that the promotion of cooperative or individual processing depended on circumstances and that both approaches were important, the former mainly for small producers and the latter for larger scale producers.

Patterns of acquisition and consumption of milk and other dairy products in Bamako, Mali

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Abstract

This study describes the patterns and levels of consumption of locally produced, factory-manufactured and directly imported, readily usable dairy products in the city of Bamako, Mali. It covers a sample of 240 urban households stratified by wealth category (rich, medium income and poor). Taking all dairy products together, an average consumption of 18 kg liquid milk equivalent (LME)/person per year was estimated. Rich households consumed an average of 22 kg LME/person per year and spent 1.8% of their monthly income on dairy products. Poor households consumed an average of 6.4 kg LME/person per year and spent 3.4% of their monthly income on dairy products.

Locally produced fresh milk, factory-reconstituted milk and directly imported, readily usable milk were among the most frequently consumed dairy products. Financial difficulties was cited as the most important reason for the low level and irregularity of consumption of dairy products by the poor households. Consumers considered convenience in terms of proximity, favourable terms of purchase and product quality when acquiring dairy products. In general, between 71% and 86% of total expenditure on dairy products was on directly imported products. Only between 9 and 20% was spent on domestically produced dairy products.

Introduction

Most African countries south of the Sahara have large cattle herds and, as a consequence, have considerable potentials for domestic milk production, yet they remain net importers of dairy products. The adverse effects of these imports on the balance of payments and other development projects have led most importing countries to embark on programmes aimed at increasing domestic dairy production. An appropriate domestic dairy development effort needs to consider the present and future dairy demand of the population as a whole and more particularly of the urban population where demand for dairy products is generally high.

The objectives of this study included:

i) determining the patterns of dairy product consumption by different income classes in the Bamako area

ii) evaluating the relative shares of the different dairy products (locally produced, factory-reconstituted and imported, readily usable dairy products) in total consumption of the various income categories and

iii) quantifying the relationships between dairy consumption, household income, prices and socio-demographic variables across income groups.

This report focuses on the patterns of acquisition and consumption of the various dairy products by different income categories and the evaluation of the relative shares of the different dairy products in total consumption and expenditures.

Methodology

A multistage sampling technique was used in the selection of 240 sample households in the city of Bamako. In the first stage, three "quartiers" or city wards were selected from each of the six "communes" or administrative divisions of the city. In each commune, which comprises between 6 and 18 quartiers, distinct concentrations of households in different income categories (rich, middle income and poor) can be found in particular localities. The quartiers selected from each commune for the next stage of the sampling represented the three income groups. During the 1985 population census of Mali, quartiers were divided up into several strata called enumeration zones (EZs), each of which consisted of about 100 households. Having selected the target quartiers and listed the enumeration zones in each, the next stage of the selection was to select at random an EZ from each quartier. In the final stage, a predetermined number of households was randomly selected from the EZ selected from each quartier.

Data collection

The household was adapted as the unit of investigation and was defined, following the 1988 census definition, as consisting of a family who live together and take at least one meal a day together. Household data were collected by interviews using structured questionnaires between October 1988 and September 1989. Two general types of data were collected from each household in the sample. First, one-shot interviews of each sample household were used to collect data on household structure and characteristics that were not likely to change at all or were likely to change only slightly during the survey year. Examples of such characteristics were the ethnicity of the household head, sex and ages of the family members and their levels of formal education. Information on total monthly household income from all sources and from all income earners was also collected. The general patterns of consumption of dairy products, particularly the frequencies with which households consumed the various dairy products in the past year, were solicited during the one-shot interview.

This was followed by a weekly survey, in which each household was visited once a week for eight weeks during each of three seasons: dry cool season (November to January), dry hot (March to May) and rainy (July to September). The total sample of 240 households was divided into six equal groups of 40 households each. In the first week of the interview, each group was assigned to one of the six working days of the week (Sundays were rest days for the enumerators). Each day, 40 households were each interviewed by one of six enumerators, each interviewing six or seven households. At the end of the first week, all 240 households had been interviewed, and in the weeks following, the groups were rotated over the days of the week, such that by the end of the eight weeks in the season, each household had been interviewed at least once on each of the six work days in the week.

Data collected during the weekly interview included the types and sources of supply of the different dairy products (i.e. whether obtained by purchase, through gifts or through own production). The quantities of each product consumed and the mode of its consumption (i.e. whether as part of a meal or consumed outside regular meals) were also ascertained. Data were also collected on total expenditures on all dairy products, purchase locations and reasons for patronising particular purchase outlets. The responses were based on dairy product acquisition and consumption by the household during the 24 hours preceding the interview.

Results

Information on household characteristics including income distribution of the sample, socio-demographic characteristics and frequency of consumption of

the various dairy products by households was obtained from the one-shot survey. The levels of dairy consumption, expenditures and utilisation patterns were estimated from data collected from the weekly survey.

General characteristics of the sample

Household income distribution

Monthly household income ranged from a minimum of 4500 FCFA ($15) to a maximum of 700,000 FCFA ($2333) with an average of 85,000 FCFA ($284).

Income was unevenly distributed among the sample households (Gini coefficient = 0.47), with the poorest 10% receiving only 1% of the total income and the richest 10% receiving 36% (Table 1). On the basis of this finding, three income categories were defined by assigning all those households earning between 4500 and 30,000 FCFA to the "poor" category, households earning between 30,000 and 100,000 FCFA to the "medium-income" category and those earning more than 100,000 FCFA to the "rich" category.

Socio-demographic characteristics of the sample

Table 2 shows the socio-demographic characteristics of the sample. The poor households had an average family size of 8, compared with 14 for the rich

Table 1. *Distribution of monthly households income in Bamako, Mali, November 1988.*

Percentage of households, ranked by income	Cumulative percentage of households	Percentage of income received by household category	Cumulative percentage of income
Lowest 10%	10	1	1
10–20	20	2	3
20–30	30	3	6
30–40	40	5	11
40–50	50	6	17
50–60	60	8	25
60–70	70	10	35
70–80	80	13	48
80–90	90	16	64
Highest 10%	100	36	100

Table 2. *Socio-demographic characteristics of households in Bamako, Mali, 1988/89.*

	Whole sample	Income category		
		Poor	Medium	Rich
Households (number)	237	54	120	63
Households (%)		(25)	(50)	(25)
Average household income (FCFA/month)	85,370	19,472	61,722	185,309
No of households	10.6	8.1	9.8	13.6
Per caput income (FCFA/month)	8053	2403	6298	13,625
Formal education (%)				
None	38	58	41	29
2–6 years	58	42	55	61
> 6 years	4	0	4	10
Type of employment (%)				
Civil service	48	9	58	54
Manual worker	30	72	22	5
Self-employed (trading, professional)	15	11	15	40
Other	7	8	5	1

households. The level of formal education was lower among the poor households in which 58% received no formal education and none had more than six years of formal education; the corresponding figures for rich households were 29% and 10%, respectively.

The majority of workers from poor households were employed in manual work and received low wages, while workers from the rich households were mostly engaged in private business or in the civil service, where salaries are higher. Per caput monthly incomes in the poor, medium-income and rich households were 2403 FCFA, 6298 FCFA and 13,625 FCFA, respectively.

Frequency of consumption and reasons for irregular or non-consumption of the various dairy products

Frequency of dairy product consumption

Frequency responses were based on the one-shot interviews that preceded the weekly data collection and represented the general behaviour of the households with respect to dairy product consumption patterns. Table 3 summarises the frequencies with which households consumed the individual dairy products.

Table 3. *Frequency of consumption of the various dairy products in the Bamako area, Mali, 1988/89.*

Type of dairy product consumed	Whole sample Frequency level[1]				Poor Frequency level				Medium Frequency level				Rich Frequency level			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Locally produced dairy products																
Fresh milk	30	27	40	3	19	33	44	4	26	32	40	2	50	11	34	5
Sour milk (unsweetened)	60	16	22	2	61	13	24	2	58	18	22	2	62	13	20	5
Sour milk (sweetened)	6	4	55	35	6	2	48	44	3	3	58	36	11	8	55	26
Butter	5	2	63	30	2	2	82	14	4	3	62	31	9	2	48	41
Ghee (sirimé)	5	6	63	26	4	4	68	24	3	9	60	28	9	5	64	12
Other local products	43	6	31	20	33	9	37	21	48	4	29	19	42	5	30	23
All locally produced products	24	10	46	20	21	11	50	18	24	11	45	20	30	7	42	21
Factory-manufactured products																
Pasteurised fresh milk	15	20	52	13	7	19	48	26	14	22	54	10	22	17	50	11
Reconstituted fresh milk	37	31	26	6	37	33	19	11	39	35	22	4	33	20	42	5
Sour milk (unsweetened)	9	9	53	29	9	6	41	44	8	9	54	29	11	11	62	16
Sour milk (sweetened)	19	26	46	9	20	26	39	15	18	25	49	8	20	27	45	8
Yoghurt (unsweetened)	12	11	50	27	6	9	44	41	11	12	55	22	19	13	45	23
Yoghurt (sweetened)	23	19	45	13	7	17	50	26	19	20	49	12	42	17	33	8

(continued)

Table 3. *Frequency of consumption of the various dairy products in the Bamako area, Mali, 1988/89* (cont.).

| | Percentage of households consuming | | | | | | | | | | | | | | | |
| | Whole sample Frequency level[1] | | | | Poor Frequency level | | | | Medium Frequency level | | | | Rich Frequency level | | | |
Type of dairy product consumed	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Sour cream (fénè)	14	14	57	15	4	9	59	28	13	13	59	15	23	20	50	7
Butter/Ghee (sirimé)	11	11	58	20	7	7	56	30	8	8	64	20	19	21	47	13
All factory-manufactured products	18	18	48	16	12	16	44	28	16	18	51	15	24	18	47	11
Directly imported dairy products																
Pasteurised fresh milk (UHT)																
Concentrated milk	37	25	32	6	26	30	33	11	36	28	33	3	50	16	30	4
Powdered milk	60	21	14	5	35	26	24	15	63	23	12	2	75	14	11	0
Yoghurt	4	6	48	42	7	2	43	48	4	1	55	40	2	6	56	36
Cheese	4	5	44	47	4	0	28	68	3	2	53	45	8	14	41	37
Butter	7	3	52	38	6	0	35	59	5	2	56	37	11	6	58	25
Others	6	7	49	38	2	4	28	66	3	6	58	33	14	11	50	25
All directly imported	17	10	41	32	12	9	31	48	17	8	46	19	24	11	42	23
Average of all dairy products	20	13	45	22	15	12	42	31	18	13	48	21	26	13	44	17

1. Frequency levels of consumption are defined as follows: 1. At least once a week; 2. At least once a month; 3. At least once every three months; 4. Rare or never.

Four consumption frequency levels of 1, 2, 3 and 4, corresponding to the consumption of a given dairy product at least once a week, once every month, once every three months or rarely, were defined and used to describe the frequencies of dairy product consumption.

For the sample as a whole, locally produced unsweetened sour milk and directly imported powdered milk were the most frequently consumed products and were consumed by 60% of the sample at least once a week. Factory-reconstituted milk and directly imported concentrated milk were each consumed by 37% of households at least once a week. Directly imported cheese, yoghurt, pasteurised milk and butter were generally consumed only rarely or not at all.

The least-frequently consumed factory-manufactured dairy products were unsweetened yoghurt and sour milk, while locally produced sweetened sour milk and butter were the least frequently consumed of the local products.

Similar consumption patterns were exhibited by the different income categories. Taking all the dairy products together, and considering households consuming at frequency levels 1–3 as "regular consumers" and those consuming at frequency level 4 as "irregular or non-consumers", 78% of the sample households were regular consumers and 22% irregular or non-consumers. The corresponding figures were 69% and 31% for the poor households, 79% and 21% for medium-income households, and 83% and 17% for rich households.

Reasons for irregular/non-consumption of the various dairy products

Households which indicated consuming dairy products rarely or not at all (frequency level 4), were also asked to give reasons for their irregular consumption patterns. Their responses were grouped into three broad categories, namely financial, health (by allergy to dairy products) and other reasons (including lack of knowledge of product's existence, non-availability of product when needed and poor taste of product).

Of the 31% of the poor households who either consumed irregularly or did not consume dairy products at all, 3% cited allergy as the reason for irregular or non-consumption, 24% cited financial reasons and 4% cited other reasons. At the other extreme, the 17% of the rich households that irregularly consumed dairy products consisted of 7% who cited allergy, 4% who cited financial reasons and 6% who cited other reasons for their irregular consumption.

Utilisation patterns of dairy products

Consumption-to-acquisition ratios

In order to have an idea of the speed with which dairy products were consumed, data from the weekly survey of per caput consumption and per caput

acquisitions were used to estimate consumption-to-acquisition ratios of the three broad categories of dairy products (locally produced, factory-manufactured and directly imported). Acquisitions include purchases, gifts and own production, but acquisitions through gifts and own production were negligible and hence only purchases were considered.

Since the reference period for purchases and consumption was the same, a consumption-to-purchases ratio of unity implies consumption of all purchases on the day of purchase. A ratio of less than unity implies consumption of only portions of total purchases, while a ratio greater than unity indicates consuming more than is purchased.

The estimated ratios of locally produced, factory-manufactured and directly imported dairy products were 0.65, 0.92 and 0.38, respectively. Thus the consumption of locally produced and directly imported products appears to be spread over time while the factory-manufactured products appear to be consumed on the day of purchase.

Form of dairy product consumption

In general, local dairy products were consumed during breakfast (16%) and dinner (38%) by the whole family (Table 4). They were usually consumed with cereals such as sorghum, millet and maize (39%). The factory-manufactured products were generally consumed outside regular meals (41%) and usually by individual family members. The directly imported, readily usable dairy products were mostly consumed at breakfast, during which 53% of total volume was consumed with cereals and shared by the entire family.

Levels of dairy consumption and expenditure

Data collected during the weekly survey were used to estimate the levels of dairy consumption during each of the three seasons for the three income categories. Consumption of each dairy product in each household was averaged over the total number of times the household was interviewed (usually eight times a season). The different dairy products were converted into liquid milk equivalents (LME)[1] and total daily household consumption was estimated by summing the consumption of the different dairy products. By dividing total household consumption by the total number of household members, per caput daily consumption was estimated.

1. LME conversion coefficients used were: Fresh milk = 1; Dry milk (skim or whole) = 7.6; Condensed, concentrated or evaporated milk = 2; Cheese and curd = 4.4; Butter = 6.6; Butter oil = 8.0; other dairy products = 2.

Table 4. *Utilisation of the various dairy products by meal type, Bamako, Mali, October 1988 to September 1989.*

	Percentage of total consumption by meal type				
Type of dairy product	Uniquely breakfast	Uniquely lunch	Uniquely dinner	Meal combin-ation	Outside regular meals
Locally produced dairy products					
Fresh milk	16	0	46	31	7
Sour milk (unsweetened)	20	4	40	29	7
Sour milk (sweetened)	8	0	60	15	17
Butter	0	0	0	100	0
Ghee (sirimé)	45	0	55	0	0
Other local products	7	0	30	59	4
All local products	16	1	38	39	6
Factory-manufactured products					
Pasteurised fresh milk	5	19	26	0	50
Reconstituted fresh milk	5	1	31	9	54
Sour milk (unsweetened)	13	0	36	27	24
Sour milk (sweetened)	8	5	40	7	40
Yoghurt (unsweetened)	0	0	0	0	100
Yoghurt (sweetened)	0	0	44	0	56
Sour cream (fénè)	12	0	43	40	5
Butter/ghee	63	0	0	37	0
All factory products	13	3	28	15	41
Directly imported dairy products					
Pasteurised fresh milk	13	8	46	23	10
Concentrated milk	79	0	3	11	7
Powdered milk	58	0	10	27	5
Yoghurt	81	0	0	29	0
Cheese	22	19	0	33	26
Butter	93	4	0	2	1
Others	24	14	2	11	49
All directly imported products	53	6	8	19	14

Table 5 summarises levels of dairy product consumption and expenditure and the shares of the three categories of dairy products in total consumption and expenditures.

Taking the sample as a whole, per caput annual consumption is estimated at 54 kg LME, while consumption levels in the poor, medium-income and rich households is estimated at 27 kg LME, 59 kg LME and 67 kg LME per person per year, respectively. There were, however, wide variations around the mean per caput consumption level as indicated by coefficients of variation of between

Table 5. *Levels and patterns of dairy consumption and expenditures by income category, Bamako, Mali, 1988/89.*

	Whole sample	Income category		
		Poor	Medium	Rich
Average per caput dairy consumption (kg LME/day)	0.148	0.075	0.162	0.183
Average per caput dairy consumption (kg LME/year)[1]	54	27	59	67
Adjusted per caput dairy consumption (kg LME/year)[2]	18	9	19	22
Share of various dairy products (% of total)				
Local dairy products	30	36	27	31
Factory-manufactured products	13	18	14	10
Directly imported products	57	46	59	59
Expenditure patterns				
Average per caput dairy expenditure (FCFA/day)	70	22	75	100
Estimated average per caput dairy expenditure (FCFA/year)[3]	25,550	8030	27,373	36,743
Adjusted per caput dairy expenditure (FCFA/year)[4]	8432	2650	9033	12,125
Share of various products (% of total expenditure)				
Local dairy products	11	20	12	9
Factory dairy products	6	9	5	5
Imported dairy products	83	71	83	86
Dairy product share of household income (%)	2.6	3.4	2.5	1.8

1. This estimate assumes daily consumption.
2. This estimate represents dairy consumption on every third day instead of every day of the year.
3. Based on daily dairy purchases.
4. Based on purchases every third day.

119% and 283%. Considering the variability in consumption and the irregularities with which sample households reported consuming dairy products, the annual per caput consumption appears to have been overestimated by basing the estimate on daily consumption. These estimates were thus multiplied by a factor of 0.33 to reflect consumption on every third day instead of every day.

The adjusted estimated annual consumption level for all dairy products over the sample as a whole was 18 kg LME/caput, while the levels of consumption in the poor, medium-income and rich households were 9, 19 and 22 kg LME/caput, respectively. The shares of the different categories of dairy products consumed (i.e. locally produced, factory-manufactured and directly imported) in total per caput dairy consumption were estimated. For the sample as a whole, locally produced dairy products represented 30% of total consumption while factory-manufactured and directly imported dairy products represented 13% and 57%, respectively. A similar pattern was reflected in the shares of total consumption of the three income categories where directly imported products represented the largest share, followed by locally produced dairy products.

Daily per caput expenditures on all dairy products was estimated at 70 FCFA for the sample as a whole, 22 FCFA for poor households, 75 FCFA for the medium-income households and 100 FCFA for rich households. Adjusted annual per caput expenditures were estimated at 8432 FCFA for the sample as a whole, 2650, 9033 and 12,125 FCFA for the poor, medium-income and rich households, respectively. Locally produced products represented 11% of total expenditures while factory and imported products represented 6% and 83%, respectively. The sample as a whole spent 2.6% of their monthly household income on dairy products. Poor households spent a larger percentage of their monthly income on dairy products than did rich households (3.4 vs 1.8%).

Purchase outlets, retail prices and expenditure patterns

Dairy products were purchased from six main sources:

i)   itinerant market traders

ii) fixed traders in the neighbourhood or quartier markets

iii) fixed traders in the city's central market

iv) home deliveries

v)   farm gate and

vi) all-purpose retail kiosks.

For the analyses, these purchase outlets were grouped into three categories, namely (1) market sales (combining itinerant and fixed traders in the

neighbourhood and central markets), (2) home delivery/farm gate (combining home deliveries and purchases at the farm gate) and (3) all-purpose kiosk sales.

Retail prices of selected dairy products at the three categories of outlet during the three seasons of the study are summarised in Table 6. The market sale outlet accounted for 52% of the total local dairy product purchases, while home delivery/farm-gate sales and kiosk sales accounted for 45% and 3%, respectively. While 98% of purchases of factory-manufactured dairy products were from the all-purpose kiosks, 66% of the total purchases of all directly imported dairy products was from all-purpose kiosk outlets and 34% was through the market outlet.

Consumers' reasons for using particular outlets and their expenditure patterns

Several reasons were cited for using particular purchase outlets of which proximity of outlet, high quality of product through the outlet, low prices, constant availability of product at the given outlet and the possibility of purchasing product on credit (favourable terms of purchase) were the most frequently mentioned. These reasons were classified into three main categories: (1) product and favourable terms of purchase, (2) low price and (3) high quality.

Using per caput expenditures on the six most consumed dairy products as variables of interest, chi-square analyses were done to test whether the intensity of outlet use was dependent on "services" provided by the outlet. The reasons for outlet use were used as proxy for services provided. There was a strong and significant association between outlet usage and services provided. For locally produced fresh milk, for example, 40% of total expenditure was the farm gate outlet because of the high quality of the product there at market outlets because of their convenience. For directly imported condensed milk, 80% of total expenditure was at the all-purpose kiosk outlets because of their convenience. Low prices did not appear to be a major factor in choosing a purchase outlet.

Conclusion

The study estimated annual per caput dairy consumption in the poor, medium-income and rich households in Bamako at 9, 19 and 22 kg LME, respectively. These are below the 62 kg LME/caput per year recommended by the FAO for an adult. Locally produced dairy products accounted for between 27% and 36% of total dairy consumption, compared with between 47% and 59% for directly imported dairy products. Expenditures follow a similar pattern, directly imported dairy products accounting for a larger share of dairy expenditure (between 71% and 86%) than locally produced dairy products (between 9% and 20%).

Table 6. *Retail prices of selected dairy products at different purchase outlets in the Bamako area (November 1988–September 1989).*

Purchase outlets	Local fresh milk FCFA/litre	CV (%)	Local sour milk FCFA/litre	CV (%)	Factory-pasteurised milk FCFA/litre	CV (%)	Factory-reconstituted milk FCFA/litre	CV (%)	Imported concentrated milk FCFA/litre	CV (%)	Imported powdered milk FCFA/litre	CV (%)
Market sales												
Cool season	248	12	197	4	300	0	170	0	537	15	1185	11
Hot season	236	11	198	4	295	2	203	4	532	13	1197	11
Rainy season	219	13	194	7	–	–	–	–	534	14	1232	12
Home delivery/farm gate												
Cool season	254	8	194	5	–	–	–	–	–	–	–	–
Hot season	240	14	198	2	–	–	–	–	–	–	–	–
Rainy season	234	18	187	12	–	–	–	–	–	–	–	–
All-purpose kiosks												
Cool season	–	–	–	–	251	3	174	6	589	12	1304	13
Hot season	–	–	–	–	251	3	200	3	589	12	1315	12
Rainy season	–	–	–	–	250	2	171	5	591	10	1369	11
Average of all locations												
Cool season	251	10	195	5	275	2	172	3	563	13	1244	12
Hot season	238	12	198	3	273	2	201	3	561	12	1256	12
Rainy season	226	16	190	9	250	2	171	5	562	12	1300	11

Consumers considered convenience in terms of proximity, favourable terms of purchase and constant availability of products as important factors in selecting a purchase outlet. High product quality was also important. Low prices were not as important to consumers as convenience and quality. Efforts to increase consumption of dairy products, particularly of domestically produced products, need to consider quality and convenience in their marketing strategies.

Discussion

The paper was commended as a valuable input to policy-making in terms of information on who consumes what and how much, what drives consumption and what the existing seasonal patterns are. It was suggested that the policy and institutional environment, and production, consumption and cross-commodity linkages be brought into the analysis to provide a fuller picture of the importance of dairying for employment and household and farm income. The authors were asked to explain whether their finding that poorer households were more dependent than wealthier ones on factory-manufactured and imported products was an outcome of the location of their sample and what the implications of this were for trade policies. Sissoko indicated that he would not go as far as describing poorer households' higher consumption of milk from the Union Laitière de Bamako (ULB) as dependence and that the emphasis of the analysis, in this respect, was on showing the relative importance of different dairy products in household consumption. Because of data and estimation problems the econometric analysis was deleted from the original paper.

Consumption of dairy products in northern Nigeria

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Introduction

Justification for studying dairy consumption in Nigeria

In most African countries, growth in livestock production has been insufficient to maintain consumption levels. For example, FAO (Food and Agriculture Organization of the United Nations) figures for sub-Saharan Africa as a whole indicate that milk production (i.e. the sum of fresh milk, dry milk and evaporated and condensed milk) increased by an average of less than 0.5% per year between 1970 and 1980. On the basis of growth in population and gross national product (GNP) alone, the increase in demand can be estimated at 3.4% per year. Consequently, most countries in sub-Saharan Africa have become increasingly dependent on imports of dairy products. Nigeria, with approximately 110 million inhabitants, is no exception in this respect. Nigeria's milk self-sufficiency rate decreased from 64.2% in 1970 to 30% in 1982. Since 1983 the self-sufficiency rate has been steadily increasing, to 73% in 1986. Imports of dairy products have increased from 190,100 t liquid milk equivalent (LME) in 1973 to a peak of 995,000 t in 1982. Since then imports have decreased every year until they reached a level of 164,000 t in 1986. FAO figures indicate that imports of dairy products into Nigeria came to 183,000 t LME in 1988, at a cost of US$ 53.5 million.

Nwoko (1986) concluded that the two main factors responsible for the substantial increase in dairy imports into Nigeria during the 1970s and early 1980s were real import prices and the difference between the official and real exchange rates. However, the effects of the overvalued currency on the domestic price of dairy products has been largely removed in Nigeria after a series of devaluations in

the 1980s. As the Naira cost of imported ingredients has increased, import volumes have declined substantially.

Local milk production in Nigeria is mainly from indigenous cattle breeds which are kept primarily by about 6 million pastoralist tribesmen most of whom are Fulani. Over 95% of the approximately 13 million head of cattle in Nigeria indigenous breeds. Average milk production per cow is about 0.74 litres per day, ranging from 1.27 litres during the wet season to 0.36 litres during the dry season, resulting in an estimated local milk production of roughly 450,000 t per annum. Organised, non-traditional milk production and processing, with the exception of reconstitution of imported raw materials, is undertaken by state governments through parastatal or limited-liability companies. However, organised milk processing under government control is very limited in both absolute and utilised capacity, despite a whole series of attempts to re-establish milk-collection centres during the 1970s and 1980s. Milk production under modern intensive and semi-intensive systems in Nigeria contributes only about 3% of the national output of milk. In addition to government-owned dairy plants private dairy firms have sprung up over the years. However, virtually all the dairy firms in Nigeria have either shut down or are having serious problems.

Dairy marketing in Nigeria can be described as a relatively free enterprise, with minimal state interference. Three marketing systems can be identified: the traditional, modern and dairy import marketing systems. Although most of the dairy products in the traditional livestock production subsector are consumed within the producing household, the sale of milk and milk products by the Fulani is becoming increasingly important with the monetisation of the traditional livestock economy. However, in view of the failure of most modern commercial dairy plants, it seems likely that imports of dairy products will continue to play an important role in meeting the demand for dairy products in Nigeria in the foreseeable future.

Dairy consumption behaviour in the Kaduna area can be considered largely representative of that in northern Nigeria. However, the actual levels of consumption of dairy products in and around Kaduna are not known. In addition to the absence of data on consumption levels, neither the patterns of consumption nor the relationships between individual dairy product consumption, prices and income levels are known. It is important to determine these in view of the government's interest in reducing imports further by encouraging domestic production and to be able to offer advice regarding future government dairy policies.

Objectives of the study

This paper analyses consumption of dairy products in Kaduna town and the surrounding villages. It is largely based on a survey carried out in and around

Kaduna in December 1988 and January 1989. The main objectives of the dairy product consumption survey were to:

- quantify consumption levels of various dairy products (imported as well as locally produced) according to income group ethnic group, and geographical location

- ascertain acquisition and consumption patterns

- ascertain reasons for non-consumption

- determine market niches for individual dairy products

- quantify the relationships between income level and consumption of various dairy products and

- determine the influence of economic and socio-demographic parameters on the consumption of dairy products.

The analysis considers income-group specific consumption levels and expenditures on various dairy products, frequencies of consumption, price levels, and relationships between expenditures, levels of income and socio-demographic factors for individual products.

Methodology

The study area

Kaduna town lies almost exactly on the boundary between the subhumid and the semi-arid zones; long-term average annual rainfall is about 1100 mm. The hinterland is dry savannah and the rural population depends mainly on rainfed cereal crops. The Kaduna region is still relatively sparsely settled.

Eighty years of migration from all over Nigeria to Kaduna has resulted in an exceptionally diverse population. Although the population of the town was originally Gbari, it is now an amalgam of northern and southern ethnic groups. It is estimated that at least 200 ethnic groups from all parts of Nigeria can be found in Kaduna today. Many of these have formed small but coherent communities, creating small centres of demand for local foods from their areas of origin.

The most important communities are Hausa (originating from the north), Yoruba (originating from Oyo, Ogun, Ondo and Lagos states with parts of Kwara and Bendel states; mostly Christian, although a few are Muslim), Igbo (originating from the east, i.e. Anambra and Imo states as well as parts of Bendel and Rivers states; almost exclusively Christian), Fulani (nomadic, settled or semi-settled; almost exclusively Muslim), Nupe (from Niger state, either Muslim or Christian) and Gbari (the original population of the region, either Muslim or Christian). For

the study the other populations have been grouped according to approximate geographical origin: Southern Zaria, northern (other) and southern (other).

Kaduna town is linked to all the major commercial centres of Nigeria by good roads. Although there is also a railway link, most bulk traffic goes by road.

Survey methods

The household was adopted as the unit of investigation. Information was obtained mainly from household heads and included general family characteristics such as demographic aspects, income, wealth, frequency of acquisition and consumption of dairy products, and prices paid, general preferences of family members for the various dairy products and expenditure on dairy products and other items during the week preceding the week in which the interview took place.

Basic characteristics of the sample

The total number of sample households was 737, of whom 715 were headed by men. Seventy-two per cent of the households were classified as Muslim and 27% as Christian; the remaining 1% practised some form of traditional religion.

Geographical distribution

The survey covered 489 households in 13 villages surrounding Kaduna. In addition, 11 wards were selected in Kaduna town and a total of 248 households surveyed.

Ethnic distribution

By far the largest proportion (56%) of the households classified themselves as Hausa. Including the other northerners (i.e. Fulani, Gbari, Southern Zaria, Nupe and the residual northerners category), 83% of the sample consisted of people originating from the north. The Yoruba, Igbo and the residual southerners categories accounted for only 17% of the total number of sample households.

Income levels and distribution

The total monthly income earned by each household was determined by asking the household head and was termed "declared income". The sample average was Naira 572 per household per month, with a standard deviation of Naira 1098. Income distribution showed marked inequality (Table 1): whereas the poorest 20% of the sample households accounted for just over 7% of the total income

Table 1. *Cumulative and percentage ranking of incomes of sample households*

Percentage of households, ranked by income	Cumulative % of households	Percentage of income received by group	Cumulative % of income
Lowest 10%	10	1.9	1.9
10–20	20	3.4	5.3
20–30	30	4.1	9.4
30–40	40	5.0	14.4
40–50	50	5.6	20.0
50–60	60	6.6	26.6
60–70	70	8.2	34.8
70–80	80	9.9	44.7
80–90	90	13.7	58.4
Highest 10%	100	41.6	100.0

Note: n= 733 rather than 737 due to three cases of zero declared income and one case of unrealistically high declared income.

earned by all sample households, the richest 10% received over 40% of total income. This income distribution is very similar to that found by a similar study in Bamako, Mali (ILCA, Addis Ababa, Ethiopia, unpublished data).

Given the considerable degree of inequality in income distribution among the sample households, the sample was sorted into three income categories: the poorest quartile, the middle 50% and the richest quartile (Table 2).

Income proxies such as inventories of capital items were used as indicators of a household's wealth and as a cross-check on the income level reported. The

Table 2. *Income categorisation of sample households.*

Category	Number in category	Income (Naira/ household per month)		Percentage of total income
		range	mean	
Poorest quartile	183	14–250	167	7
Medium 50%	367	250–580	367	32
Richest quartile	183	600–15,200	1387	61

Note: n= 733 due to three cases of zero declared income and one case of unrealistically high reported income.

correlation between household wealth and declared income was positive and highly significant (r= 0.33, P< 0.0001).

Occupational structure

Over 30% of the household heads classified themselves as farmers and/or livestock rearers. Other major occupations included artisan (19%), trader (19%), civil servant (13%) and private businessman (12%).

Educational structure

Thirteen per cent of the household heads had received no formal education at all, while 45% had undergone only Koranic education. Eighteen per cent of household heads had received primary education, 13% had received secondary education and 10% had received post-secondary education.

Household size

The number of people living in the sample households ranged from a minimum of 1 to a maximum of 50, with an average of 7.02. A sample household was composed, on average, of 1.07 infants (between 0 and 4 years), 2.63 youngsters (boys and girls between 5 and 16 years of age) and 3.04 adults (men and women over 16 years of age).[2] The low-income households had an average size of 5.42 members, compared with 9.11 among high-income households and 6.80 in medium-income households.

General patterns of acquisition and consumption of dairy products

In this section the major dairy products consumed are characterised. The frequency with which households generally acquired and consumed the various dairy products, and their source, will be discussed.

All domestic dairy products in Nigeria are made from cow and camel milk. Camel milk is consumed by only a small proportion of the population along the northern border; it is never sent down to Kaduna and its hinterland.

Dairy products can be divided into those produced under traditional systems and those that are imported or based on imported products. Dairying is virtually confined to a single ethnic group, the Fulani, and each product has a specific

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2. Due to certain inconsistencies in the data-set, the sum of the average number of infants, youngsters and adults does not quite add up to the sample average household size.

name in their language, Fulfulde, as well as in Hausa, the common language of northern Nigeria.

About 3% and 1% of the consumption of locally produced dairy products was obtained via own production and gifts, respectively. Imported dairy products and dairy products produced from imported ingredients are only purchased. Thus, most of the dairy products consumed during the survey were purchased.

Domestically produced dairy products

Traditional dairying in the Kaduna area consists of the production of fresh and sour milk, butter and cheese by pastoralists. In the semi-arid zone, these include the Tuareg and the Koyam. However, further south towards the subhumid zone, dairying has remained the province of the Fulani, despite the widespread ownership of zebu cattle among arable farmers. Detailed descriptions of traditional dairying are given by Waters-Bayer (1985; 1986; 1987).

Dairy products, known as *kosam* in Fulfulde, are usually eaten without cooking or further processing. Pasteurisation is rarely undertaken.

Fresh milk

Compared with sour milk (*pindam* in Fulfulde, *nono* in Hausa), fresh milk (*biraadam* in Fulfulde, *madara* in Hausa) is relatively little sold in Nigeria, although it is common to offer it to guests in Fulani households. The main reason seems to be that milk sours rapidly in hot weather and it is therefore simpler to produce *nono*. Few consumers in the villages are prepared to make the extra effort to get fresh milk. Seventy per cent of the total sample reported no consumption of fresh milk. Almost all consumers of fresh milk obtain it from Fulani women.

Sour milk

This is a very important product for Fulani dairywomen. *Nono* is made from skimmed milk and is usually sold with *fura*, doughy patties of sorghum or millet mixed with spices and sugar. Fulani women typically bring about six litres of *nono* for sale; although many sit in one place some also take the sour milk round to regular customers. Fifty-eight per cent of the total sample consumed sour milk at least once a week. Nearly all sour milk is acquired from Fulani saleswomen.

Yoghurt

A particular type of yoghurt (*lamudam* in Fulfulde and *kindirmo* in Hausa), although available in the Kaduna area, is more often found in more remote rural areas. It is thicker than *nono* and made from whole milk. It is either drunk as it is

or mixed with *fura*. One-third of the sample reported consumption of *kindirmo*. *Kindirmo* is sold almost exclusively by Fulani women.

Butter

In terms of quantities consumed, local butter is by far the most popular dairy product in the survey area. It is consumed in 65% of all households. Known as *nebbam* in Fulfulde and *man shanu* in Hausa, it is prepared over a period of several days. One woman usually sells butter produced by several others. The butter is usually melted and poured over food, especially rice. It tastes extremely strong—a feature valued by consumers. Local butter is also sold as a cosmetic to be rubbed into the hair. Almost all local butter is sold by Fulani women.

Cheese

The main type of cheese (*cuku* in Fulfulde, *wara* in Hausa and Yoruba) sold in the Kaduna area is a soft, wet, feta-like cottage cheese made from whole milk. It is sold in small cones, sometimes fresh, but more often fried. Most *wara* is brought in from Niger and Kwara states and is consumed by Yorubas originating from south-western Nigeria. Other ethnic groups tend not to consume *wara*, consequently, 90% of the sample reported zero consumption of *wara*. It is sold mostly by village market traders (mostly Yoruba women).

Imported and derived dairy products

Evaporated milk

Evaporated milk, sold in small tins, is the single most widely used imported dairy product in Nigeria. Fifty per cent of the total sample consumed evaporated milk at least occasionally, 34% at least weekly and 17% daily. Evaporated milk is sold mainly in markets, small shops and kiosks.

The major use of evaporated milk is in tea, coffee or milky drinks. It is also diluted with water and given to babies. Indeed its rapidly rising price during the survey period was seen as a threat to infant nutrition.

Sweetened condensed milk, although a major import in many other West African countries, is no longer imported into Nigeria and was virtually unavailable during the survey. None of the households reported using sweetened condensed milk.

Powdered milk

Powdered milk is sold in various quantities and packages. Up to the early 1980s powdered milk was very common. However, as the cost of powdered milk increased, it has become far less popular than evaporated milk. Only 16% of the sample consumed powdered milk which is sold mainly in markets and small shops.

Packaged liquid milk

Packaged liquid milk is simply imported powdered milk diluted with water and sold in 'Tetrabrik' packages. Being substantially more expensive than the powdered milk itself, it is purchased only by the wealthy for the convenience of having the liquid made-up and ready to serve. Only 8% of the households reported some consumption of packaged liquid milk. Packaged liquid milk is almost unavailable outside large towns. It is marketed through a variety of outlets, including bicycle boys, markets and various kinds of shop.

More popular than plain milk is sweetened chocolate milk, almost exclusively sold in 'Tetrabrik' sachets by bicycle boys. It is manufactured by Fan and Limani in 100, 200 and 330 ml sizes and mainly consumed by impulse purchasers. However, chocolate milk seems considerably more popular in the south than in the north where sweetened yoghurt is more common.

Baby formulae

As of February 1989, there were some 15 brands of baby formula available in Kaduna, usually sold in 400 or 450 g tins. Baby formulae are sold by a wide variety of retailers and were extremely popular when they were still cheap. Now that they are more expensive, only 15% of the total sample reported using them. Of the households with at least one infant only 12% reported regular (i.e. at least weekly) consumption of baby formulae. Most baby formulae are sold in markets and small shops.

Yoghurt

Yoghurt usually comes in rectangular or tetrahedral 'Tetrabrik' packs of either 125 or 150 ml, and is sold in shops and kiosks with freezers or (most frequently) by bicycle boys. Although some supermarkets stock imported plastic tubs of fruit yoghurt, these were rarely mentioned by consumers. After evaporated milk, yoghurt is the most widely bought product made with imported ingredients. Most of the six brands are heavily sweetened and relatively thin compared with traditional yoghurt. Fourteen per cent of the northerners and 17% of the southerners reported regular consumption of yoghurt.

Ice-cream

Although ice-cream was included in the survey, it will be largely ignored in this paper because of its typically extremely low dairy content. Ice-cream is sold in two ways: in polythene tubs or small buckets in supermarkets and as confectioneries from shops and bicycle boys. While extremely sweet by European standards, it is very popular among consumers of southern origin, especially children. Because of the large proportion of northerners in our sample, consumption of ice-cream was reported by only 15% of the households.

Butter

Butter imported from Europe or New Zealand is mostly consumed by the wealthy and expatriate community and as such is relatively little known to consumers in and around Kaduna. It is sold at some major supermarkets and in some small shops. Its consumption was reported by only 44 households (6%), 35 of which reported daily consumption.

Cheese

Although the principal supermarkets stock a range of both imported and locally manufactured European-style cheeses, such cheeses are bought mainly by wealthy and expatriate customers. Most outlets that sell imported butter also sell cheese. Only 46 sample households mentioned consumption of European-style cheeses; 41 households reported daily consumption.

Margarine

Although margarine is not a dairy product it was included in the survey because it is widely perceived to be similar to butter; many consumers are not aware that it is made from vegetable products. Margarine was consumed in 21% of the sample households. It is sold in markets and small shops, and in some kiosks and supermarkets.

Frequency of consumption

Eighty-two per cent of all households regularly (i.e. as least weekly) acquired and consumed a dairy product. Percentages for low-income, medium-income and high-income households were 73, 82 and 89%, respectively.

The most popular traditional dairy products are sour milk (*nono*) and local butter (*man shanu*), whereas evaporated milk is the most frequently acquired non-traditional dairy product. All other non-traditional dairy products are consumed by only relatively few households. With the notable exception of *nono*, the consumption of which seems to be about equally widespread across income groups, consumption frequencies are positively associated with income level. Consumption frequencies of fresh milk (*madara*) and traditional yoghurt (*kindirmo*) are about equal. About 40% of the households that reported consumption of either *madara* or *kindirmo* also reported consumption of the other commodity. Consumption of local cheese (*wara*) is limited mainly to the Yoruba ethnic group.

There exists a not-unexpected difference in consumption patterns between consumers of northern and southern ethnic origin (Table 3). Whereas consumption of domestically produced dairy products was more widespread among people who belong to ethnic groups that originate from the north than

Table 3. *Consumption frequencies of dairy products by aggregated ethnic groups.*

	Percentage of consumption group regularly consuming							
	Northerners				Southerners			
	Income group[1]				Income group[1]			
Commodity	S	L	M	H	S	L	M	H
Domestically produced dairy products								
Fresh milk (*madara*)	18	16	15	24	13	12	8	19
Sour milk (*nono*)	64	60	65	70	27	29	27	25
Yoghurt (*kindirmo*)	19	15	14	35	9	6	5	15
Butter (*man shanu*)	37	30	34	51	14	18		17
Cheese (*wara*)	5	5	5	4	9	6		8
Imported and derived dairy products								
Evaporated milk	31	21	31	43	50	18	52	60
Powdered milk	8	7	7	10	9	12	5	15
Packaged liquid milk	5	7	5	4	4	0	3	6
Baby formulae	8	8	8	11	11	12	10	13
Yoghurt	14	11	13	21	17	0	16	25
Table butter	5	5	5	4	8	0	2	19
Cheese	5	6	5	5	6	6	2	13
Ice-cream	7	6	7	10	20	6	16	29
Margarine	10	7	10	13	19	6	21	21
N	606	166	305	135	127	17	62	48

1. S = whole sample; L = low income; M = medium income; H = high income.

among those belonging to ethnic groups from the south, the reverse is true for imported and derived dairy products, although to a somewhat lesser extent. For domestically produced dairy products the north–south difference is roughly equal across income groups; for imported and derived products the difference between northerners and southerners seem to become more pronounced as income rises.

A comparison between Tables 3 and 4 shows that, for domestically produced products, consumption frequencies differ much less between rural and urban consumers than between northerners and southerners, even though the rural–urban difference seems to get more pronounced when incomes rise.

Table 4. *Consumption frequencies of dairy products by geographical location.*

	Percentage of consumption group regularly consuming							
	Rural				Urban			
	Income group[1]				Income group[1]			
Commodity	S	L	M	H	S	L	M	H
Domestically produced dairy products								
Fresh milk (*madara*)	17	16	14	26	17	14	15	21
Sour milk (*nono*)	63	56	65	71	48	62	45	46
Yoghurt (*kindirmo*)	17	15	12	34	18	11	15	26
Butter (*man shanu*)	36	29	35	51	27	27	21	34
Cheese (*wara*)	5	6	4	5	7	5	9	6
Imported and derived dairy products								
Evaporated milk	28	19	31	33	46	24	41	61
Powdered milk	6	7	5	7	12	8	10	14
Packaged liquid milk	5	7	4	7	6	5	7	8
Baby formulae	6	8	5	4	14	8	14	16
Yoghurt	12	10	12	14	21	11	18	29
Table butter	4	6	3	5	8	3	7	11
Cheese	5	6	4	5	8	5	7	9
Ice-cream	7	6	6	9	15	5	14	21
Margarine	9	7	9	12	16	8	17	19
N	486	146	254	86	248	37	114	97

1. S = whole sample; L = low income; M = medium income; H = high income.

However, as expected, regular consumption of imported and derived dairy products is largely confined to urban consumers and high-income rural dwellers.

In conclusion, whereas ethnic origin is more important than geographical location in determining consumption frequencies of domestically produced dairy products, the reverse is true for imported products.

Levels of dairy product consumption and their determinants

Consumption levels

Quantities consumed were obtained by dividing the households' expenditure on each specific dairy product by the average prices of the various dairy products at the time the survey was carried out (Table 5).

Table 5. *Average prices of various dairy products.*

Dairy product	Average price (Naira)
Domestically produced dairy products	
Fresh milk	3.00/litre
Sour milk	2.00/litre
Yoghurt	3.00/litre
Butter	10.00/kg
Cheese	15.00/kg
Imported and derived dairy products	
Evaporated milk	11.80/litre
Powdered milk	31.20/kg
Packaged liquid milk	8.00/litre
Baby formulae	44.40/kg
Yoghurt	12.00/litre
Butter	24.00/kg
Cheese	40.00/kg
Margarine	15.00/kg

Table 6 shows the overriding importance of sour milk (*nono*) and local butter (*man shanu*) in the dairy consumption pattern in and around Kaduna. Compared to *nono* and *man shanu*, consumption of most other dairy products, whether traditional or imported, appears rather insignificant.

In Table 7 yearly consumption of individual dairy products has been converted into liquid milk equivalents (LME) to arrive at total LME consumption. Standard

Table 6. *Weekly quantities of dairy products consumed per household[1] and per cent of households consuming, by income group.*

Dairy product	Sample	Low	Medium	High
		Income category		
Domestically produced dairy products				
Fresh milk (litre)	0.38	0.28	0.34	0.55
	(30)	(30)	(28)	(36)
Sour milk (litres)	1.66	1.29	1.59	2.20
	(79)	(81)	(81)	(75)
Yoghurt (litre)	0.40	0.19	0.34	0.71
	(33)	(26)	(30)	(44)
Butter (g)	452	302	425	670
	(66)	(60)	(65)	(72)
Cheese (g)	24	13.70	17	47
	(10)	(9)	(9)	(12)
Imported and derived dairy products				
Evaporated milk (litre)	0.26	0.13	0.28	0.37
	(50)	(36)	(52)	(60)
Powdered milk (g)	49	28	50	69
	(16)	(11)	(15)	(21)
Packaged liquid milk (litre)	0.04	0.02	0.02	0.10
	(8)	(9)	(6)	(11)
Baby formulae (g)	52	18	46	98
	(15)	(9)	(14)	(23)
Yoghurt (litre)	0.10	0.06	0.09	0.17
	(33)	(26)	(31)	(45)
Table butter (g)	9	4	8	16
	(6)	(5)	(4)	(10)
Cheese (g)	0.7	1.4	0.3	1
	(6)	(6)	(5)	(8)
Margarine (g)	47	12	57	62
	(21)	(11)	(22)	(30)

1. Includes both consuming and non-consuming households.

Figures in brackets are percentages of households consuming.

Total sample size is 733 with 183 low-income, 367 medium-income and 183 high-income households.

Table 7. *Yearly quantities of dairy products consumed per household.*[1]

Dairy product	Sample	Low	Medium	High
		Income	category	
Domestically produced dairy products				
Fresh milk (litres)	19.70	14.50	17.70	28.80
Sour milk (litres)	86.30	66.70	82.40	113.60
Yoghurt (litres)	20.70	10.10	17.90	36.80
Butter (kg)	23.60	15.70	22.10	34.70
Cheese (kg)	1.20	0.71	0.89	2.50
Total domestic products (kg LME)	261.40	177.70	239.70	383.70
Imported and derived dairy products				
Evaporated milk (litres)	13.60	6.80	14.40	19.00
Powdered milk (kg)	2.60	1.40	2.60	3.60
Packaged liquid milk (litres)	2.10	1.00	1.20	5.10
Baby formulae (kg)	2.70	1.00	2.40	5.10
Yoghurt (litres)	5.10	2.90	4.70	8.00
Table butter (kg)	0.50	0.20	0.40	0.85
Cheese (kg)	0.04	0.07	0.01	0.05
Total imported products (kg LME)	70.50	34.80	69.20	109.70
Grand total (kg LME)	331.90	212.50	308.90	493.40
kg LME per person	47.30	39.20	45.40	54.20

1. Includes both consuming and non-consuming households.

FAO conversion factors were used (FAO, 1978). The correlation between total dairy consumption (measured in LME) and declared income was positive and highly significant (r= 0.29, P< 0.0001).

Although there is little difference in consumption of domestic dairy products between urban and rural households, total dairy consumption in the average urban household exceeds that in the average rural households by about 20% because urban households consume nearly twice as much imported products as do rural households (Table 8). Consumption of sour milk by rural households exceeds that of urban households by nearly 50%; the reverse is true for fresh milk. Perhaps somewhat surprisingly, consumption of local butter and local

Table 8. *Weekly quantities of dairy products consumed per household[1] and per cent of households consuming in rural and urban areas.*

	Rural				Urban			
	Income group[2]				Income group[2]			
Commodity	S	L	M	H	S	L	M	H
Domestically produced dairy products								
Fresh milk (litres)	16.4	11.5	16.7	20.5	24.6	15.0	26.2	31.2
	(27)	(30)	(24)	(31)	(36)	(30)	(35)	(40)
Sour milk (litres)	94.4	72.0	88.1	29.2	66.7	51.0	64.2	87.8
	(82)	(80)	(84)	(81)	(74)	(84)	(74)	(69)
Yoghurt (litres)	20.8	10.1	15.7	41.7	19.7	10.5	25.6	16.9
	(33)	(29)	(29)	(54)	(31)	(14)	(33)	(36)
Butter (kg)	23.5	13.9	22.5	34.9	22.6	18.5	17.2	37.4
	(67)	(56)	(69)	(79)	(62)	(76)	(54)	(65)
Cheese (kg)	0.6	0.9	0.3	1.0	2.4	2.1	1.4	4.9
	(7)	(8)	(6)	(6)	(16)	(14)	(15)	(18)
Total domestic products (kg LME)	260.6	167.3	243.9	387.1	250.1	194.6	216.0	376.6
Imported and derived dairy products								
Evaporated milk	11.6	7.9	12.1	14.3	19.9	8.9	21.4	28.0
(litres)	(43)	(35)	(47)	(44)	(63)	(41)	(62)	(73)
Powdered milk	1.5	0.9	1.2	2.6	4.4	4.0	3.9	5.9
(kg)	(10)	(8)	(10)	(13)	(27)	(22)	(27)	(29)
Packaged liquid	0.6	0.7	0.8	0.3	5.2	1.3	4.4	10.7
milk (litres)	(6)	(9)	(4)	(6)	(12)	(8)	(11)	(16)
Baby formulae	1.6	0.5	1.6	2.6	4.6	1.2	5.4	6.4
(kg)	(11)	(10)	(11)	(16)	(23)	(8)	(22)	(29)
Yoghurt (litres)	3.4	2.6	2.9	5.2	8.7	7.6	8.7	9.7
	(25)	(25)	(24)	(27)	(50)	(30)	(47)	(61)
Table butter (kg)	0.4	0.0	0.4	0.5	0.5	0.6	0.3	0.9
	(4)	(6)	(3)	(6)	(9)	(5)	(7)	(13)
Cheese (kg)	0.004	0.0	0.01	0.0	0.002	0.0	0.0	0.01
	(5)	(7)	(4)	(5)	(8)	(5)	(7)	(10)
Total imported products (kg LME)	48.7	28.4	48.1	70.5	113.7	67.2	115.0	157.8
Grand total (kg LME)	309.3	195.7	292.0	457.6	363.8	261.8	331.0	534.4
N	483	121	241	121	243	61	122	60

1. Includes both consuming and non-consuming households.

2. S= whole sample; L= low income; M= medium income; H= high income.

Figures in brackets are percentages of households consuming.

yoghurt does not differ significantly between rural and urban consumers, although the influence of the level of income on quantities consumed seems to be larger for rural than for urban households. Consumption of powdered milk, packaged liquid milk, baby formulae and imported butter is largely confined to high-income city dwellers.

Table 9 reveals the sharp difference in consumption patterns between people originating from the north and those originating from the south. Whereas people from northern ethnic groups consume about twice as much traditional dairy products as people from southern ethnic groups, the reverse is true for imported products. The exceptions are fresh milk and traditional cheese (*wara*); fresh milk is consumed in about equal quantities by both northerners and southerners, whereas consumption of *wara* is largely confined to the Yorubas, who originate from the south. The share of locally produced products in total dairy consumption (expressed in LME) is much higher among northerners than among southerners. For example, imported products account for only 13% of dairy products consumed by low-income northerners, compared with over 40% for low-income southerners.

Structure of dairy product consumption

Domestically produced products account for over 80% of total dairy consumption, with little variation between income groups. Shares of individual products do not differ dramatically across income groups, although the share of traditional yoghurt (*kindirmo*, a whole milk product) seems to increase with rising income, at the expense of sour milk (*nono*).

Evaporated milk and powdered milk together account for about half of total consumption of imported and derived products. However, their share declines with rising income, indicating that the remaining products (i.e. packaged liquid milk, baby formulae, yoghurt, table butter and cheese) are luxury goods. In addition, with rising income consumers tend to substitute powdered milk for evaporated milk.

Table 10 summarises dairy consumption patterns in the sample households. Average per caput consumption of dairy products in and around Kaduna is over twice the average level for sub-Saharan Africa (about 22 kg per head).

Even low-income consumers consume far more dairy products than their counterparts elsewhere in Africa. For example, average yearly consumption of dairy products among low-income consumers in Bamako, Mali, was only 6.4 kg per head (ILCA, Addis Ababa, Ethiopia, unpublished data), against nearly 40 kg in the Kaduna area in Nigeria, despite an average monthly income level for low-income households in Bamako of over 2.5 times that of low-income households in Kaduna (US$78 vs US$30). Dairy product expenditure accounted for an average of about 10% of total expenditure on food items by the Kaduna

Table 9. *Yearly quantities of dairy products consumed per household[1] and percentage of households consuming, by aggregated ethnic group.*

Commodity	Northerners				Southerners			
	Income group[2]				Income group[2]			
	S	L	M	H	S	L	M	H
Domestically produced dairy products								
Fresh milk (litres)	18.8	12.8	18.3	25.8	20.4	17.8	16.9	29.8
	(32)	(31)	(29)	(39)	(22)	(18)	(19)	(27)
Sour milk (litres)	94.8	72.1	87.0	133.1	38.8	34.4	39.8	41.0
	(85)	(84)	(87)	(83)	(52)	(53)	(52)	(52)
Yoghurt (litres)	23.5	9.0	21.4	42.1	6.2	7.1	5.7	6.4
	(35)	(26)	(32)	(54)	(20)	(24)	(21)	(17)
Butter (kg)	25.7	15.8	24.4	38.5	10.3	8.0	7.6	18.0
	(71)	(60)	(71)	(84)	(39)	(59)	(30)	(38)
Cheese (kg)	0.5	0.7	0.3	0.8	4.4	3.7	2.5	9.1
	(7)	(7)	(7)	(6)	(24)	(24)	(22)	(29)
Total domestic products (kg LME)	280.7	179.5	262.4	417.9	139.3	116.5	110.4	219.8
Imported and derived dairy products								
Evaporated milk (litres)	12.3	7.0	12.2	17.8	24.4	13.8	21.5	40.8
	(45)	(34)	(48)	(53)	(72)	(53)	(73)	(77)
Powdered milk (kg)	2.2	1.1	1.8	3.9	3.8	4.7	2.2	6.1
	(14)	(10)	(14)	(19)	(24)	(24)	(21)	(27)
Packaged liquid milk (litres)	1.1	0.6	0.7	2.4	6.9	2.8	3.4	17.9
	(7)	(9)	(6)	(9)	(12)	(6)	(10)	(17)
Baby formulae (kg)	2.5	0.2	2.4	4.8	3.4	1.4	3.9	4.4
	(14)	(9)	(14)	(22)	(19)	(12)	(16)	(25)
Yoghurt (litres)	4.5	2.8	4.1	7.2	7.5	3.5	7.5	11.5
	(30)	(22)	(29)	(40)	(47)	(29)	(44)	(56)
Table butter (kg)	0.07	0.0	0.04	0.2	1.9	1.2	1.6	3.4
	(5)	(5)	(5)	(5)	(10)	(6)	(2)	(23)
Cheese (kg)	0.001	0.0	0.0	0.002	0.02	0.04	0.01	0.01
	(6)	(6)	(6)	(6)	(7)	(12)	(2)	(13)
Total imported products (kg LME)	59.4	26.6	55.3	100.6	122.1	84.2	100.8	202.4
Grand total (kg LME)	340.1	206.1	317.7	518.5	261.4	200.7	211.2	422.2
N	601	150	301	150	132	33	66	33

1. Includes both consuming and non-consuming households.

2. S= whole sample; L= low income; M= medium income; H= high income.

Figures in brackets are percentages of households consuming.

Table 10. *Pattern and levels of dairy product consumption.*

Parameter	Whole sample	Low	Medium	High
		Income category		
Dairy consumption pattern				
% of households that regularly consumed	82	73	82	89
Consumption/head per year (kg LME)	47.3	39.2	45.4	54.2
Dairy product expenditures				
Dairy share of household food items budget (%)	9.0	7.0	10.3	8.3

sample. Assuming that about half of the average household's income is spent on food, the comparable figure for Bamako households is about 5%.

Factors influencing the demand for dairy products

The analysis in the previous sections suggests that both economic and non-economic factors are potentially important in explaining the demand for dairy products. In addition to socio-demographic factors such as ethnic origin, geographical location and family size and composition, economic factors such as incomes and prices may also affect dairy product demand. Regarding prices, cross-sectional price variation, in principle, allows calculation of own-price as well as cross-price elasticities. As far as prices in our data-set are concerned, however, there are three problems which *de facto* preclude the calculation of price elasticities. First, most of the price information in the data-set did not refer to standard (known) quantities and as such could not be used to construct separate price variables. Second, very little indication of price variation can be obtained from a single-visit type survey such as ours. Third, the period during which the survey was carried out was one of regulated foreign exchange control and very rapid inflation.

We used per caput expenditure as the dependent variable in our demand-type regression models. The independent variables included income per caput, family structure, geographical location, ethnic origin and level of education.

A double-log functional form was used allowing the estimated coefficients to be readily interpreted as elasticities. The problem of zero values for both dependent and independent variables was recognised and one was added to all numbers. The presence of large percentages of households with zero consumption for individual dairy products tends to give biased ordinary least-squares (OLS)

estimates. However, software for applying Tobit analysis was not available and time was too limiting for its application in the present paper. Therefore, the following log–linear consumption function was used to analyse product-specific demands for dairy products in and around Kaduna:

$$\ln(EXP_{ih}) = (INT_i) + b_1 * \ln(INC_h) + b_2 * \ln(CHILD_h) + b_3 * \ln(ADULT_h) + b_4 * \ln(DUM1_h) + b_5 * \ln(DUM2_h) + b_6 * \ln(DUM3_h) + e_{ih}$$

where:

EXP_{ih} is per caput yearly expenditure on dairy product i in household h expressed in Naira;

INT_i is an intercept term of dairy product i over all households;

INC_h is per caput yearly income in household h expressed in units of 100 Naira; $CHILD_h$ is the number of people in household h between 0 and 6 years of age;

$ADULT_h$ is the number of people in household h over 6 years of age;

$DUM1_h$ is a dummy variable for geographical location (O= rural, 1= urban);

$DUM2_h$ is a dummy variable for ethnic origin (0= northerner, 1= southerner);

$DUM3_h$ is a dummy variable for educational level of the household head (0= primary or less, 1= secondary or above);

e_{ih} is an error term.

Tables 11 and 12 present the regression results. Table 11 includes both consumers and non-consumers whereas the results in Table 12 are based on subsamples of non-zero consumers only. The model results in Table 12 are biased estimates for predicting aggregate consumption. F-values were all significant at the 1% level or better. The numbers of observations in Table 11 were all in the range 726–732. Although the explanatory power of the regression models based on the total sample is fairly limited (making comparisons of the relative magnitude of the individual regression coefficients problematic), the regressions' results are in line with the results of the descriptive statistical analysis of the previous sections. The relatively large and significant intercepts of the models in Table 12 point to the limitations of the survey data in that they prevent development of adequately specified regression models. A collinearity check on the data revealed that the relatively better educated people tend to live in urban areas and tend to be of southern ethnic origin. Also, per caput income is negatively correlated with the number of adults and children in a household. The magnitude of the correlation coefficients presented no cause for alarm, however.

Domestically produced dairy products such as fresh and sour milk, yoghurt and butter are consumed mainly by northerners with above- average per caput

Table 11. *Factors influencing the demand for dairy products in and around Kaduna, Nigeria, all income groups (double-log regressions, including both consumers and non-consumers).*

Dependent variable[1]	INT	INC	CHILD	ADULT	DUM1	DUM2	DUM3	$\overline{R}^2$
Locally produced products								
Fresh milk	0.55	0.17	-0.20	0.01	0.37	-0.76	0.41	0.03
	(0.36)	(0.09)	(0.10)	(0.12)	(0.19)	(0.24)	(0.22)	
Sour milk	2.93	0.21	-0.04	-0.33	-0.27	-1.66	-0.34	0.11
	(0.36)	(0.09)	(0.10)	(0.12)	(0.19)	(0.24)	(0.22)	
Yoghurt	-0.15	0.44	0.13	0.08	-0.11	-0.91	-0.17	0.05
	(0.35)	(0.09)	(0.10)	(0.12)	(0.15)	(0.23)	(0.22)	
Butter	1.26	0.55	0.17	-0.07	-0.11	-1.79	-0.46	0.08
	(0.44)	(0.11)	(0.12)	(0.15)	(0.23)	(0.29)	(0.28)	
Cheese	0.01	0.004	-0.03	0.04	0.14	0.78	0.11	0.08
	(0.18)	(0.04)	(0.05)	(0.06)	(0.10)	(0.12)	(0.11)	
Imported/derived products								
Evaporated milk	0.50	0.62	-0.07	-0.27	0.50	0.81	1.04	0.19
	(0.43)	(0.11)	(0.12)	(0.15)	(0.22)	(0.28)	(0.26)	
Powdered milk	-0.30	0.24	-0.004	0.006	0.68	0.10	0.90	0.09
	(0.35)	(0.09)	(0.10)	(0.12)	(0.18)	(0.23)	(0.22)	
Packaged milk	-0.04	0.04	0.06	0.03	0.17	0.21	0.25	0.03
	(0.18)	(0.05)	(0.05)	(0.06)	(0.10)	(0.12)	(0.11)	
Baby formulae	-0.63	0.11	0.49	0.18	0.59	0.19	0.37	0.07
	(0.33)	(0.08)	(0.09)	(0.11)	(0.17)	(0.22)	(0.21)	
Yoghurt	0.66	0.35	-0.17	-0.38	0.97	-0.09	0.64	0.16
	(0.35)	(0.09)	(0.10)	(0.12)	(0.18)	(0.23)	(0.22)	
Table butter	-0.10	0.04	-0.02	0.03	0.006	0.29	0.07	0.02
	(0.13)	(0.03)	(0.04)	(0.04)	(0.07)	(0.08)	(0.08)	
Mean	–	13.33	1.64	5.11	0.34	0.18	0.23	
CV	–	1.46	1.03	0.66	1.39	2.14	1.78	

The explanatory variables span columns INT, INC, CHILD, ADULT, DUM1, DUM2, DUM3.

1. Annual per caput expenditure in Naira.

Figures in brackets are estimated standard errors.

income. Per caput consumption is higher in small families. The income elasticities for locally produced dairy products are generally less than 0.5. The positive and significant regression coefficient for ethnic origin in the case of local cheese in the model based on the full sample reflects the fact that consumption of local cheese is largely limited to the Yoruba ethnic group. Per caput

Table 12. *Factors influencing the demand for dairy products in and around Kaduna, Nigeria, all income groups (double-log regressions, excluding non-consumers).*

Dependent variable[1]	INT	INC	CHILD	ADULT	DUM1	DUM2	DUM3	N	$\overline{R}^2$
			Explanatory variables						
Locally produced products									
Fresh milk	4.15	0.18	-0.16	-0.57	-0.16	-0.02	0.49	177	0.30
	(0.35)	(0.09)	(0.10)	(0.12)	(0.17)	(0.24)	(0.20)		
Sour milk	3.30	0.38	-0.10	-0.43	-0.34	-0.38	0.10	558	0.23
	(0.25)	(0.06)	(0.07)	(0.08)	(0.13)	(0.18)	(0.15)		
Yoghurt	4.02	0.25	0.27	-0.63	-0.10	-0.57	0.31	201	0.35
	(0.36)	(0.09)	(0.10)	(0.12)	(0.18)	(0.28)	(0.22)		
Butter	3.85	0.38	0.14	-0.37	-0.31	0.40	0.11	458	0.29
	(0.22)	(0.05)	(0.06)	(0.07)	(0.11)	(0.17)	(0.14)		
Cheese	4.93	0.25	-0.31	0.99	0.02	-0.50	-0.38	44	0.19
	(1.67)	(0.36)	(0.41)	(0.47)	(0.63)	(0.65)	(0.56)		
Imported/derived products									
Evaporated milk	4.48	0.26	-0.31	-0.79	0.02	0.01	0.41	343	0.37
	(0.30)	(0.08)	(0.09)	(0.10)	(0.15)	(0.17)	(0.17)		
Powdered milk	6.71	0.05	-0.51	-1.03	-0.11	0.07	0.04	87	0.66
	(0.36)	(0.08)	(0.12)	(0.12)	(0.19)	(0.21)	(0.19)		
Packaged milk	3.76	0.11	0.20	-0.57	0.17	0.73	1.20	29	0.25
	(1.04)	(0.23)	(0.33)	(0.35)	(0.72)	(0.71)	(0.51)		
Baby formulae	5.97	0.08	-0.19	-0.76	0.02	0.28	0.01	82	0.27
	(0.48)	(0.12)	(0.16)	(0.16)	(0.24)	(0.27)	(0.24)		
Yoghurt	4.47	0.23	-0.42	-0.90	-0.01	-0.003	0.08	216	0.50
	(0.34)	(0.09)	(0.10)	(0.11)	(0.16)	(0.19)	(0.17)		
Table butter[2]									

1. Annual per caput expenditure in Naira.

2. The regression model for table butter had only 12 observations and produced a negative $\overline{R}^2$.

Figures in brackets are estimated standard errors.

consumption of evaporated milk is significantly associated with the educational level of the household head and per caput income, and is larger in relatively small urban households of southern ethnic origin. Similarly, the results for powdered milk point to the influence of income, geographical location and educational

level; consumers of powdered milk tend to be urban-based, relatively well-educated people with above-average incomes.

Expenditure on baby formulae increases as the number of older children increases and is greater in urban households than in rural households. The number of adults per household is also relatively important in that larger and more mature families tend to have higher incomes. Consumption of yoghurt is largely a function of per caput income and geographical location and is higher in relatively small households.

In the case of table butter, with the exception of the dummy variables for ethnic origin and educational level, the estimated regression coefficients for the explanatory variables included in the full-sample model are not significantly different from zero. Although consumption of table butter is certainly limited to high-income consumers, the explanatory power of the corresponding regression equation is very limited.

In addition to the regressions reported in Tables 11 and 12, two other regressions were run (one linear and one log–linear) with the same independent variables but with the total quantity of dairy products consumed (expressed in kg LME) as the dependent variable, with the following results (standard errors in brackets; COR refers to the Pearson correlation coefficient between actual and predicted values):

Linear: $LME = 69.52 - 4.36*CHILD - 4.29*ADULT + 1.30*INC$
              (6.66)   (1.74)   (0.87)   (0.16)

$- 1.70*DUM1 - 24.54*DUM2 + 20.74*DUM3$
(6.28)   (7.97)   (7.39)

$N = 732; \overline{R}^2 = 0.20; F = 30.8; COR = 0.45$

Log–linear: $\ln(LME) = 2.81 - 0.34*\ln(CHILD) - 0.99*\ln(ADULT) + 0.50*\ln(INC)$
                  (0.25) (0.07)   (0.09)   (0.06)

$+ 0.10*\ln(DUM1) - 0.82*(DUM2) + 0.22*\ln(DUM3)$
(0.13)   (0.16)   (0.15)

$N = 732; \overline{R}^2 = 0.42; F = 90.5; COR = 0.65$

Aside from the relatively large and significant intercepts, the results of the two LME models draw attention to per caput income as an important determinant of total quantity of dairy products consumed per person, with people of southern ethnic origin consuming significantly less than people of northern origin. Income elasticities of aggregate LME consumption based on the linear and log–linear model came to 0.30 and 0.50, respectively, both suggesting an income inelastic demand. Larger families consume less dairy products per family member. The

linear regression result also suggests that education has a strong positive effect on consumption of dairy products, a result that is in contrast with that of the log–linear model, which shows no significant association with education.

Consumers' preferences for dairy products

Consumer preferences were elicited by asking them to indicate one preferred product out of each of three different groups of dairy products: milk-type products, butter-like products and dairy snacks. They were also asked the reasons underlying their expressed preferences.

Sour milk is by far the most preferred milk-type product, followed by evaporated milk, fresh milk and local butter or traditional cheese. The reasons given by children and adults for their preferences were very similar. Perceived nutritional value, taste and familiarity (in that order) were the most frequently reported reasons for the expressed preference; the absence of significant differences between children and adults suggests some problems in eliciting correct responses from children.

When presented with the choice between local butter, imported butter and margarine, an overwhelming majority of the respondents expressed a clear preference for local butter. Although imported butter seems to be almost unknown, price differences could have influenced the response in that it is not clear from the survey data whether respondents preferred local butter to imported butter as such, or local butter at lower prices to imported butter at higher prices.

Yoghurt is by far the most preferred dairy snack, followed by ice-cream, which is especially popular among children. Familiarity with European-type cheeses is low. Again the same four factors are of overriding importance in determining consumers' preferences for a particular product—taste, perceived nutritional value, custom and hygiene-related considerations—although a response by children that they consume ice-cream for nutritional reasons again points to problems in eliciting correct responses.

Policy implications

The most important message for policy-makers from the preceding analysis of dairy consumption patterns in and around Kaduna is that there is a strong demand for traditional dairy products such as milk, yoghurt and butter. Besides price-related factors, the widespread preference for local products is based on taste, perceived nutritional value and custom. Although the view that dairy development programs should primarily focus on traditional dairy producers (i.e. on existing settled and semi-settled herd owners) is not new, it has been neglected in the past. Large segments of the population have either decreased or stopped consumption of imported milk products because of the greatly

increased costs after the repeated devaluations of the Naira. In view of the rather widespread prevalence of the enzootic diseases, brucellosis and tuberculosis in Nigerian cattle, the basic challenge facing the country's dairy industry is to raise the standards of hygiene and presentation to satisfy what could be a much higher demand for local dairy products.

Increased emphasis on the development of peri-urban small-scale dairy farming is called for. However, smallholder dairy production and processing near urban areas currently are not very well developed in Nigeria. There is a need for production and processing close to the point of sale in order to minimise costs of marketing, particularly packaging, storage and transportation. Large-scale dairy plants have largely failed in Nigeria mainly because of high operational costs.

Given the relatively low cattle population and high human populations in Nigeria, most milk can be sold locally but this requires an efficient way of handling small volumes of milk. No one area of Nigeria has a marked comparative advantage in dairy production, providing an opportunity for minimising the distance between producer and consumer. Although from an individual entrepreneur's point of view the need to minimise transportation costs might not be too urgent due to the extremely high subsidy on petrol (priced at US$ 0.07 per litre), the economic or shadow price of transport is quite substantial given its high foreign-exchange component. There are indications that the Government would like to reduce the fuel subsidy at an appropriate time.

Localised production based on many small-scale producers is most likely to be successful if it is based on local breeds of cattle and existing adapted production systems.

References

FAO (Food and Agriculture Organization of the United Nations). 1978. *Milk and milk products: Supply, demand and trade projections 1985.* FAO Commodity Projections 1985. FAO, Rome, Italy.

Nwoko S G. 1986. *The development of dairy imports in Nigeria.* LPU Working Paper 10. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 70 pp.

Waters-Bayer A. 1985. *Dairying by settled Fulani women in central Nigeria and some implications for dairy development.* ODI Pastoral Development Network Paper 20c. Overseas Development Institute, London, UK. 24 pp.

Waters-Bayer A. 1986. Dairy subsector of the agropastoral household economy. In: von Kaufmann R, Chater S and Blench R (eds), *Livestock systems research in Nigeria's subhumid zone.* Proceedings of the Second ILCA/NAPRI Symposium held in Kaduna, Nigeria, 29 October–2 November 1984. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 414–426.

Waters-Bayer A. 1987. *Dairying by settled Fulani agropastoralists in central Nigeria.* PhD thesis, Department of Agriculture, University of Hohenheim, Stuttgart, Germany.

Discussion

The discussant, Akinwumi, felt that some of the author's conclusions were too sweeping and mentioned as an example that the findings to local milk consumption in Kaduna should not be generalised to northern Nigeria as a whole. Jansen argued that his survey results for Kaduna could carefully be generalised for the north if adequate weight was given to ethnic composition. Methodological issues arising from the study were discussed and related mainly to the inadequacy of the one-shot cross-sectional or longitudinal survey in capturing seasonal and other variations in consumption over time; model misspecification; reasons for non-consumption of milk and the treatment of non-consumers in the analysis. Jansen stated that he had not been involved in the survey design and said it was unfortunate that reasons for non-consumption were not elicited to draw a fuller picture of the milk-consumption situation. He further indicated that, given the data-set that was available to him and the fact that he was unsure of it, he opted for a linear function. The relative proportion of non-consumers in the survey was found to be low for such items as sour milk/local butter but high for such items as imported cheese and powder milk, and both consumers and non-consumers in the sample were included in the regression analysis. Jansen disagreed with Akinwumi's view that his demand function ran into problems of low explanatory power because of the exclusion of the price variable and of misspecification, which was partly reflected in the improvement of the $\overline{R}^2$ as the dependent variable was changed into liquid milk equivalents.

It was recommended that another study be carried out to investigate the added costs of specific types of milk containers or packaging materials, which represented as much as 30 to 40% of the final consumer prices of some dairy products and were important for purchases by low- and medium-income families. The paper was revised in light of the discussion and subsequent review..

Dairy consumption patterns in southern Nigeria

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Abstract

A survey was conducted of 982 indigene households and 203 Hausa/Fulani households in southern Nigeria between October 1988 and March 1989. Results show that 70% of the indigenes and 98% of the Hausa/Fulani consumed some dairy products. Prevalence and regularity of consumption of local products among the indigenes was high around the points of production but low elsewhere, while the regularity of consumption for imported products was high among both indigenes and the Hausa/Fulani. The type and quantity of products consumed and expenditure on dairy products differed markedly among ethnic groups, urban and rural populations and between the south-west and the south-east. Per caput income of indigenous households that consumed dairy products did not differ significantly in any of the locations from that of indigenous households that did not consume dairy products. Among the consumers, income elasticity of demand was higher for rural households in the south-west and for urban households in the south-east, and was higher for urban Hausa than rural Fulani, who are producers of dairy products.

Introduction

The indigenous Yoruba and Ibo populations living, respectively, in the south-west (SW) and south-east (SE) of Nigeria traditionally did not produce or consume milk. Cattle rearing in the humid southern environment was impossible due to the prevalence of trypanosomiasis, a disease transmitted by the tsetse fly.

The small number of trypanotolerant cattle reared in the area were not of milk breeds. However, in recent times, with increased population pressure, jungle

clearance, crop cultivation and tsetse-control measures, the degree of tsetse challenge has been reduced. Consequently there has been an influx of transhumant and semi-settled Fulani cattle rearers into the region and some domestic dairy products have become available to and accepted by the local people. A taste has also developed for various foreign dairy products which have become available either through food aid or imports.

Since the 1940s, an increasing proportion of the dairy products consumed has been imported. Much of the imported dairy products has been consumed in the urban areas of the south (Nwoko, 1986). During the oil-boom years, consumption of dairy products increased but domestic dairy production suffered from government policies promoting cheap imports. After the rapid devaluation of the Naira in the early 1980s, dairy products have become dearer and import levels have declined.

The effects of these changes on dairy consumption and on the domestic dairy production sector are not clearly known. A survey was conducted between October 1988 and March 1989 in southern Nigeria to determine the dairy consumption patterns of various segments of the population and the factors shaping these patterns. The objectives were to help predict future demand, particularly for domestic products, and to help devise production and marketing strategies to develop the domestic dairy sector.

Sampling and data collection

A non-probability sample of 1185 households were interviewed in Oyo State in the SW and in Anambra and Imo States in the SE. A three-stage sampling procedure was followed. Two urban centres were chosen purposively from each region: Ibadan and Oyo in the SW and Enugu and Umuahia in the SE. Several Local Government Areas around each selected urban centre were then chosen at random from which to sample rural populations. The majority of the population of the study area is indigenous but a few northern Hausa live in some urban enclaves and some Fulani live in the rural areas. The indigenes and the Hausa/Fulani were sampled separately because of the differences in their population sizes, settlement patterns and history of dairy consumption. Households were selected at random from each of the urban centres and Local Government Areas. A few Hausa/Fulani were selected along with the random sample of indigenes but they were later combined with the main Hausa/Fulani samples for analysis.

The distribution of the sample is shown in Table 1. It should be emphasised that, in the absence of full population lists, the size of sample for each location/ethnic group may not represent the true weight of its population. Preliminary analysis revealed no major difference between the Enugu and Umuahia samples, so they

Table 1. *Distribution of sample households according to location, ethnic origin and religion, Nigeria, 1988–89.*

Ethnic origin and location		Total sample	Per cent of sample households by location			
			Ethnic group		Religious group	
			Yoruba	Ibo	Muslim	Christian
Indigenes						
Ibadan	Urban	248	81.0	19.0	36.7	63.3
	Rural	119	100.0	–	78.2	21.8
Oyo	Urban	162	99.3	0.7	80.9	19.1
	Rural	118	100.0	–	57.7	42.3
South-east	Urban	163	–	100.0	1.8	98.2
	Rural	172	–	100.0	1.8	98.2
All locations		982	61.0	39.0	39.6	60.4
Hausa/Fulani[1]						
Ibadan	Urban	64	–	–	100.0	–
Oyo	Rural	81	–	–	100.0	–
South-east	Urban	33	–	–	100.0	–
	Rural	25	–	–	100.0	–
All locations		203	–	–	100.0	–

1. With few exceptions, urban dwellers are Hausa while rural dwellers are Fulani.

were combined into one SE unit but the ethnic and rural/urban divisions for that unit remained.

The major sampling units revealed specific ethnoreligious characteristics. Among the indigenes, the great majority in the SW were Yoruba and all the households sampled in the SE were Ibo. Nearly all the SE sample households and a majority of the Ibadan urban sample households were Christian but the majority of the Ibadan rural and Oyo samples were Muslim. All the Hausa/Fulani households were Muslim. Generally, religion did not appear to influence dairy consumption.

A detailed pre-tested questionnaire was used for data collection. The questionnaire was prepared in English and translated into Yoruba, Igbo and Hausa/Fulfulde languages, and the enumerators put the questions in those languages whenever needed.

Data were collected on family composition and income, how often each household consumed various dairy products, how much they consumed during the week before the interview, from where they obtained dairy products, the form

in which they were used and their prices. Data on monthly expenditure on different food items and ownership of selected assets including cattle were also collected.

Two major problems were encountered during data collection. First, imported and reconstituted dairy products were sold in standard packs or tins, so information on quantities and prices could be collected without much difficulty but there were no standard weights or measures for domestic dairy products and other food items. For example, *wara* (a soft cheese) was sold by the piece and the size of a piece varied between locations from about 40 g to over 100 g. Similarly dry food items were sold in *congos*, which are small enamel bowls or basins, but the size of a *congo* varied from one food item to another and from one location to another. In order to overcome this problem, quantities and prices reported by the respondents were recorded in local units; some sample measuring units and goods were purchased from each location and used to standardise quantities and prices. Obviously, it was difficult to maintain high standards of accuracy.

The second major problem was with respect to price. In single-visit cross-section surveys price is not expected to vary significantly. Because of the large geographical spread of the sample units and shortage of supervisory staff, field work had to be staggered between October 1988 and March 1989. Interviews were conducted in Ibadan from mid-October to mid-November 1988, in Oyo from mid-November to the end of December 1988 and in the SE during February and March 1989. This turned out to be a period of rapid fall in the value of the Naira, the Nigerian currency, and a consequent rise in commodity prices. As a result, unit prices of dairy products varied widely between sample locations and were considerably higher in the SE than in the SW. Since incomes in periods of rapid inflation are unlikely to keep pace with price increases, consumption of and expenditure on dairy products might have been affected by price increases. However, because the price variations were both spatial and temporal, it was possible to estimate the effect of price on consumption.

Results and discussion

Two major groups of products were considered: domestic products, which included fresh milk, sour milk (*nono*), yoghurt (*kindirmo*), butter (*manshanu*) and *wara* (a soft cheese); and imported and import-based products, which included evaporated and condensed milk, powdered milk, baby milk, Ultra-Heat Treated (UHT) milk, yoghurt, ice-cream, butter and cheese.

Prevalence, amount and regularity of consumption of dairy products, product combinations, form of use, major consumers and expenditure on dairy products were examined to assess consumption patterns in the different locations and ethnic groups. Income– consumption relationships were estimated.

Consumption prevalence

Consumption prevalence was defined as the proportion of households consuming a specific dairy product and was determined by asking respondents if they consumed various dairy products. Responses aggregated for local and imported products are summarised in Table 2. About one-third of Ibadan rural indigenes, a vast majority of indigenes in other locations and almost all Hausa/Fulani households consumed some dairy products. In the SE, none of the indigenes consumed any local product and none of the rural Hausa/Fulani consumed any imported product. Among the SW indigenes, consumption prevalence, particularly of local products, was very high in both urban and rural Oyo, where Fulani cattle rearers live and produce milk.

The most widely used local product among the indigenes was *wara*, followed distantly by fresh milk. The most widely used imported product was evaporated milk, followed by powdered milk, yoghurt and ice-cream (Table 3). Few rural Fulani in Oyo consumed local yoghurt and sour milk, while Fulani and Hausa in the SE generally consumed these products but few there consumed *wara* (Table 4). Fewer urban Hausa households consumed local products than did rural Fulani households, most probably due to lack of access to local products.

Table 2. *Proportion of households consuming dairy products, by ethnic origin and location, Nigeria, 1988–89.*

Ethnic origin and location		Households consuming dairy products (%)		
		Local product	Imported product	Local and/or imported
Indigenes				
Ibadan	Urban	36.3	77.8	81.0
	Rural	7.6	32.8	32.8
Oyo	Urban	64.2	65.4	78.4
	Rural	76.3	66.1	86.4
South-east	Urban	–	74.8	74.8
	Rural	–	58.1	58.1
All locations		29.8	65.0	70.4
Hausa/Fulani				
Ibadan	Urban	93.8	90.6	98.4
Oyo	Rural	96.3	11.1	96.3
South-east	Urban	81.8	66.7	97.0
	Rural	100.0	–	100.0
All locations		93.6	43.8	97.5

Table 3. *Proportion of indigenous households consuming various dairy products, by location, Nigeria, 1988–89.*

| | Households consuming (%) | | | | | | |
| | Ibadan | | Oyo | | South-east | | |
Product	Urban	Rural	Urban	Rural	Urban	Rural	All locations
Local products							
Fresh milk	8.9	14.3	19.1	16.9	–	–	9.2
Sour milk	1.2	–	5.6	2.5	–	–	1.5
Yoghurt	0.4	–	–	–	–	–	0.1
Butter	3.2	0.8	1.8	–	–	–	1.2
Wara	62.1	82.4	94.4	94.9	–	–	52.6
Imported products							
Evaporated milk	89.5	99.2	84.6	86.4	74.9	68.6	83.4
Powdered milk	52.4	51.2	31.5	25.4	38.6	19.2	37.5
Baby milk	14.1	17.6	6.2	7.6	11.0	9.3	11.1
Liquid milk	4.4	0.8	–	1.7	1.2	0.6	1.7
Yoghurt	53.2	21.0	28.4	10.2	1.8	0.6	22.3
Ice-cream	59.3	35.3	47.5	18.6	36.2	18.6	38.6
Butter	6.8	5.9	8.6	1.7	3.1	2.2	5.0

Consumption of imported products was more common among urban than rural households, particularly in Ibadan.

The differing consumption patterns of indigenes in the SW and SE may be partly explained by the fact that indigenes in the SW came into contact with Fulani cattle rearers and developed a dairy-consumption habit much earlier than their counterparts in the SE. The difference in consumption prevalence between rural Fulani in the two regions may be partly explained by the fact that the Fulani in the SW were more permanently settled and grew some crops. They thus had a more diversified dietary habit than those in the SE and also could exchange milk products for other products at favourable terms.

Regularity of consumption

Those who reported consuming dairy products were asked about the frequency of consumption. Those who reported consuming dairy products at least once a week were considered regular consumers. Very few indigenes consumed local products regularly (except in the case of *wara* in Oyo) but a larger proportion regularly consumed imported products, particularly evaporated milk (Table 5). A

Table 4. *Proportion of Hausa and Fulani households consuming various dairy products, by location, Nigeria, 1988–89.*

Product	Ibadan urban	Oyo rural	South-east Urban	South-east Rural	All locations
Local products					
Fresh milk	75.0	97.5	75.8	100.0	87.2
Sour milk	42.2	6.2	75.8	100.0	40.4
Yoghurt	32.8	1.2	75.8	100.0	35.5
Butter	89.1	65.4	81.8	100.0	79.8
Wara	57.8	98.8	6.1	–	58.6
Imported products					
Evaporated milk	87.5	27.2	66.7	–	49.3
Powdered milk	9.4	4.9	9.1	–	6.4
Baby milk	21.8	1.2	18.2	–	10.3
Liquid milk	17.2	–	–	–	5.4
Yoghurt	65.6	8.6	3.0	–	24.6
Ice-cream	39.1	12.3	9.1	–	18.7
Butter	4.7	–	3.0	–	2.0

(The header "Households consuming (%)" spans all data columns; "South-east" spans the Urban and Rural columns.)

large proportion of Hausa/Fulani households regularly consumed both local and imported products (Table 6).

Product combinations and their sources

Most indigenous households in both the SW and the SE consumed only evaporated milk or evaporated and powdered milk (Table 7). Consumers of fresh milk drank it alone in over 90% of the cases; others used it with some food, e.g. bread. Over 90% of consumers of evaporated and powdered milk used them in tea, coffee and chocolate drinks; others used these with some food or drank them alone. Only in a few households were fresh, evaporated and powdered milk both drunk and used in coffee, tea and other drinks.

Almost all the yoghurt-consuming indigenes consumed imported yoghurt. Nearly all the yoghurt-consuming Hausa/Fulani in Oyo and the SE consumed local yoghurt. However, 55% of Hausa consumers in Ibadan consumed only imported yoghurt, 33% consumed both local and imported yoghurt and 12% consumed only local yoghurt.

Table 5. *Proportion of indigenous households regularly consuming various dairy products, by location, Nigeria, 1988–89.*

Product	Households regularly consuming (%)						
	Ibadan		Oyo		South-east		
	Urban	Rural	Urban	Rural	Urban	Rural	All locations
Local products							
Fresh milk	2.8	0.8	1.9	5.9	–	–	1.8
Sour milk	0.4	–	0.6	0.9	–	–	0.3
Yoghurt	–	–	–	–	–	–	–
Butter	1.2	–	–	–	–	–	0.3
Wara	10.5	5.9	51.2	64.4	–	–	19.6
Imported products							
Evaporated milk	62.9	24.4	43.8	32.2	57.1	40.1	46.4
Powdered milk	29.8	3.4	9.9	6.8	19.0	9.3	15.2
Baby milk	10.5	6.7	6.2	7.6	9.8	6.4	8.1
Liquid milk	0.8	–	–	–	1.2	–	0.4
Yoghurt	18.1	0.8	9.3	0.9	–	–	6.3
Ice-cream	20.2	0.8	19.8	4.2	14.7	5.2	12.3
Butter	2.8	–	6.2	0.9	3.1	1.7	2.6

Among the small number of indigenous consumers of butter nearly all consumed only imported butter whereas nearly all Hausa/Fulani butter consumers consumed only local butter.

Among the cheese consumers in Ibadan, about 60% of the urban consumers and 82% of the rural consumers consumed both local and imported cheese. The rest consumed only imported cheese; none consumed only local cheese. In Oyo, nearly all cheese consumers consumed local cheese (*wara*).

Quantity consumed

Those who reported consuming dairy products were asked about the quantity of each product consumed during the week prior to the interview. Apart from regular (daily and/or weekly) consumers, a few irregular consumers also consumed dairy products during that week and these were included in the quantity estimation. As mentioned earlier, interviews were conducted in different locations at different times, so the reference week was not the same for all locations.

Table 6. *Proportion of Hausa and Fulani households regularly consuming various dairy products, by location, Nigeria, 1988–89.*

| Product | Households regularly consuming (%) | | | | |
| | Ibadan urban | Oyo rural | South-east | | All locations |
			Urban	Rural	
Local products					
Fresh milk	54.7	92.6	51.5	100.0	74.5
Sour milk	40.6	4.9	69.7	100.0	38.4
Yoghurt	14.1	–	66.7	100.0	27.7
Butter	75.0	46.9	75.8	100.0	67.0
Wara	37.5	93.8	6.1	–	50.2
Imported products					
Evaporated milk	84.4	7.4	63.6	–	39.9
Powdered milk	6.3	1.2	–	–	2.5
Baby milk	21.9	1.2	9.1	–	8.9
Liquid milk	14.1	–	–	–	4.4
Yoghurt	50.0	1.2	–	–	16.3
Ice-cream	23.4	1.2	3.0	–	8.4
Butter	3.1	–	3.0	–	1.5

Indigenous households consumed an average of 45 g of liquid milk equivalent (LME) per person daily, of which 14% was local products. Hausa/Fulani households consumed nearly 13 times as much (582 g/person daily), with 91% coming from local products. These figures are much higher than those reported by Senait Seyoum (1989) for urban and rural populations in West Africa (16 and 60 g LME/person per day, respectively).

Dairy-product prices

Tables 8 and 9 show prices of local and imported products, respectively. Prices were generally higher in the SE because data were collected there later in the survey period. The spatial price differences for each product therefore also reflect temporal price differences.

In the SW, prices of local products, particularly fresh milk and *wara*, were lowest in the area of production (Oyo rural) and highest farthest from the production area (Ibadan urban). Although no accurate processing costs were known for the various dairy products, such costs can be assumed to be very low given the rudimentary nature of the processing, which used only family labour with very

Table 7. *Distribution of households according to combination of fresh, evaporated and powdered milk consumed, by ethnic origin and location, Nigeria, 1988–89.*

Ethnic origin and location		None	FM	EM	FM+ EM	EM+ PM	FM+ EM + PM	Other combi- nations
Indigenes								
Ibadan	Urban	8.5	–	34.8	3.2	43.3	4.1	6.1
	Rural	–	–	45.4	3.4	38.7	10.9	1.6
Oyo	Urban	4.9	3.1	49.4	11.1	19.1	4.9	7.5
	Rural	11.1	1.7	53.0	8.6	18.0	6.0	1.6
SE	Urban	20.9	–	40.5	–	33.1	–	5.5
	Rural	27.9	–	52.3	–	15.7	–	4.1
All locations		12.7	0.7	44.7	4.1	29.2	3.9	4.7
Hausa/Fulani								
Ibadan	Urban	3.5	6.9	13.8	60.3	3.5	1.7	10.3
Oyo	Rural	–	72.8	1.2	21.0	1.2	3.7	0.1
SE	Urban	3.0	30.3	15.2	42.4	6.1	3.0	–
	Rural	–	100.0	–	–	–	–	–
All locations		1.5	49.8	7.1	33.5	2.5	2.5	3.1

FM= fresh milk (local or imported); EM= evaporated milk; PM= powdered milk.

Table 8. *Average prices paid/reported per kg of liquid milk equivalent (LME) of various local products, by ethnic origin and location, Nigeria, 1988–89.*

Ethnic origin and location		Price per kg LME (N)[1]				
		Fresh milk	Sour milk	Yoghurt	Butter	*Wara*
Indigenes						
Ibadan	Urban	2.20	1.13	0.96	1.17	3.68
	Rural	1.44	NA	NA	3.03	3.76
Oyo	Urban	1.39	1.23	NA	2.32	3.68
	Rural	1.30	1.13	NA	NA	3.44
SE	Urban	NA	NA	NA	NA	NA
	Rural	NA	NA	NA	NA	NA
Hausa/Fulani						
Ibadan	Urban	1.46	1.41	0.83	2.00	3.68
Oyo	Rural	1.37	2.09	0.77	2.75	2.80
SE	Urban	6.04	2.85	1.61	3.75	16.00[a]
	Rural	7.15	4.12	1.61	3.85	NA

a. Not produced locally, imported from another State.

1. Average exchange rate during Oct 1988–Sept 1989: US$ 1 = N 6.40.

NA= not applicable/available.

Table 9. *Average prices paid per kg of liquid milk equivalent (LME) for various imported dairy products, by ethnic origin and location, Nigeria, 1988–89.*

		Price per kg LME (N)[1]					
		Evaporated milk	Powdered milk	Baby milk	Liquid milk	Yoghurt	Butter
Indigenes							
Ibadan	Urban	4.45	3.14	4.80	5.69	4.94	2.53
	Rural	4.40	3.43	4.53	NA	4.81	2.30
Oyo	Urban	4.50	3.97	4.42	NA	5.45	5.22
	Rural	4.48	3.26	4.32	NA	3.61	1.82
SE	Urban	6.34	5.09	5.48	22.84	7.21	1.73
	Rural	6.33	4.53	5.17	NA	2.40	1.74
Hausa/Fulani							
Ibadan	Urban	4.36	3.25	4.27	4.81	6.32	3.03
Oyo	Urban	5.51	3.29	7.60	NA	4.81	NA
SE	Urban	7.94	NA	5.75	NA	2.40	0.73
	Rural	NA	NA	NA	NA	NA	NA

NA= not applicable/available.

1. Average exchange rate during Oct 1988–Sept 1989: US$ 1 = N 6.40.

low opportunity cost as an input. Assuming processing cost to be minor, processing milk into *wara* appeared to be highly profitable. Generally, local products were cheaper than imported products.

Income and dairy expenditure

Table 10 shows per caput monthly income, expenditure on dairy products and share of income spent on dairy products. Figures on income and share of income spent on dairy products should be interpreted with caution because the share of income spent on dairy products appears to be high, particularly for the Hausa/Fulani. For example, a household expenditure survey in Nigeria in 1980–81 found that urban households spent 50% of their income on food and 2.1% on dairy products (Federal Office of Statistics, 1983).

The income figures were based on the reports of respondents rather than on detailed estimates by sources of income. Estimated incomes were cross-checked with the value of assets owned by the households and with the general condition of the households, as ascertained by the enumerators. A high degree of correspondence was found on both criteria, indicating that the income estimates were consistent. However, the income might have been underestimated because the respondents probably did not report the income of their wife or wives and other women family members. Moreover, only cash

Table 10. *Average family size, per caput monthly income and expenditure on dairy products by ethnic origin and location, Nigeria, 1988–89.*

Ethnic origin and location		Average family size	Monthly income per caput (N)[1]	Monthly expenditure on dairy products	
				N[1]	%
Indigenes					
Ibadan	Urban	7.6	132.19	9.23	7.0
	Rural	7.6	95.37	2.67	2.8
Oyo	Urban	8.0	62.72	3.88	6.2
	Rural	7.2	58.94	3.32	5.6
SE	Urban	7.6	97.75	7.97	8.1
	Rural	8.4	70.57	3.54	5.0
All locations		7.8	90.96	5.64	6.2
Hausa/Fulani					
Ibadan	Urban	5.6	266.28	41.88	15.7
Oyo	Rural	6.9	85.59	13.45	15.6
SE	Urban	8.3	189.58	44.61	23.5
	Rural	10.5	233.50	200.98	85.9
All locations		7.2	177.68	50.57	28.5

1. Average exchange rate during Oct 1988–Sept 1989: US$ 1 = N 6.40.

income might have been reported in the rural areas. The income estimates for the Hausa/Fulani are likely to be less accurate because of lesser monetisation of their production and consumption activities. Thus, although there was consistency in the income estimates across the samples, the level might have been underestimated in some locations.

Dairy expenditure was a function of product mix, quantities consumed and prices per unit. The prices in the SE were higher, which might have inflated expenditure in those locations.

Income–consumption relationship

Among the indigenous households in each location there were a considerable number that did not consume any dairy products. Under such a situation Tobit analysis is generally considered the most appropriate technique for measuring income–consumption relationships. Tobit analysis gives the income elasticity of demand for a product for those currently consuming the product and also the elasticity of the probability of consuming that product with changes in income.

The latter is often referred to as the entry/exit elasticity (for mathematical formulation and derivation of the Tobit model see, for example, McDonald and Moffitt, 1980).

The separation of basic and entry/exit elasticities implicitly presupposes that the non-consuming households are at the bottom of the income ladder. With increased income, one may enter the consuming group and with decreased income, one may exit from the consuming group.

Average incomes of consuming and non-consuming households in each location were compared for evaporated milk, all local dairy products, all imported dairy products, all milk products and all dairy products. The results for all dairy products are shown in Table 11.

Table 11. *Per caput monthly income of consumers and non-consumers of dairy products, by ethnic origin and location, Nigeria, 1988–89.*

		Consumers		Non-consumers	
		No.	Per caput income (N)[1]	No.	Per caput income (N)[1]
Indigenes					
Ibadan	Urban	205	146.98	43	61.67
			(209.71)		(32.92)
	Rural	41	105.91	78	89.83
			(46.64)		(28.95)
Oyo	Urban	129	63.69	33	58.92
			(24.60)		(19.38)
	Rural	102	59.62	16	54.66
			(22.86)		(21.52)
South-east	Urban	124	106.85	39	68.82
			(92.36)		(29.24)
	Rural	105	76.48	67	61.33
			(37.52)		(32.13)
Hausa/Fulani					
Ibadan	Urban	63	268.60	1	120.00
			(206.02)		
Oyo	Rural	78	85.21	3	95.54
			(140.09)		(28.22)
South-east	Urban	32	187.69	1	250.00
			(131.08)		
	Rural	25	233.50	–	–
			(71.74)		

1. Average exchange rate during Oct 1988–Sept 1989: US$ 1 = N 6.40.

Figures in the parentheses are standard deviations.

Although average income was generally higher in all locations for consuming households than for non-consuming households, in no case did the incomes differ significantly between consumers and non-consumers, mainly because of the high standard deviation of income of the consuming households. Thus, income was not the primary determinant of whether or not a household consumed dairy products. Tobit analysis was thus considered to be not an appropriate technique for the sample under study. Instead, an equation of the following form was used to measure the effect of income on the dairy expenditure of only consuming households:

$$\text{Log } Y = \text{Log} A + b \log X + E$$

Where Y = total expenditure (Naira, N) on dairy products per person per month

X = per caput monthly income (N)

E = random disturbance term

The function was estimated separately for each ethnic group and location mainly because there were spatial price differences for different products but also in recognition of temporal price differences. Consequently, it would be difficult to separate the effects of income and prices on consumption expenditure from the aggregate sample. Location- and ethnic-group-specific equations were estimated on the assumption that intra-group price variation was minimal.

Estimated parameters and related statistics are shown in Table 12. It appears that, among the indigenes, income elasticities of demand were highest for the rural consumers in the SW and for the urban consumers in the SE. Among the Hausa/Fulani, elasticities were higher for the urban consumers, who are mostly purchasers, than for rural consumers, who are usually milk producers.

Summary and conclusions

A survey was conducted among 982 indigenous households and 203 Hausa/Fulani households in southern Nigeria between October 1988 and March 1989 to determine the dairy consumption patterns of various segments of the population and factors shaping these patterns. Results show that 70% of the indigenous households and 98% of the Hausa/Fulani households consumed some dairy products. Only 30% of the indigenes consumed local products while 44% of the Hausa/Fulani consumed imported products. The type of product consumed and frequency of consumption differed markedly between ethnic groups, between urban and rural populations and between the south-west and the south-east. Regularity of consumption was generally higher for imported products. However, local products were consumed regularly near the points of production, indicating that inadequate availability of products was a factor limiting consumption.

Table 12. *Estimated parameters and related statistics for dairy consumption functions, by ethnic group and location, Nigeria, 1988–89.*

Ethnic origin and location		Estimated parameters		R^2	F	No.	Prob-ability
		Constant	Income				
Indigenes							
Ibadan	Urban	0.75127	0.48252	0.12	13.72	204	0.001
		(0.9281)	(0.1310)				
	Rural	-4.20246	1.18055	0.08	3.56	40	0.060
		(2.8838)	(0.6254)				
Oyo	Urban	-0.70905	0.45008	0.09	3.38	128	0.070
		(1.004)	(0.2449)				
	Rural	-2.85574	0.89707	0.09	9.71	101	0.002
		(1.1621)	(0.2878)				
SE	Urban	-3.20486	1.05196	0.23	34.78	123	0.001
		(0.7980)	(0.1783)				
	Rural	0.45050	0.63871	0.15	9.17	104	0.001
		(1.6699)	(0.30737)				
Hausa/Fulani							
Ibadan	Urban	-1.05316	0.83211	0.42	43.89	62	0.001
		(0.6759)	(0.1256)				
	Rural	0.22157	0.52461	0.24	23.99	77	0.001
		(0.4400)	(0.1071)				
SE	Urban	-0.65839	0.77265	0.14	5.15	32	0.03
		(1.7330)	(0.3405)				
	Rural	4.77557	0.43080	0.48	10.34	24	0.001
		(1.6075)	(0.2197)				

The indigenous households and the Hausa/Fulani households respectively consumed 45 g and 582 g LME per caput per day of which 14 and 91% was local products, and 61 and 25% was consumed in the form of milk. Local fresh milk, yoghurt, cheese and butter were used as substitutes for similar imported products in some locations by some consumers, both indigenes and Hausa/Fulani.

Average income of consuming and non-consuming households did not differ significantly, which indicated that factors other than income were important in determining whether or not a household consumed dairy products. Such factors could include inadequate availability of products and their poor hygiene.

Dairy consumption functions estimated for only consuming households show that income elasticities of demand for dairy products were highest for rural households in the SW and urban households in the SE.

Reduced imports and rising prices of dairy products as a result of the structural adjustment programme in Nigeria might have reduced the number of consumers and/or reduced the regularity of consumption and the quantity consumed. This survey indicates that regularity and quantity of consumption have been affected. Whether the number of dairy consumers also decreased could not be ascertained in the absence of inter-temporal data. A significant shift toward local dairy products was still not apparent, in spite of their lower prices, most probably because of limited supply beyond the production points. Appropriate production, processing and marketing strategies have to be developed to increase production and encourage consumers to shift toward domestic products.

References

McDonald J F and Moffitt R A. 1980. The uses of Tobit analysis. *The Review of Economics and Statistics* 62(2):318–321.

Federal Office of Statistics. 1983. *National integrated survey of households: Report of national consumer survey, June 1980–May 1981.* Federal Office of Statistics, Lagos, Nigeria.

Nwoko S G. 1986. *The development of dairy imports in Nigeria.* LPU Working Paper 10. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 70 pp.

Senait Seyoum. 1989. *Consumption of dairy products in West Africa: Past trends and future prospects.* ALPAN (African Livestock Policy Analysis Network) Network Paper 23. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 25 pp.

Discussion

The discussant commended the work to those involved in dairy development planning. A number of points were raised with regard to the methodology used and the need for elaborating on the implications of the study. Although costly in terms of time and money, continuous observation and recording of activities were deemed necessary when fitting functions and estimating elasticities. The low coefficient of multiple determination (R^2), the unexpected signs and non-significance of some of the parameters reported in the study were, as a consequence, partly attributed to data problems and model misspecification. Caution was

advised in the use of the income variable, the definition and measurement of which are difficult. Since income was identified as the most important factor influencing milk consumption, the need was also stressed for considering the effects and implications of rising prices (especially under structural adjustment) on actual consumption and nutrition. Furthermore, it was suggested that the higher prices prevalent in the south-east during the survey period could have been caused by seasonality in milk supply/prices and researchers were advised to account for such factors in their differential timing of enumeration. The observed distinction between Muslims and Christians was deemed unnecessary since, unlike pork, dairy products had general acceptance among both religious groups. The discussant mentioned that he had hoped to find more detailed recommendations on appropriate production, processing and marketing strategies to encourage consumption. To the concern raised about his non-involvement in the design and implementation of the survey, Jabbar indicated that the survey was done well but with different objectives in mind. Consequently, he did not feel comfortable running a demand function on the survey data. The econometric analysis presented at the symposium was revised in light of the discussion and subsequent review.

Dairy consumption patterns from the 1987 Lesotho national survey of household consumption

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Introduction

Patterns of food consumption are influenced by economic, geographic and social factors. This is particularly true for Lesotho. The country's lowlands are well served by roads which connect to markets in the Republic of South Africa (RSA), whereas the lack of roads can make it difficult for people living in the mountains to obtain food and other supplies. The dependency of Lesotho on the RSA for a growing percentage of its food supplies as well as its income is a factor that influences food consumption patterns.

The purpose of this paper is to examine the patterns of dairy consumption in Lesotho. The data came from the Household Budget Survey (HBS) that was carried out in 1986/87 by the Bureau of Statistics (BOS). The paper focuses on fresh milk which is the major dairy product consumed in Lesotho. Some attention is paid to five other dairy products for which information was obtained in the HBS.

The paper is organised into three major sections. The first section provides background structural information on Lesotho in order for the reader to understand the significance of the differential consumption patterns. Tables are presented illustrating what the authors believe to be two of the most important influences on dairy product consumption, namely income and geography. In the second section the methodology of the HBS is outlined. The third section provides the description and analysis of dairy consumption patterns.

The setting

Lesotho is a land-locked country of 30,340 square kilometres of which 90% consists of foothills and mountains. Of its population of 1.66 million (1986), approximately 87% reside in rural areas. The urban population consists of 113,000 people in Maseru, the capital, and 104,000 people in other smaller urban

centres, the majority of which are in the lowlands. Over half (51.9%) of the population is 19 years old or younger. Another 30.6% are between 20 and 44 years old, 12.6% are between 45 and 64 years old and 5.3% are 65 years old or older. (Information on age distribution was missing on 1.4% of the population.)

The main characteristic of Lesotho's economy is its dependence on the RSA. This can be illustrated in a number of ways. For example, Lesotho's gross national product (GNP) is significantly larger than its gross domestic product (GDP) (Table 1).

Table 1. *Aggregate indicators for the Lesotho economy (constant 1980 prices).*

	1980	1982	1984	1986	1988
	million maloti[1]				
GDP at market prices	286.3	300.0	299.1	311.8	372.7
GNP at market prices	491.3	577.5	586.2	560.5	610.6
Imports of goods and services (CIF)	350.2	396.6	398.3	353.2	398.5
GDP as % of GNP	58.3	51.9	51.0	55.6	61.0
Imports as % of GNP	71.2	68.7	67.9	63.0	65.3
Annual inflation rate	14.3	11.2	8.9	16.2	16.3
Population (million)	1.33	1.40	1.46	1.58	1.66
GNP per caput (maloti)	369	413	402	355	368

Source: Bureau of Statistics, Lesotho National Accounts 1980–1988.

1. The 1988 exchange rate was US$ 1= 0.31 maloti.

What Lesotho produces domestically (GDP) represents between 50 and 60% of its total GNP. The difference between GDP and GNP primarily represents factor income from abroad, earned by Basotho working in the RSA.

Imports of goods and services, which come primarily from the RSA, represent between 63 and 71% of GNP. Not surprisingly, there is a large trade imbalance. In 1988, exports of goods and services were worth 185.9 million maloti (US$ 1= 2.56 maloti in March 1989), compared with imports of goods and services of 1185.9 million maloti (in current prices). This means that exports are worth only 15.6% of the value of imports.

Figures show that the economy grew by 20.4% in real terms between 1980 and 1988, an average annual rate of approximately 2.6%.

It is also useful to examine the structure of GDP as it reveals the sources of economic strengths and weaknesses. This is shown in Table 2.

Table 2. *Gross domestic product by sector, 1980–1988 (constant 1980 prices).*

	Gross domestic product (million maloti)				
	1980	1982	1984	1986	1988
Primary sector					
Agriculture	58.3	49.6	53.4	48.8	65.0
Mining and quarrying	20.7	15.7	1.5	2.1	1.0
Subtotal	79.0	65.3	54.9	50.9	66.0
Secondary sector	50.8	64.4	58.8	65.5	88.4
Tertiary sector	117.4	125.2	141.6	155.2	172.8
GDP at factor cost	247.2	255.0	255.2	271.7	327.2
of which					
- industries	177.3	179.7	170.7	182.8	232.6
- government	44.4	47.1	53.6	56.5	60.1
- non-profit organisations	25.4	28.2	30.9	32.4	34.4
Indirect taxes	39.1	45.0	43.8	39.3	45.5
Total GDP	286.3	300.0	299.1	311.0	372.7

Source: Bureau of Statistics, Lesotho National Accounts, 1980–1988.

Agriculture represents only 17.4% of GDP or 10.6% of GNP. Lesotho has virtually no income from mining and quarrying. Manufacturing (and handicrafts) make up only 11.7% of GDP. These figures show the weaknesses of Lesotho's resource and manufacturing bases, hence its stage and degree of economic development. For a country with 87% of its population in rural areas, the productivity of its agriculture is extremely low. It represents one of the country's significant development challenges.

The income distribution in the country is another area of concern. Table 3 shows distribution of households by monthly household income categories for both urban and rural areas. These figures show that 29.0% of the rural households have a maximum income of 49 maloti per month. The urban areas are better off, with 6.5% of households in Maseru and 10.4% of households in other urban centres having incomes of less than 49 maloti per month. Estimates presented elsewhere indicate that the poorest 25% of the population have less than 1.5% of total income. For Lesotho as a whole, 42.7% of the households have a monthly income of less than 99 maloti per month. These figures appear much different at the per caput level (not shown). For example, for all Lesotho, 70.2% of the population has a per caput income of between one and 49 maloti per month. This rises to 73.9% for the rural areas, compared with 38.0% for Maseru.

As a large percentage of the population lives in rural areas, one might expect that even with a low level of income they might be self-sufficient in basic

Table 3. *Distribution of households covered by the Household Budget Survey 1986/87 by monthly income.*

	Percentage of household sample			
Income (maloti/month)	Urban Maseru	Urban other	Rural	Lesotho
0	2.0	4.3	2.0	2.0
1–49	4.5	6.1	27.0	23.9
50–99	8.5	12.8	17.8	16.7
100–199	21.8	26.0	20.1	20.6
200–499	36.7	34.4	22.6	24.5
500 and over	26.5	16.4	10.4	12.1

Source: BOS (1988).

necessities: food, shelter and clothing. But to be self-sufficient households require land to produce staple grains (maize, wheat, pulses and vegetables) and livestock for milk, meat, hides and skins and dung for fuel. However, there is a large (and apparently increasing) number of households without land or livestock (Table 4). The figures show that only 47.4% of rural households have both land and livestock. Another 28% have land only, 8.0% have livestock only and 16.4% have neither land nor livestock. It is not clear how these last households survive. It could be that they represent older people who have given up their land and livestock to their children but still receive support from their families. They could also be households that receive income from relatives working elsewhere. But there is evidence that it is becoming difficult for a young married couple to expect to be allocated fields from the district (or village) chief, which was the traditional custom of the Basotho. Land has become scarce.

The dependence of the rural population in particular on remittances from migrant workers as their main source of income is shown in Table 5. It shows that 52.7% of rural households list remittances from migrant mine workers as their main source of income. Only in the rural mountain area does agriculture exceed migrant remittances as the main source of income.

How these structural characteristics affect food consumption patterns is an important issue for health and nutrition and hence for agricultural and food policy.

The Household Budget Survey

This section briefly presents information from the Household Budget Survey (HBS) that is pertinent to dairy consumption patterns. The HBS is described in detail elsewhere (BOS, 1988).

Table 4. *Households possessing land and/or livestock, Lesotho, 1986/87.*

	Rural lowlands	Rural foothills	Rural mountain	Rural Senqu River	All rural
Households with fields and livestock					
Number	53,122	33,567	32,696	15,182	134,568
Per cent	43.6	47.8	55.9	45.5	47.4
Households with fields only					
Number	38,324	20,769	12,378	7,986	79,459
Per cent	31.5	29.6	21.2	24.0	28.0
Households with livestock only					
Number	10,459	4,972	3,608	3,773	22,812
Per cent	8.6	7.1	6.2	4.3	8.0
Households with no fields or livestock					
Number	19,912	10,809	9,406	66,301	46,429
Per cent	16.3	15.4	16.1	18.9	16.4
Households for which information was missing					
Number	0	6.0	360	96	517
Per cent	0.0	0.1	0.6	0.3	0.2
Total	121,818	70,180	58,450	33,339	283,788

Source: BOS (1988).

The survey was carried out by the Bureau of Statistics of the Lesotho Government, with technical and financial assistance from the Swedish International Development Authority (SIDA) and Statistics Sweden (SCB).

The following definitions are important to an understanding of the survey:

Consumption unit: Defined to account for the economy of scale in multiperson households. A one-person household is composed of one consumption unit, while each additional adult is counted as 0.7 consumption unit and each child (up to 19 years old) is counted as 0.5 consumption unit.

Household: Defined as a group of people who live together in the same compound or dwelling and share the same sleeping facilities and/or the same cooking or eating facilities. Servants living in the household are considered part of the household unless they occupy their own quarters where they sleep and prepare their own meals.

Table 5. *Distribution of total household income by main source.*

Variable	Percentage of total household income by source							
	Urban Maseru	Urban other	Rural lowland	Rural foothills	Rural mountain	Rural Senqu River	All rural	Lesotho
Subsistence farming	0.5	1.2	12.9	19.5	19.3	17.3	16.1	12.4
Cash cropping/livestock	4.7	1.9	4.7	14.3	20.4	12.7	10.6	8.9
Business income	6.7	21.3	6.4	3.3	2.8	1.9	4.6	6.5
Wages and salaries	70.1	41.4	11.8	9.0	12.9	10.0	11.1	22.4
Migrant mineworker remittances	15.1	25.2	59.8	49.6	38.4	51.0	52.7	44.7
Other sources	2.8	8.9	4.5	4.2	6.2	6.9	4.9	5.0
Information missing	0.1	0.1	0.0	0.0	0.1	0.2	0.0	0.1

Source: BOS (1988).

Income: Total income includes cash income (earnings from employment, rent, interest etc) and income in kind.

Migrant worker: Defined as a person who is a member of a household but is temporarily absent and working in another location either in or outside Lesotho.

Urban areas: Includes urban Maseru and other urban centres, i.e. the nine district towns, plus Maputsoe, Morija and Roma).

The survey was carried out over a 12-month period, October 1986–September 1987. There were 640 different households surveyed each month, for a total of 7680 households. Each participating household recorded detailed expenditure and income data for one month. For some items the reference period was one year.

Four forms were used:

- Form I comprised questions on demographics and social characteristics.

- Form II was a daily record book in which the household recorded daily quantity and value of all income and expenditure in cash and in kind.

- Form III was used by the enumerator working with the household to make a weekly summary of the cash transactions recorded on Form II.

- Form IV was a summary of transactions in kind, compiled by the enumerator from entries on Form II.

The total sample comprised 4800 households in rural areas and 2880 households in urban areas. Household lists were prepared from selected Primary Sampling Units (PSUs) based on enumeration areas in the 1986 population census.

Form III provided for the reporting of all cash disbursements and receipts. There were 113 listings of food, beverage and tobacco items. In the dairy category the listings were fresh milk, powdered milk, condensed milk, sour milk, butter and cheese.

The data have been coded and entered on computer by the Bureau of Statistics. Some preliminary reports have been prepared but to date no extensive analysis has been carried out. For the purpose of this paper the data were transferred onto diskettes, brought to the University of Saskatchewan and entered onto the mainframe computer.

The data are organised into four three-month quarters. The expenditure and consumption data are contained in separate files from that on household characteristics (age, education etc). The data for expenditures are seemingly complete for each household in the sample set. The problem is with the data on quantities purchased. First, there are no quantity data for the first quarter

(October to December). Secondly, there is inconsistency in the units used to record many of the products. Thirdly, data on quantity do not exist for some of the households.

Dairy product purchases in Lesotho[1]

As outlined in the previous section, the HBS questionnaire included six dairy products: fresh milk, powdered milk, condensed milk, sour milk, cheese and butter. It is not possible in one paper to provide the complete information plus analysis for all six products. The decision was to provide a broad indication of the purchases of all six products by Basotho households, with a focus on fresh milk. The frequency of household purchases of the six dairy products is outlined in Table 6. The data are organised by quarter and by region.

Overall, only 48.4% of households reported purchasing fresh milk (average of four quarters). The results show a wide difference between regions. In the capital city of Maseru, 72.0% of households purchased milk, compared with 56.9% of households in other urban centres. However, in the rural areas only 37.2% of households reported purchasing milk.

In most cases consumption was lower in the rural areas than in urban areas in terms of the percentage of households purchasing these products. There are a number of possible explanations for this. It could, for example, be associated with lower income or higher prices in the rural areas and/or lack of availability of dairy products.

Fresh-milk purchases by season

In Table 7 the impact of seasonality and children on purchases by the household is examined. The data show that 77.7% of the households surveyed had children and a larger percentage of households with children reported buying milk than did households without children. An average of 47.8% of all households purchased milk each month; the average for households with children was 49.9%, compared with 40.6% of households without children.

The results suggest that many children are not getting milk. The problem is that "children" includes children up to 19 years of age; the HBS did not include a finer age categorisation. However, irrespective of this, it still suggests that there are some young children who probably do not receive milk. Although one needs to be cautious in asserting that these results indicated that there is a malnutrition

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1. Technically it is important to recognise that the HBS provides information on product purchases and consumption in kind.

Table 6. *Percentage of households that reported purchasing dairy products, by quarter and region, Lesotho, 1986/87.*

	Maseru				Urban other			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Households surveyed	480	480	480	480	240	240	240	240
Percentage of households consuming:								
Fresh milk	74.5	69.0	73.5	71.3	63.3	58.7	62.1	60.4
Powdered milk	16.9	22.1	20.6	17.1	15.8	15.8	23.3	16.3
Condensed milk	6.5	5.2	5.8	7.1	3.3	2.9	4.6	4.2
Sour milk	5.2	5.0	5.2	5.4	5.8	4.2	6.7	6.7
Butter	7.9	4.8	5.0	6.3	5.0	2.9	5.0	4.2
Cheese	9.2	11.3	9.2	7.7	5.8	3.8	6.3	4.6

	Rural				Lesotho			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Households surveyed	1200	1200	1200	1200	1920	1920	1920	1920
Percentage of households consuming:								
Fresh milk	41.0	36.1	35.0	36.8	52.2	47.1	48.0	48.4
Powdered milk	14.1	11.0	11.3	11.3	15.1	14.4	15.2	13.3
Condensed milk	2.4	1.9	2.1	2.2	3.5	2.9	3.3	3.6
Sour milk	6.1	3.8	2.2	1.1	5.8	4.1	3.5	2.9
Butter	1.7	1.3	1.0	1.4	3.6	2.3	2.5	3.0
Cheese	0.6	0.8	0.6	0.7	3.4	3.8	3.4	2.9

Source: BOS (1988).

problem, they do tend to support other studies that indicate a nutrition problem in Lesotho.

Estimates for quantity of milk purchased presented certain difficulties. As explained earlier, not all households that reported expenditures provided data on the quantities of milk purchased.[2] Approximately 30% of the households surveyed did not report quantity. As a result, it was necessary to adjust the

2. It is important to remember that each month consists of a different set of households.

Table 7. *Influence of the presence of children on purchase of milk, by month, Lesotho, 1986/87.*

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Households surveyed	640	640	640	640	640	640	640	640	640	640	640	640	640
Households with children													
Number	492	509	511	500	508	482	470	507	434	507	535	513	497
Per cent	76.9	79.5	79.8	78.1	79.4	75.3	73.4	79.2	67.8	79.2	83.6	80.2	77.7
Households without children													
Number	148	131	129	140	132	158	170	133	206	133	104	127	143
Per cent	23.1	20.5	20.1	21.9	20.6	24.7	26.5	20.8	32.1	20.7	16.3	19.8	22.3
Households purchasing milk													
Number	330	319	250	293	312	280	322	316	283	313	325	324	306
Per cent	51.5	49.8	39.0	45.8	48.8	43.8	50.3	49.4	44.2	48.9	50.8	50.6	47.8
Households with children purchasing milk													
Number	261	264	209	247	262	234	247	256	199	254	274	263	248
Per cent	79.1	82.3	83.6	84.3	84.0	83.6	76.7	81.0	70.3	81.1	84.3	81.2	81.0
Households without children purchasing milk													
Number	69	55	41	46	50	46	75	60	84	59	51	61	58
Per cent	20.9	17.2	16.4	15.7	16.0	16.4	23.3	19.0	29.7	18.8	15.6	18.8	19.0

Source: BOS (1988).

quantity figures to reflect actual expenditures. This was done on the assumption that households that did not report quantity figures had, on average, similar expenditure patterns to those that did report quantities. The number of households reporting expenditures and the level of those expenditures and quantities purchased by month are outlined in Table 8.[3] The monthly data are provided to show seasonal patterns. What the data first reveal is that only 19.7% of the households surveyed reported milk purchases. There was little difference between months, with 22.1% of households reporting purchasing milk in September compared with 18.6% in January, March and November.

The data also show that the quantity of milk purchased per caput changes very little over the year. The average annual consumption was 9.82 litres/caput, ranging from 8.08 litres/caput in March to 12.00 litres/caput in January.

The reported expenditure per caput was an average of 11.20 maloti for the year, ranging from a high of 12.60 maloti/caput in September to a low of 9.11 maloti/caput in March.

It may be useful to draw a comparison with other countries. For several African countries estimates of production coupled with population data provide estimates for consumption[4]. The consumption figures[5] given below do not take into account milk donations, imports and exports.

	Annual consumption (litres/caput)	
	1980	1986
Botswana	114.8	89.5
Lesotho	14.9	14.5
Kenya	6.0	4.8
RSA	91.2	80.5
Swaziland	67.6	58.2
Uganda	27.7	22.7

Fresh-milk purchases (consumption): Income effects

What is the impact of income (or expenditure) on fresh-milk consumption? To examine this question, the households were divided into four income categories:

3. The monthly figures were "annualised" by multiplying them by 366 and dividing the result by the number of days in the month to put the data on a uniform basis.

4. Production data were provided in tonnes and converted to litres by assuming 1 kg is equivalent to 1 litre.

5. Data obtained from United Nations, Statistical Yearbook, 1988.

Table 8. *Expenditure on fresh milk and quantity purchased (annualised), Lesotho, 1986/87.*

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
Number of households surveyed	1777	1654	1343	1502	1632	1399	1491	1621	1283	1522	1745	1650	1552
Number of households that reported purchasing milk	330	319	250	293	312	280	322	316	283	313	325	324	306
Households purchasing milk (%)	18.6	19.3	18.6	19.5	19.1	20.0	21.6	19.5	22.1	20.6	18.6	19.6	19.7
Amount of milk purchased monthly (litres/caput)	12.00	9.95	8.08	9.92	10.71	9.59	8.84	9.61	9.69	[9.66]*	[11.02]	[10.98]	9.82
Monthly expenditure on milk (maloti)	11.54	10.96	9.11	10.98	11.50	10.46	10.77	10.97	12.60	10.82	12.34	12.30	11.20
Expenditure per litre (maloti)	0.96	1.10	1.13	1.11	1.07	1.09	1.22	1.14	1.30	[1.12]	[1.12]	[1.12]*	1.14

Source: BOS (1988).

* Estimated, since quantity figures were not collected in the survey for these months. Estimates are based on an average expenditure of 1.12 maloti per litre for 9 months and known per caput expenditure.

0–199, 200–499, 500–999 and > 999 maloti per month per household. The results are reported in Table 9. All data were converted to an annualised uniform basis as explained previously. Further, an adjustment was made to the data on quantity purchased to correct for the bias in the households that reported only expenditure and not quantity.

For the low-income households the average expenditure was 7.17 maloti per caput.[6] The quantity purchased was 6.59 litres per caput. For the next income category (200–499 maloti per year) the average expenditure was 9.60 maloti per caput and the per caput purchase was 8.34 litres. For the 500–599 maloti income category, the per caput expenditure was 11.60 maloti and per caput purchase was 12.52 litres. For the highest-income category (> 999 maloti a year) the average expenditure was 16.18 maloti per caput, with purchases of 13.27 litres per caput.

The most interesting aspect of the results is that expenditure and quantity purchased per caput are higher in households that consist of only adults than in households with children. This does not necessarily mean that adults purchased and consumed more milk than children where household income is the same. Households are grouped by income, and since there were fewer family members in households consisting of only adults than in those with children, income per caput is higher in households with adults only than in households with children. Nevertheless, the differences are still large.

Expenditure on milk and quantity purchased increased markedly as income increased. Even without estimating an Engel function this would suggest that milk is a normal consumer good in Lesotho.

Fresh-milk consumption: Regional effects

Annual per caput expenditure on milk was highest in the mountain areas and Senqu River Valley region (Table 10). Per caput purchases followed a similar pattern to per caput expenditure. Somewhat surprisingly, dairy product prices were lowest in the Senqu River Valley (Table 10). The only explanations are that cheaper milk is coming in from the RSA or that there is a lot of local milk being bought and sold.

Consumption of "in-kind" milk

The data presented up to this point represent milk purchased by households. It does not include milk from cows and other species (primarily goats) owned by

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6. These figures do not appear in Table 9, and are obtained by averaging over four quarters in the case of expenditure and over three quarters for quantity purchased.

Table 9. *Per caput expenditure on and purchase of fresh milk by income category and quarter, Lesotho, 1986/87.*

	Income category (maloti/month)			
	0–199	200–499	500–999	> 999
Quarter 1				
Per caput expenditure (maloti/year)				
All households	8.36	11.12	13.92	20.75
Households with children	7.58			20.24
Households with adults only	18.32			42.21
Per caput purchase (litres/year)				
All households				
Households with children		Not available		
Households with adults only				
Quarter 2				
Per caput expenditure (maloti/year)				
All households	7.65	8.53	12.30	14.41
Households with children	6.77			12.86
Households with adults only	18.92			32.61
Per caput purchase (litres/year)				
All households	7.99	8.23	10.44	14.68
Households with children	7.07			12.54
Households with adults only	18.44			39.78
Quarter 3				
Per caput expenditure (maloti/year)				
All households	6.22	10.13	9.26	15.07
Households with children	5.52			14.64
Households with adults only	15.01			21.54
Per caput purchase (litres/year)				
All households	5.99	9.82	7.40	13.09
Households with children	5.33			12.42
Households with adults only	14.42			22.29
Quarter 4				
Per caput expenditure (maloti/year)				
All households	6.44	8.61	10.95	14.49
Households with children	5.75			13.25
Households with adults only	12.47			29.96
Per caput purchase (litres/year)				
All households	5.79	6.96	9.27	12.05
Households with children	5.16			10.70
Households with adults only	14.60			28.49

Source: BOS (1988).

Table 10. *Per caput expenditure on and purchase of fresh milk, by region, Lesotho, 1986/87.*

	Urban		Rural			
	Maseru	Other	Lowlands	Foothills	Mountain	Senqu River
Per caput expenditure (maloti/year)						
October–December	7.71	6.06	5.64	3.54	17.91	14.31
January–March	7.29	6.12	4.20	3.99	16.53	14.40
April–June	7.62	5.31	5.37	7.83	16.74	10.20
July–September	8.37	7.35	6.48	6.87	17.01	13.08
Mean	7.75	6.21	5.52	5.56	17.05	13.00
Per caput purchase (litres/year)						
October–December	–––––––––––––––––––––––––– Not available ––––––––––––––––––––––––––					
January–March	7.19	4.26	4.23	3.51	15.60	16.31
April–June	5.57	5.40	2.88	7.11	15.26	11.73
July–September	11.04	5.10	5.24	6.10	12.98	14.02
Mean	7.93	4.92	4.22	5.57	14.61	14.02
Unit price (maloti/litre)	0.98	1.26	1.31	1.00	1.17	0.93

Source: BOS (1988).

the household that is consumed by the household ("in-kind" milk). There are two sources of information on in-kind consumption; the HBS survey and a survey carried out by Swallow et al (1987).

The Swallow et al (1987) study was based on a survey of 537 households, of which 462 had cattle. The study showed that 50.8% of the households with cattle milked their cows at some time during the year. There were 203 households (37.8%) that reported purchasing milk during the year. There were 16 households that reported selling milk during the year; of these, 12 said they sold milk daily.

Of the 185 households that provided information on their frequency of milk purchases, only 51 (27.6%) reported purchasing milk daily. Another 84 (45.4%) reported purchases from four times a week to once every second week, 23 (12.4%) purchased milk monthly and the remaining 27 households (14.6%) from once every three months to occasionally. Of the 389 households reporting their consumption frequency, 184 reported purchasing no milk. Another 131 households purchased less than 1 litre per week.

The HBS recorded food consumed that was not purchased. This was referred to as "in-kind" food availability. Table 11 provides information on in-kind milk consumption by month. The results show that very few households produced milk for their own consumption. For example, out of 640 households surveyed in January only 27 reported in-kind milk consumption. Out of the total sample of 7680 households surveyed, 182 households reported in-kind milk consumption; of these, 139 (76.4%) were in the rural areas and 74 (40.7%) were in the low-income category. Only 7.7% were in the high-income category.

As was done previously, the data were annualised. The results show a relatively high level of consumption per caput.[7] The average annual consumption was 71.93 litres per caput (Table 11), compared with 9.82 litres of milk purchased per caput (see Table 8). The in-kind figures are quite close to milk consumption levels found in Canada and the RSA.

Summary and conclusions

The results of the HBS show that the majority of households in Lesotho consume little or no dairy product. Only approximately 48% of the households report purchasing fresh milk. Fewer than 10% of the households report purchasing butter, cheese or other dairy products.

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7. Since the number of family members was not available for the in-kind data, these were taken from Table 7 for each month.

Table 11. *"In-kind" milk consumption (annualised), Lesotho, 1986/87.*

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
Households reporting "in-kind" milk consumption													
Number	27	21	9	21	16	19	8	7	6	16	14	18	15
Per cent	4.2	3.3	1.4	3.3	2.5	3.0	1.3	1.1	0.9	2.5	2.2	2.8	2.3
Per caput consumption (litres/year)	81.75	83.92	62.53	78.97	20.74	74.24	78.00	61.83	138.67	60.24	58.07	64.16	71.93

Source: BOS (1988).

Average per caput milk purchase was estimated at approximately 9.82 litres per year. Since only 48% of households purchased milk, per caput consumption would be approximately 20 litres a year for those households that did buy milk.

Income had a large influence on milk consumption. High-income households consumed almost twice as much milk per caput as did low-income households (13.27 vs 7.2 litres per caput).

Per caput milk purchases were higher in the mountain and Senqu River Valley regions. This was somewhat surprising given the inaccessibility of these regions and that household income is generally lower in the mountains than elsewhere in Lesotho.

Only a very small percentage (2.3%) of the 7680 households surveyed reported in-kind milk consumption. However, for those households consuming milk they produced themselves, the per caput consumption was very high at 71.93 litres per year. This approximates the consumption level of developed countries.

Given the large percentage of households that did not seem to purchase or, hence, consume milk and the low level of consumption it can be concluded that much needs to be done to increase milk consumption in Lesotho.

The analysis carried out on the HBS data for this paper was constrained by data-retrieval problems and time. Further work is needed. Analysis is being carried out on income elasticities as part of Ms L. Sopeng's MSc thesis, being written at the University of Saskatchewan. Another study will attempt to estimate a demand system for selected food products, which will include milk. This will provide information on price elasticities.

References

BOS (Bureau of Statistics). 1988. *Incomes, expenditure and consumption of Basotho households.* Tabulation report from the Household Budget Survey, 1986/87. Bureau of Statistics, Maseru, Lesotho. 105 pp.

Swallow B M, Motsamai M, Sopeng L, Brokken R F and Storey G G. 1987. *A survey of the production, utilization and marketing of livestock and livestock products in Lesotho.* Lesotho Ministry of Agriculture Research Division Report RD–R–81. Ministry of Agriculture, Co-operatives and Marketing, Maseru, Lesotho. 276 pp.

Discussion

The paper, which uses data from the 1986/87 Lesotho National Household Budget Survey is well organised and clearly written. It contains useful background information and provides an excellent description of the Lesotho household budget survey. Much as the data it contains is detailed, the paper is, however, short on analysis. The

discussant mentioned some of the income effects in Table 9 as a good example of some of the questionable table entries. These errors were corrected in the present revision. Breaking the survey into many pieces for analysis might also have caused a lack of variability in some of the tables because there were few reports. It is always good to look for outliers in tables in order to draw attention to possible data problems or identify issues for further analysis. Measuring the possible influence of "in-kind" consumption on the income elasticity estimates is another important area of analysis. The paper was revised in light of the points raised during the discussion.

Efficiency of fresh milk marketing in the Bamako area of Mali: Some preliminary results

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Abstract

The marketing systems in sub-Saharan Africa have been alleged to be inefficient, yet relatively little research has been done on marketing efficiency. This study investigates the efficiency of fresh milk marketing in the Bamako area of Mali. A sample of 105 dairy market participants made up of producers, retailers, itinerant milk collectors and wholesalers was interviewed twice a week during the height of the dry and rainy seasons. Fresh milk trade was concentrated in the rainy season when 64% of all transactions (by volume) took place. Producers who sold fresh milk directly to consumers handled 45% of the total volume, compared with 20% handled by itinerant collectors. Retail prices observed at the various sale outlets were generally similar after adjusting for transportation costs. On average, traders made a margin of 45 FCFA/litre, which is not excessive relative to services rendered. The preliminary conclusions are that fresh milk marketing in the Bamako area is fairly efficient.

Introduction

Despite the large number of ruminant livestock in West Africa, estimated at about 35 million tropical livestock units (TLUs) (ILCA, 1987), aggregate production of dairy products has always lagged behind aggregate consumption. The deficit is often covered by food aid or commercial imports, particularly from the European Economic Community (EEC) countries. Between 1983 and 1985, for example, the region imported 45% of the dairy products it consumed (Senait Seyoum, 1988).

Whereas dairy production is widely scattered, consumption, particularly of imported dairy products, is concentrated in the urban centres. The city of

Bamako (which has a population of approximately 700,000 people) is estimated to consume 65% of all dairy products imported into Mali (von Massow, 1985). In Chad, Bouscharain (1965) estimated that 70% of dairy imports into Chad was consumed in N'djamena, the capital. Sidibe (1982), Nwoko (1986) and Atse Atse (1987) found similar situations in Niger, Nigeria and Côte d'Ivoire.

Given the perishable nature of fresh milk, high ambient temperatures, inadequate refrigeration facilities and poor infrastructure, perhaps the major constraint to increased domestic dairy production and consumption in the West African region is the inefficiency with which dairy products are moved from producing points to high demand areas. Efficient marketing is of benefit to both producers and consumers. If the marketing systems function efficiently, operations will be undertaken at lower costs, which may, through lower marketing margins, result in both higher prices for the producers and lower costs for consumers.

There is a growing concern that marketing systems for fresh milk and other dairy products are inefficient due to inappropriate product pricing, market location, abnormal trade margins of the numerous market intermediaries between producers and consumers, and inappropriate government policies. This might be an important reason why Mali, a country with a large cattle herd and a tremendous dairy production potential, cannot satisfy urban demand for dairy products and continues to depend on dairy imports.

Despite allegations of inefficient functioning of marketing systems (both formal and informal) in the West African region, few studies have been carried out on dairy marketing efficiency in Africa (Hollier, 1985; Debrah and Berhanu Anteneh, 1991). Dairy marketing research has in fact received less attention than livestock and crop research in the region. As a result, there is no scientific base on which policy makers in the region could base dairy marketing policy decisions. This paper is intended to bridge this information gap by examining the efficiency of dairy marketing systems operating in the Bamako area.

Conceptual framework

This study used a combination of market function and market organisation approaches (Kohls and Uhl, 1985). We investigate the spatial and form dimensions of the dairy trade (market function approach) and market performance, particularly margins of market participants (market-organisation approach).

The two main attributes of an efficient market system are: (1) the provision of efficient and economical services and ownership transfers in the movement of commodities from seller to buyer; and (2) the provision of an effective price-setting mechanism (Bressler and King, 1978). Marketing efficiency can thus be judged according to how efficiently services are provided and how well

prices guide resources into production of goods and services. A marketing system cannot be judged in any absolute sense, but only with respect to some standard of performance. A perfectly competitive model is used as a yardstick with which to compare the relative efficiencies of the dairy marketing systems operating in the Bamako area. In a competitive market, the costs of production (including the production of marketing services) will be at minimum consistent with the given conditions of resources, technology and demand. Prices for goods and services will be interrelated through space by transfer costs, through form by costs of processing and through time by the costs of storage. Price discrimination in any form is not admissible under competitive conditions since discrimination may result in prices differing in space, form or time by more than the transfer, processing or storage costs.

Analytical technique

The analysis concentrates on the efficiency of fresh milk marketing in the Bamako area. Our major hypothesis is that fresh milk marketing in the study area (i.e. within 75 km of Bamako) is efficient. Efficiency is measured from the viewpoints of (i) the equality of fresh milk prices over the various outlets, except for transfer costs between supply areas and points of sale, (ii) equality of prices among different categories of consumer and (iii) normal trade margins.

A spatial analysis is used and observed prices are compared with theoretical price limits at each pricing point. The site-price function (equation 1) is used to establish the theoretical price limits between production and sale locations:

$$P_m = P_f + T = P_f + f(D) = P_f + t(D) \tag{1}$$

where P_m is the price at the sale outlet defined as the price at the supply point (P_f) plus the transfer cost (T). The transfer cost is in turn defined as a function of distance between the two points (D) and the cost per unit distance (t). Table 1 expresses the theoretical prices expected at the various sale outlets. If the fresh milk market is efficient, the prices at the n sale outlets will differ from each other by transfer costs. In this study comparisons are also made across different categories of consumer purchasing from the same source (seller and outlet).

Table 1. *Theoretical producer/retail price limits for fresh milk produced/sold at n locations in the Bamako area.*

	Sale outlets		
Supply sources	1	2	n
1	P_1	$P_1 + t(D_{12})$	$P_1 + t(D_{1n})$
2	$P_2 + t(D_{21})$	P_2	$P_2 + t(D_{2n})$
n	$P_n + t(D_{n1})$	$P_n + t(D_{n2})$	P_n

Similarly, in the absence of price discrimination (e.g. where the market is separated according to user group, so that one category of user is charged a different price than the others), we expect customers to pay the same price for the same product at a given point in time and at the same location.

Trade margins are also estimated for the market participants. The margins are examined to see if they are excessive over the costs incurred for transferring the milk from point of sale to resale outlets.

A covariance model of the form in equation 2 is used to explain the variations in trade margins:

Margin = f (marketing channel, season, proportion
of dairy income in total, locations)   (2)

where margin is per unit margin, marketing channels are represented by the different channels, C0, C1, C2 and C3, season represents dry and rainy seasons, the proportion of dairy income is defined as dairy income divided by total income, and location of sale is represented by locations such as farm gate, city of Bamako and areas outside Bamako.

Study area

The study was carried out in the city of Bamako and its surrounding areas. Three local fresh milk production systems with distinct characteristics operate in the study area. These are: the private peri-urban dairies, communal dairies and the village production system. Table 2 summarises the major features of the three production systems.

The private dairies are one of the oldest livestock farming systems in Mali. Herds are owned by individuals and can be as large as 200 cattle. They are the largest producers of fresh milk and are generally located within 25 km of Bamako. Their production is market oriented and their principal customer is the Union Laitière de Bamako (ULB), the only parastatal dairy processing plant in Bamako. The dominant cattle breed found in the private dairies is the Maure zebu, together with some exotic cattle. The producers in the private dairy systems, most of whom are active or retired government officials, are often considered to have privileged access to inputs such as feed supplements and veterinary services.

The communal corrals consist of herds of several producers grouped under the management of a single herdsman. The corrals are within the city limits and the areas where they may be sited are determined by the city authorities. Consequently, as demand for land for housing grows the communal corrals can be moved to locations further from the city. Producers in this system suffer from lack of grazing land as most of the land immediately outside city limits is cropped.

Table 2. *Summary of principal characteristics of three dairy production systems in the Bamako area.*

| | Production system | | |
	Private dairies	Communal dairies	Village system
Herd ownership	Single	Communal	Single/communal
Major output	Fresh milk for sale	Fresh milk for sale/consumption	Fresh/sour milk for sale/consumption
Locality	Peri-urban (25 to 40 km from Bamako	Urban/peri-urban within 25 km of Bamako	Villages (over 25 km from Bamako)
Dominant breeds	Maure zebu/some exotic	Fulani zebu N'dama/zebu	N'Dama/zebu
Herding system	Year-round	Year-round/ seasonal	Year-round
Feeding system	Pasture daytime and supplements evenings	Limited access to pasture and supplements	Pasture daytime plus crop residues during evenings
Veterinary care	Continuous	Sporadic	Occasional

Producers in the village system are located more than 25 km from Bamako. They raise local cattle, mainly on pasture with hardly any supplementary feed. Production is both for home consumption and for sale. Some itinerant market intermediaries, such as milk collectors, buy milk from producers in the village system to resell in Bamako.

The dairy marketing system in the study area involves the private informal system operating parallel to, and in competition with, the formal marketing system. In the former, sales are made either directly to consumers or through market intermediaries; prices are not controlled. In the formal marketing system, the ULB buys, processes and distributes dairy products at officially sanctioned prices. The dairy marketing system in Bamako involves a variety of dairy products of varying shelf-life from widely dispersed producing areas at varying distances from the city and which are brought to Bamako by various means of transport. Near-substitute products such as fresh milk, sour milk and reconstituted milk reach different consumer categories through different marketing channels.

Sampling and data collection

In this study the target population is defined as dairy market participants operating within 75 km of Bamako, either part-time or full-time, during the year of study (1990). This population includes:

- members of dairy cooperatives who regularly sell fresh milk directly to ULB

- producers who are not members of cooperatives but who regularly sell fresh milk to ULB

- producers who sell fresh or sour milk directly to individual consumers or indirectly to consumers through other market intermediaries and

- milk traders who buy fresh or sour milk and resell it through outlets other than ULB.

A list of 200 ULB suppliers, of whom 15% were not members of cooperatives, was obtained from ULB. No list was available of private dairy traders who neither were members of cooperatives nor supplied ULB. An exploratory survey was therefore carried out to establish a sampling frame for this category of dairy market participant. The exploratory survey was first conducted in all the 22 markets of the six administrative divisions (*communes*) in Bamako. Subsequently, visits were made to residential areas and to main roads leading into the city to identify individuals who sold milk through outlets other than markets. Using structured questionnaires, information was collected on product origin, system of production, amounts of fresh and sour milk produced and sold, prices received, terms of payment, categories and origins of buyers and modes of transportation.

A total of 150 dairy market participants were identified during the three-day exploratory survey. They included producers selling directly to consumers and intermediaries such as collectors, wholesalers, processors and retailers. The responses enabled the classification of dairy marketing activities into six marketing channels. The classification was made according to the number of intermediaries between the producer and the final consumer. Channels C0, C1, C2 and C3 correspond to zero, one, two and three market intermediaries between the producer and the final consumer. Two other channels involving dairy processing were also defined: TP for small-scale dairy processors using traditional methods, and IP for industrial, large-scale processors.

Because daily milk deliveries to ULB were recorded for each ULB supplier, and producer prices were fixed, regular field data collection on quantities and prices was concentrated on the 150 non-ULB suppliers identified in the exploratory survey. Our resources made it necessary to limit the survey to 50 participants per season, represented by the months of June, September and December respectively for the dry, rainy and cool seasons. A random sample of 50

participants was drawn from the 150 and interviewed twice a week in June 1990. A second random sample of 50 people was interviewed, again twice a week, in September 1990, and a final random sample of 50 people was drawn and interviewed in December 1990. Data collected included amount and sources of earnings from all income-generating activities, quantities of fresh and sour milk bought and sold, types of buyer and their origins, approximate distances between supply and sale outlets, transfer costs, processing costs, payment terms and prices at the various pricing locations.

Results

The results presented here are based on the surveys conducted in June and September 1990. Although data on sour milk was also collected and imported dairy products were used as raw materials for processing, the analysis for this paper was limited to the fresh milk marketing system.

Fresh milk supply, sales and prices

Twenty-four per cent of the sample members earned less than half of their total income from dairy trade, 10% earned between 50 and 85% of their total income from it and 65% earned at least 85% of their total revenue from the trade.

Fresh milk supply

During the survey period, a total of 53,499 litres of fresh milk were offered for sale. About a third of the total (36%) was offered in June (dry season) and 64% in September (rainy season). The distribution of fresh milk across marketing channels and seasons is shown in Table 3.

Milk producers in the C0 channel supplied 45% of the milk available for sale. Their supply came mainly from within the Bamako area. The private dairies supplied 84% of the C0 share, the communal dairies supplied 11% and the village

Table 3. *Fresh milk offered for sale in the Bamako area, June and September 1990, by marketing channel.*

Marketing channel	Amount offered (litres)		
	June 1990	September 1990	Total
C0: producer channel	12,334	12,051	24,384
C1: retailer channel	2580	7702	10,284
C2: collector channel	4143	6832	10,976
C3: wholesaler channel	0	7856	7856
Total	19,057	34,441	53,499

production system supplied the other 5%. Traders in the C1, C2 and C3 channels supplied 19%, 20% and 15% respectively of the fresh milk available for sale. Their supplies came from producers within the Bamako area, and from those located up to 75 km from Bamako. Differences in the quantities offered for sale by channel and season were significant at $P < 0.001$ (chi square= 7281, df= 3).

Fresh milk sales

Table 4 shows the distribution of fresh milk sales across marketing channels and seasons. A total of 53,851 litres of fresh milk was sold by the entire sample during the survey period. Milk was sold both by the litre and using traditional wooden ladles ("louches", of which about 12 louches make a litre), hence total quantity sold exceeded the quantity available for sale reported in Table 3. Sales as a percentage of fresh milk available for sale consequently exceed 100% in some cases, particularly for retailers in the C1 channel during the rainy season.

Table 4. *Fresh milk sales in the Bamako area, June and September 1990, by marketing channel.*

| | Fresh milk sales | | | | | |
| | June 1990 | | September 1990 | | Total | |
Marketing channel	(litres)	(% sold)	(litres)	(% sold)	(litres)	(% sold)
C0: producer channel	10,725	87	13,207	109	23,923	98
C1: retailer channel	2585	100	9688	126	12,273	119
C2: collector channel	3258	78	6588	96	9846	90
C3: wholesaler channel	0	0	7800	99	7800	99
Total	16,568	87	37,283	108	53,851	100

Producer and retail prices for fresh milk

Producer prices for fresh milk averaged 215 ± 72 FCFA/litre across channels, seasons and localities and ranged from 100 to 300 FCFA/litre. Retail prices averaged 221 ± 46 FCFA/litre and ranged from 110 to 325 FCFA/litre across channels, seasons and locations.

Tables 5 and 6 show producer and retail prices respectively, organised by marketing channel and season. In general, prices for fresh milk were higher in the dry season than in the rainy season. Producers in the C0 channel received higher prices than those who sell to retailers, collectors or wholesalers. Retail prices in the retailer channel (C1) are higher than those in either the collector (C2) or the wholesaler (C3) channel.

Table 5. *Producer prices (FCFA/litre) for fresh milk in the Bamako area, June and September 1990, by marketing channel.*

| Marketing Channel | Producer price (FCFA/litre) | | | | | |
| | Dry (June) | | | Rainy (September) | | |
	Min	Max	Ave (SD)	Min	Max	Ave (SD)
C0: producer	125	300	273 (41)	110	225	187 (23)
C1: retailer	135	300	197 (31)	100	175	119 (16)
C2: collector	100	225	130 (33)	125	200	134 (17)
C3: wholesaler	-	-	-	125	150	127 (12)

Table 6. *Retail prices (FCFA/litre) for fresh milk in the Bamako area, June and September 1990, by marketing channel.*

| Marketing channel | Retail price (FCFA/litre) | | | | | |
| | Dry (June) | | | Rainy (September) | | |
	Min	Max	Ave (SD)	Min	Max	Ave (SD)
C0: producer	-	-	-	-	-	-
C1: retailer	200	325	288 (30)	150	250	119 (16)
C2: collector	175	300	221 (26)	150	250	172 (26)
C3: wholesaler	-	-	-	140	200	157 (16)

Spatial distribution of fresh milk prices in the Bamako area

Milk traders usually bought fresh milk from more than one source and sold through more than one outlet during the survey period. The alternative purchase/sale outlets may be summarised as:

- the central market in Bamako

- other parts of Bamako (e.g. residential areas, shopping areas etc) within a 25-km radius

- the milk plant in Bamako (ULB)

- localities between 25 and 50 km from Bamako

- localities between 50 and 75 km from Bamako

- farm gate or place of production.

Producer prices were highest in Bamako, averaging between 202 FCFA and 223 FCFA/litre, and declined with increasing distance from Bamako. Between 25 and

50 km from the city, producer prices averaged 167 FCFA/litre, while between 50 and 75 km from the city, the average was 161 FCFA/litre.

In the city of Bamako, producer price at the milk plant is fixed at 210 FCFA/litre year-round while prices elsewhere vary. The milk plant is now insisting on fresh milk supplies from cooperatives so as to prevent individual producers taking advantage of the higher ULB prices when prices in the open market fall below 210 FCFA/litre. Similarly, ULB does not sell fresh milk for resale in the open market at higher prices.

Comparison of theoretical price limits and the average retail prices at various producer/retail outlets

Table 7 summarises theoretical price limits and observed prices for the different production/retail outlet pairs in the Bamako area. The theoretical price limits were set by using approximate distances from the points of production/collection to the retail outlets. The costs per unit distance were based on the ULB delivery prices. In the city of Bamako, except at the milk plant, the theoretical producer price limit was estimated at 205 FCFA/litre averaged over all production/collection points, while the retail prices were 207 FCFA/litre in the central market and 228 FCFA/litre in other parts of Bamako. At the milk plant, producer prices were estimated at 209 FCFA/litre while the plant paid producers 210 FCFA/litre.

Comparison of producer prices for fresh milk paid by different categories of customers

Producers sold fresh milk to more than one customer. These were categorised into: (a) a principal customer, (b) a secondary customer and (c) other customers. Producer prices paid by the different categories of customer for the same product at the same location and point in time are summarised in Table 8. At the Bamako central market, for example, the principal customer paid on average 202 FCFA/litre while secondary and other customers paid 223 and 225 FCFA/litre respectively. The producer price paid by ULB is non-discriminatory since it remains at 210 FCFA/litre to all customers throughout the year.

Trade margins

Members of the sample earned between -53 FCFA/litre and 135 FCFA/litre on their fresh milk sales. The average trade margin per litre was 45 FCFA, with a standard deviation of 26 FCFA/litre. Table 9 shows the distribution of trade margins over the sample. Sixty per cent of the sample fell within one standard deviation of the mean margin. About 15% lost money while 85% broke even or made profits. A regression of trade margins as a function of marketing channel,

Table 7. *Theoretical retail price and observed price (FCFA/litre) for fresh milk at various producer/retail outlet points in the Bamako area.*

Production, collection or point of first sale	Retail price (FCFA/litre) of fresh milk at retail points					
	Farm gate	Bamako central market	Other areas of Bamako (0–25 km)	Milk plant (ULB)	25–50 km from Bamako	50–75 km from Bamako
Theoretical prices						
Farm gate	200 (0)	205 (15)	207 (20)	207 (20)	217 (50)	225 (75)
Bamako centralmarket	217 (0)	217 (0)	219 (5)	219 (0)	229 (35)	237 (60)
Other areas of Bamako (0–25 km)	241 (0)	243 (5)	241 (0)	244 (10)	251 (30)	259 (55)
Milk plant (ULB)	210 (0)	-	-	210 (0)	-	-
25–50 km from Bamako	172 (0)	184 (35)	182 (30)	193 (40)	172 (0)	180 (25)
50–75 km from Bamako	156 (0)	176 (60)	174 (55)	178 (65)	164 (25)	156 (0)
Average theoretical price	199	205	205	209	207	211
Observed retail price	200	207	228	210	189	225
Spread	1	2	23	1	-18	14

The figures in parentheses are approximate distances between pairs of points. The cost per unit-km of 0.33 FCFA per litre-km is based on the delivery price charged by ULB to deliver processed and reconstituted milk in the Bamako area.

season and dairy share of total income was significant at $P < 0.001$ and together explained 51% of the total variation in trade margins. The interaction between marketing channels and season, and the share of dairy in total income did not contribute substantially to the total variation in trade margins.

A least-squares means analysis of the marketing channels and season indicates that milk collectors in the C2 channel obtained the largest margin of 58 FCFA/litre (standard error= 6.6) followed by retailers in the C1 channel (54 ± 4.2 FCFA/litre) and producers in the C0 channel (23 ± 4.8 FCFA/litre). Profits were greater in the dry season across all channels than in the wet season (62 ± 3.9 FCFA/litre vs 25 ± 4.1 FCFA/litre).

Conclusions

The preliminary conclusions from the study are that the different fresh milk marketing channels operate fairly efficiently in the Bamako area. The producers

Table 8. *Producer prices (FCFA/litre) for fresh milk paid at different locations by different categories of customer, June and September 1990.*

		Principal customer	Secondary customer	Other customers	Average
Farm gate	Min:	100	100	100	
	Max:	300	300	300	
	Ave:	190 (42)	200 (46)	210 (24)	200 (37)
Bamako central market	Min:	150	125	225	
	Max:	300	300	225	
	Ave:	203 (46)	223 (57)	225 (56)	217 (53)
Other areas of Bamako (0–25 km)	Min:	125	100	125	
	Max:	300	300	300	
	Ave:	223 (58)	247 (61)	255 (64)	241 (61)
Milk plant (ULB)	Min:	210	-	-	
	Max:	210	-	-	
	Ave:	210 (0)	-	-	210 (0)
Areas 25–50 km from Bamako	Min:	100	100	100	
	Max:	300	300	300	
	Ave:	167 (41)	170 (49)	180 (65)	172 (51)
Areas 50–75 km from Bamako	Min:	100	100	100	
	Max:	250	200	200	
	Ave:	161 (40)	146 (32)	162 (43)	156 (38)

in the C0 channel supply 45% of the total fresh milk, of which the majority comes from the peri-urban private dairies. Although most of the milk from the private dairies is sold to the milk plant for processing, some of it is sold through the informal market (i.e. directly to consumers or indirectly through milk collectors). Intermediaries such as retailers, collectors and wholesalers also play a very important role in bringing fresh milk from as far as 75 km from Bamako. This group of traders caters mainly to the informal market. None of the channels appeared to have any major difficulties in selling the fresh milk offered for sale. More milk is available and sold during the rainy season than in the dry season and prices are lower in the rainy season than in the dry season.

Fresh milk retail prices in general appear to be similar at the different retail outlets after adjusting for transport costs. However, to the extent that producers at the same outlets sell the same products to different categories of consumer at different prices (not related to transfer, processing or storage), one senses some element of market discrimination in the fresh milk producer market. An average trade margin of 45 FCFA/litre appears reasonable.

Table 9. *Distribution of fresh milk marketing margins (FCFA/litre) in the Bamako area, June and September 1990.*

Trade margin(FCFA/litre)	Sample in range		Cumulative	
	n	%	n	%
Less than -15	3	2.9	3	2.9
-15 to 0	13	12.4	16	15.3
0 to 15	4	3.8	20	19.1
15 to 30	20	19.0	40	38.1
30 to 45	15	14.3	55	52.4
45 to 60	19	18.1	74	70.5
60 to 75	9	8.6	83	79.1
75 to 90	5	4.7	88	83.8
90 to 105	15	14.3	103	98.1
over 105	2	1.9	105	100.00
	105	100	105	100.00

The study will be pursued further to include the form dimensions of the dairy trade. Analysis of data on the industrial and traditional processing channels is underway to determine the efficiency of dairy processing and distribution in the Bamako area. It is when all the channels are analysed that definite statements about dairy marketing efficiency in the Bamako area can be made.

Acknowledgements

References

Atse Atse P. 1987. *Production laitière en Côte d'Ivoire: Possibilités de développement.* These de Doctorat Vétérinaire, Ecole Nationale Vétérinaire de Toulouse, France.

Bouscharain G. 1965. *Enquête laitière dans la Republique du Tchad (Region de Fort-Lamy) effectue au titre de la Campagne Mondial contre la Faim.* FAO (Food and Agriculture Organization of the United Nations), Freedom from Hunger Campaign, March 1965. FAO, Rome, Italy. 12 pp.

Bressler G and King A. 1978. *Markets, prices and international trade.* Norman-Weathers Printing Co, Raleigh, NC, USA. 426 pp.

Debrah S and Berhanu Anteneh. 1991. *Dairy marketing in Ethiopia: Markets of first sale and producers' marketing patterns.* ILCA Research Report 19. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 21 pp.

Hollier G P. 1985. Examining allegations of exploitation and inefficiency in rural marketing systems: Some evidence from west Cameroon. *Journal of Developing Areas* 19(3):393–416.

ILCA (International Livestock Centre for Africa). 1987. *ILCA's strategy and long-term plan.* ILCA, Addis Ababa, Ethiopia. 99 pp.

Kohls R and Uhl J. 1985. *Marketing of agricultural products.* Macmillan Publishing Company, New York, USA.

von Massow V H. 1985. *Dairy imports and import policy in Mali and their implications for the dairy sector in the Bamako area.* LPU Working Paper 8. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 57 pp. + 10 appendices.

Nwoko S. 1986. *The development of dairy imports in Nigeria.* LPU Working Paper 10. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 43 pp. + 14 appendices.

Senait Seyoum. 1988. *Patterns of consumption of dairy products in West Africa.* LPU Working Paper 11. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 52 pp.

Sidibe B. 1982. *Circuit de ramassage du lait. Organisation-Cout-Proposition.* Ministère du Développement Rural. Ecole des Cadres de l'Elevage. Memoire de Fin d'Etudes: Cycle Assistant Elevage, Niger. 50 pp.

Discussion

The discussant's (Badiane) comments centred around three points: (1) technical issues relating to the sampling frame used over the two seasons of the survey and possible difficulties in capturing inter-period and seasonal changes; (2) implications of specific characteristics described in the paper for marketing promotion strategies; and (3) proposals for strengthening the analytical part of the paper. As far as the sampling framework was concerned, a sample of 150 was selected, from which 50 individuals were redrawn randomly in each season.

With respect to item (2), the discussant noted that there appeared to be an insulation of large-scale producers in the market which could shift the burden of adjustment to the unprotected and non-regulated dairy sector. Achuonjei explained there was no insulation of seasonal producers, who often preferred to sell on the informal market where prices were not controlled and were higher during the dry season, instead of belonging to a cooperative. ULB protects producers who stay with it all year round and the cooperative sets conditions which sometimes prevent private producers becoming ULB suppliers. Many sensitive issues are involved

with respect to the control of the formal market and entry to cooperatives and the study can only provide recommendations.

Synthesising the information gathered by Achuonjei in tabular form, the discussant noted under (3) that more could have been done to explain interlinkages between such characteristics as direct sales, marketing channels, producer prices, price variation and trade margins in the dry and rainy seasons. For example, the low proportion of direct sales and the longer marketing channels in the rainy season may explain the large price differences between channels in the rainy season. Similarly, the low share of deliveries to ULB may be explained by the increased proportion of marketed quantities in the urban unregulated markets. The analysis could also address potentially desirable changes and adjustments required to bring changes in these seasonal patterns, e.g. high product prices in the rainy season or less price variability.

Marketing efficiency, pricing and policy implications: A case study of milk marketing in Addis Ababa, Ethiopia[1]

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Introduction

Dairying is an important economic activity in sub-Saharan Africa. However, sub-Saharan Africa has not performed satisfactorily in terms of achieving self-sufficiency in dairy products over the last two decades. As a result, the level of dairy imports into the region has continued to increase rapidly since the 1960s (Mbogoh, 1984; von Massow, 1984). Given this situation, there is a dire need to intensify efforts and improve dairy production in sub-Saharan Africa.

Efforts to improve dairy production should be accompanied by improvements in the marketing system to ensure that: (i) there are sufficient outlets to cater for increased output of dairy products; (ii) the marketing system provides incentives to producers to provide the goods and services required by the consumers at prices they are willing to pay. In other words, the marketing system should be efficient. The concept of efficient marketing is explained later in this paper.

The problem

Alternative organisational structures of marketing systems may be expected to differ in their efficacy in achieving different goals of marketing policies. Yet many dairy development projects in sub-Saharan Africa have been accompanied by

the establishment of government marketing organisations without any evaluation of whether these would be the appropriate type of marketing system. Often, such government marketing organisations have been granted monopoly and/or monopsony power over dairy marketing.

An important policy question that arises is whether, for a given country, it would be advisable to encourage the development of either only government marketing organisations or only private marketing organisations, or a combination of both to achieve efficiency in marketing.

Earlier inferences about economic performance of the informal[2] marketing system (in terms of marketing efficiency) tended to suggest that such systems perform relatively poorly and that the only way to improve their performance is through increased government intervention. However, such inferences were largely based on casual impressions of activities in traditional market places. Detailed studies of marketing systems for live animals in sub-Saharan Africa give somewhat conflicting results (see, for instance, Hillman and Ayele Gebre Mariam, 1975; Herman, 1979; Staatz, 1979; Ariza-Nino et al, 1980; and Solomon Bekure et al, 1982). Whereas the studies in West Africa and Ethiopia suggest that the performance of informal livestock marketing systems is better than that of the systems in which governments actively intervene, the study by Solomon Bekure et al (1982) in Kenya suggests that there is no uniform picture. That study also gives a less favourable impression of the efficiency of informal marketing systems.

Available literature on the performance of government dairy marketing organisations does not give a clear or uniform picture either. Some government marketing organisations appear to have been relatively successful, while others have had some serious difficulties in fulfilling the objectives for which they were established, and this picture has varied among countries (Mbogoh, 1984). The review of available literature also does not give a precise and uniform picture of the performance of informal dairy marketing systems relative to the ones owned by the governments (ILCA, 1979; Mbogoh, 1984). The current state of knowledge about the structure and performance of alternative forms of dairy marketing systems in sub-Saharan Africa thus clearly indicates the need for further investigations.

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2. The term "informal" is often used to describe marketing systems in which governments do not intervene substantially. Such marketing systems are also referred to as parallel markets. The term "formal" is thus used to describe government (official) marketing systems.

Methodology

Conceptual framework

The objective of this study was to evaluate the relative efficiency of the different systems through which dairy products are marketed in Addis Ababa and its immediate environs (i.e. the catchment area for fresh milk within a 130 km radius of the city of Addis Ababa) by studying households' purchasing patterns for fresh liquid milk with the aim of drawing relevant policy implications.

Ideally, a dairy marketing study should involve a close scrutiny of one or more of the following: (i) marketing options of all the different kinds of producer; (ii) marketing activities of all the different kinds of middlemen, and (iii) purchasing patterns of all the different kinds of consumer. Because of time and resource constraints, a case-study approach was adopted for this study. The case study examined the marketing system for fresh liquid milk in Addis Ababa and its immediate environs from the retail end of the system to determine the relative efficiency of alternative marketing systems for dairy products. Aspects examined were: (i) consumer price levels, (ii) the types, reliability and stability or flexibility of the services offered to the consumers, (iii) the responsiveness of alternative marketing systems to consumer demands and (iv) the contribution of the alternative marketing systems to the maintenance or achievement of some specified goals of marketing policies, such as product quality and hygiene standards.

Sampling frame and procedures

Addis Ababa was mapped out and divided into three concentric zones, the inner, middle and peripheral zones, differentiated on the basis of distance from the perceived location of the city centre. The expectation was that location would influence the types of marketing chain through which consumers procure a given product.

For the purposes of official statistical data collection, Addis Ababa is mapped into about 1200 Enumeration Areas (EAs) by the Central Statistical Office of the Government of Ethiopia (CSO, 1979). Each EA covers between 150 and 200 households on average. The EA was adopted as the basic sampling unit, and 25 EAs were randomly selected for this study. The 25 EAs were each allocated to one of the three study zones with the numbers of EAs selected from each zone being proportional to the total number of EAs in that zone. The monthly cash income of each household in the selected 25 EAs was listed to serve as the sampling frame for this study.

Discriminant analysis of the results from a pilot survey which had been conducted by ILCA in July and August 1984 (Mbogoh and Negussie Tilahun,

1984) had indicated that any household whose average monthly cash income was at least 250 Ethiopian Birr (US$ 1= EB 2.07) had at least an 80% chance of being a milk consumer. On the basis of this finding, 20 households were selected for further interviews from each of the selected 25 EAs according to the following criteria:

(i) Sixteen households should have an average cash income of at least EB 250 per month.

(ii) Four households should have an average cash income of less than EB 250 per month but should have purchased some milk at least once during the week prior to the date on which the households' monthly cash incomes were listed.

This selection procedure aimed at obtaining a sample of households that were likely to be milk consumers. It was justified on the grounds that only those households that could provide information that could be used to ascertain the marketing chains for dairy products in Addis Ababa were relevant to the study. The sampling procedure was expected to identify 500 households for further interviews.

Methodological issues: Performance assessment

The relative efficiency of the alternative marketing systems for fresh milk in Addis Ababa was evaluated by both least-cost and other partial efficiency criteria. An index of relative least-cost efficiency can easily be constructed where all systems sell the same quality of milk: those systems that charge the lowest price per litre would be judged to be the most efficient by the least-cost criterion. But in Addis Ababa the different systems do not all sell milk of the same quality. Hence it became necessary to find some common standard by which different qualities of milk could be compared to each other. Retail prices of fresh milk obtained from the various sources were also investigated.

In many countries a minimum quality standard for commercial firms selling milk in urban areas is specified in terms of a minimum butterfat content. Such is the case in Kenya. This study found that in Addis Ababa the milk-consuming households did not rank butterfat content as a major factor influencing them to purchase milk from particular sources more frequently than from others. Nevertheless the government Dairy Development Enterprise (DDE) in Ethiopia aims to sell milk with a minimum butterfat content of between 2.7% and 3.0% and there is no doubt that in many people's judgement the amount of butterfat is important in determining the quality of milk. Therefore, butterfat content was used as the standard by which different qualities of milk were compared to each other. Two other standards, solids-non-fat and total solids, were also generated but not used in the analysis. These milk quality standards were assessed from liquid milk

samples that were collected from the Addis Ababa households during the course of the subsequent surveys.

For the purpose of analysing milk quality and its application in the evaluation of the efficiency of the different milk marketing systems, the city of Addis Ababa was treated as a uniform zone because it was not possible to obtain enough milk samples from each of the three study zones for a statistically significant comparison. On the basis of milk levels, the relative efficiency index (REI) for the different marketing systems for liquid milk was derived from the following relationships:

$$PEI = P^*/BF$$

where:

PEI = "quality-adjusted" least-cost efficiency index for the particular marketing system;

P^* = average price of milk sold through the particular marketing system;

BF = average butterfat content (%) of the milk purchased from the particular marketing system.

The system that had the lowest PEI was judged to be the most least-cost efficient, and the milk-quality-adjusted relative efficiency index (REI) for each of the other marketing systems was obtained by dividing the PEI of the most least-cost-efficient system by the PEI of each of the other marketing systems, i.e.:

$$REI_{(x)} = \frac{PEI_{(pes)}}{PEI_{(x)}}$$

where:

$REI_{(x)}$ = the milk-quality-adjusted relative efficiency index for system x;

$PEI_{(pes)}$ = quality-adjusted least-cost efficiency index for the system that is judged to be the most price efficient;

$PEI_{(x)}$ = quality-adjusted least-cost efficiency index for system x.

Hence REI is a measure of the relative efficiency of the marketing system, adjusted for milk quality.

The degree of responsiveness of the different marketing systems to consumers' demands is a broad, powerful and frequently used partial efficiency criterion. The relative responsiveness of different marketing systems can partly be measured by the range of services they offer to consumers and is partly reflected in the extent to which consumers choose to patronise them. Based on the range of

these services, one is also able to develop a number of other partial efficiency criteria for the marketing system.

The range of services that the alternative marketing systems for liquid milk in Addis Ababa offer to consumers was determined by asking the consumers to state why they purchased milk regularly from particular sources and to identify the single most important reason.

Data, frequency of data collection and purposes

Three broad sets of data were collected using trained research assistants:

- data from the exploratory survey
- data from the initial survey
- data from subsequent surveys.

The exploratory survey of the consuming households involved a one-time interview of each household in the 25 EAs covered by the study, primarily as the basis for generating the data to be used in further sample selection procedures. A sample of 3888 households (close to 2% of all the households in the city) were interviewed to obtain information on their sources and levels of monthly cash income and to determine the origin of any milk that had been acquired during the week prior to the interview. The origin of the milk was defined in terms of whether the milk was produced by the households, purchased or obtained as a gift.

The initial survey of the consuming households involved a one-time interview of each household and was conducted on a stratified random sample of 482 households, which had been drawn from the exploratory survey sample partly on the basis of the level of monthly household cash income and partly on the basis of whether the household had purchased any milk during the week prior to the exploratory survey interview. The initial survey was designed to determine the long-term ("normal") patterns of acquisition and consumption of milk by the selected households.

The subsequent surveys of the selected consuming households involved only those households covered by the initial survey who were found to consume milk. Each of these milk-consuming households was interviewed on seven consecutive days to determine the major factors that influenced them to deviate from their long-term milk purchasing and consumption patterns. Such deviations were defined primarily in terms of changes in the sources and geographical locations of the places from which the households purchased and collected milk.

The data were analysed primarily using the SPSS (Statistical Package for Social Sciences) programme.

Results and discussion

Households with an average monthly cash income of at least EB 250 were classified as belonging to the High-Income Group (HIG); the others were classified as belonging to the Low-Income Group (LIG).

The exploratory survey showed that only about 27% of households had acquired milk for consumption at least once during the week prior to the interview. The milk had been purchased in 90% of the cases. The rest had been acquired through own-production and as gifts. About 67% of milk consumers were from the HIG category. Thus household cash income would appear to be an important determinant of milk consumption.

Milk marketing systems in Addis Ababa

Five marketing systems for fresh milk in Addis Ababa were identified:

(i) direct sales to consumers by producers (system S_1)

(ii) sales to consumers by *kebele*[3] shops and other government sales outlets (i.e. outlets other than grocery stores, supermarkets and small private shops or kiosks) (S_2)

(iii) sales to consumers by itinerant traders (S_3)

(iv) sales to consumers by small private shops and kiosks (S_4) and

(v) sales to consumers by grocery stores and supermarkets (S_5).

Figure 1 illustrates the complexity of the marketing chains in Addis Ababa. The percentage share of each system in the total amount of milk purchased by consuming households is shown in brackets. The study did not investigate the details of the intermediate stages in the marketing process.

Further, it was established that the S_1 system had three subsystems:

- S_{11}: purchases of milk directly from producers whose cows are kept in the same *kebele* where the consuming households live

- S_{12}: purchases of milk from producers whose cows are kept within Addis Ababa but outside the *kebele* of the consuming households and

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3. Urban dwellers' association, the smallest administrative unit within an urban area or city in Ethiopia.

- S_{13}: purchase of milk from producers whose cows are kept outside Addis Ababa.

The relative importance of alternative systems by city zones

Table 1 shows the relative importance of the five milk marketing systems in terms of their share of purchases by consuming households in the different zones of the city. The total market for fresh milk in this context is defined in terms of volume.

Figure 1. *Alternative marketing chains and marketing systems for liquid milk in Addis Ababa, Ethiopia (estimated market share by volume is given in brackets).*
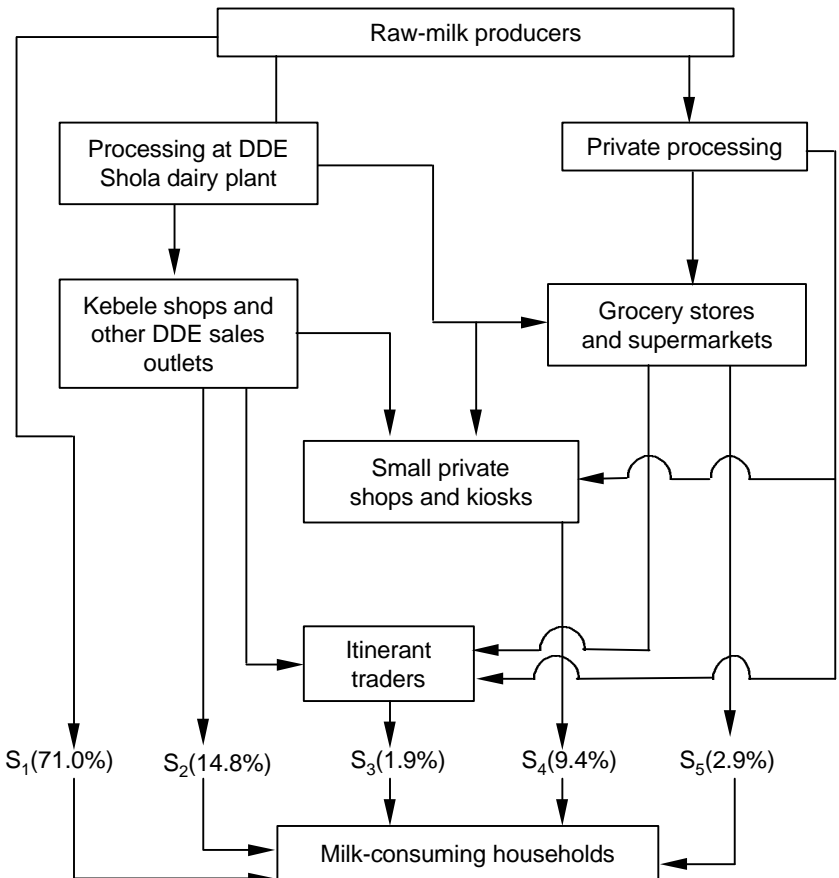
Table 1. *Relative shares by volume of alternative milk marketing systems[1] in different zones of Addis Ababa, Ethiopia.*

Zone and sample size	Market share (% by volume)				
	S_1	S_2	S_3	S_4	S_5
Middle (n = 177)	67.7	16.6	2.3	8.6	4.8
Peripheral (n = 124)	88.8	3.3	0.7	7.1	0.1
Overall (n = 395)	71.0	14.8	1.9	9.4	2.9

1. S_1= direct sales by neighbourhood producers.
S_2= sales by *kebele* shops/DDE sales outlets.
S_3= sales by itinerant traders.
S_4= sales by small private shops/kiosks.
S_5= sales by grocery stores/supermarkets.

The results presented in Table 1 demonstrate the general dominance of the direct sales from producers to consumers (S_1). However, systems S_2 and S_4 are also important, particularly in the inner and middle zones of the city.

An assessment of the relative importance of the three S_1 subsystems in the different zones of Addis Ababa indicated that subsystem S_{11} was dominant in the peripheral zone, while subsystem S_{12} was dominant in the middle and inner zones. Subsystem S_{13} was relatively unimportant in all three zones.

The relative efficiency of the alternative marketing systems

The average milk-quality indicators, i.e. the butterfat (BF) and solids-non-fat (SNF) contents, for the milk samples procured from the different marketing systems are presented in Table 2. There were substantial variations in both BF and total solids (TS) contents among the marketing systems. The differences in BF content between sources was highly significant ($P< 0.001$). There were no significant differences in SNF content between marketing systems.

Average retail price of milk varied from EB 0.76/litre in system S_2 to EB 1.00/litre in system S_5. P^* (average quality-unadjusted retail milk prices), calculated values of PEI (the quality-adjusted price efficiency index) and REI (the relative efficiency index for each marketing system) are summarised in Table 3.

Subsystem S_{13} provides milk of the highest quality at the lowest retail price in Addis Ababa (Table 3). It is thus the most least-cost-efficient milk delivery system, with a quality-adjusted price efficiency index (PEI) of 14.48. The relative efficiency of the other milk marketing systems is thus based on the efficiency of S_{13}. Ranking of the systems on the basis of price does not necessarily correspond to the ranking on the basis of quality-adjusted least-cost and relative efficiency indices.

Table 2. *Average milk solids by source in Addis Ababa, Ethiopia.*

Marketing system[1]		Average content (%)		
		Butterfat	Solids-non-fat	Total solids
	S_{11}	3.67	8.26	11.93
S_1	S_{12}	3.65	7.98	11.63
	S_{13}	4.90	9.12	14.02
S_2		2.46	8.24	10.70
S_3		3.75	7.90	11.65
S_4		2.48	7.96	10.44
S_5		2.50	8.31	10.81

1. S_1= direct sales by neighbourhood producers.
   S_2= sales by *kebele* shops/DDE sales outlets.
   S_3= sales by itinerant traders.
   S_4= sales by small private shops/kiosks.
   S_5= sales by grocery stores/supermarkets.

Table 3. *Milk prices, quality and least-cost efficiency in alternative milk marketing systems, Addis Ababa, Ethiopia.*

Marketing system[1]		P^* (EB/litre)	BF (%)	PEI	REI
	S_{11}	0.90	3.67	24.52	0.59
S_1	S_{12}	0.88	3.65	24.10	0.60
	S_{13}	0.71	4.90	14.48	1.00
S_2		0.76	2.46	30.89	0.47
S_3		0.90	3.75	24.00	0.60
S_4		0.87	2.48	35.08	0.41
S_5		1.00	2.50	40.00	0.36

1. S_1= direct sales by neighbourhood producers.
   S_2= sales by *kebele* shops/DDE sales outlets.
   S_3= sales by itinerant traders.
   S_4= sales by small private shops/kiosks.
   S_5= sales by grocery stores/supermarkets.

P^* = unadjusted price.

BF = butterfat content.

PEI = quality-adjusted price efficiency index (P^*/BF).

REI = relative efficiency index.

The average prices charged to different income groups for milk flowing through alternative systems was also investigated. The difference in average price of milk between sources and income classes was highly significant in the inner and

middle zones of the city. Table 4 presents the average prices paid by the different income classes for milk sold through the alternative milk marketing systems in the different zones of the city.

Higher-income households tend to pay slightly more for liquid milk than do poorer households. This suggests that the poorer consumers are more sensitive to price levels.

Table 5 indicates the percentage of consuming households of different income classes in the different city zones who cited each of the indicated reasons as the major factor that influenced their choice of source of milk. The differences in reasons indicated between income groups within zones were not statistically significant.

Tables 6, 7 and 8 present a summary of the performance of the alternative marketing systems in the inner, middle and peripheral zones of Addis Ababa, respectively, in terms of efficiency criteria that reflect the systems' responsiveness to consumer demand. The selected partial efficiency criteria are price, butterfat content, total solids and degree of unreliability.

Table 4. *Average price of fresh milk by marketing system, income class and zone in Addis Ababa, Ethiopia.*

		Average price of fresh milk (EB/litre)							
		Inner zone		Middle zone		Peripheral zone		Overall	
Marketing system[1]		LIG n= 53	HIG n= 41	LIG n= 97	HIG n= 80	LIG n= 58	HIG n= 66	LIG n= 208	HIG n= 187
	S_{11}	0.95	0.91	0.85	0.91	0.86	0.92	0.88	0.91
S_1	S_{12}	0.90	0.87	0.84	0.87	0.86	0.84	0.86	0.86
	S_{13}	0.67	NA	0.60	NA	0.86	NA	0.69	NA
S_2		0.76	NA	0.73	NA	0.83	0.90	0.77	0.90
S_3		0.82	NA	0.90	NA	0.80	NA	0.85	NA
S_4		0.86	NA	0.88	0.85	0.87	0.81	0.87	NA
S_5		1.00	NA	0.80	NA	NA	NA	0.87	0.88
Mean		0.85	0.89	0.80	0.89	0.85	0.87	0.83	0.88

1. S_1= direct sales by neighbourhood producers.
   S_2= sales by *kebele* shops/DDE sales outlets.
   S_3= sales by itinerant traders.
   S_4= sales by small private shops/kiosks.
   S_5= sales by grocery stores/supermarkets.

LIG = low-income group: average monthly cash income of less than EB 250.

HIG = high-income group: average monthly cash income of at least EB 250.

NA = Not available, since no relevant respondent in this class.

n = Number of households responding.

Table 5. *Major reason for choice of source of milk, by zone and household income class, Addis Ababa, Ethiopia.*

	Households citing reason (%)							
	Inner zone (n= 87)		Middle zone (n= 167)		Peripheral zone (n= 109)		Overall (n= 363)	
Main reason for choice of source	LIG (n= 28)	HIG (n= 59)	LIG (n= 59)	HIG (n= 108)	LIG (n= 30)	HIG (n= 79)	LIG (n= 117)	HIG (n= 246)
Convenience when collecting	32.1	28.8	22.0	30.6	33.3	21.5	27.1	27.2
Availability of milk when needed	21.4	10.2	15.3	12.0	6.7	13.9	14.5	12.2
Regularity of supply	10.7	16.9	11.9	15.7	10.0	5.1	11.1	12.6
Hygiene and cleanliness	14.3	11.9	20.3	22.2	36.7	27.8	23.1	21.5
Good price	14.3	11.9	15.3	7.4	0.0	10.1	11.1	9.3
Butterfat content	0.0	5.1	0.0	0.9	0.0	2.5	0.0	2.8
Taste of milk	0.0	5.1	0.0	1.9	0.0	2.5	0.0	2.8
Freshness of milk	0.0	6.8	10.2	0.9	3.3	7.6	6.0	4.5
Home delivery service	0.0	1.7	3.4	5.6	0.0	3.8	1.7	4.1
Packaging of milk	3.6	0.0	1.7	0.9	0.0	0.0	1.7	0.4
Other	3.6	1.7	0.0	1.9	10.0	5.1	3.4	2.8

n = number of respondents.

LIG = low-income group: average monthly cash income of less than EB 250.

HIG = high-income group: average monthly cash income of at least EB 250.

Table 6. *Performance of alternative milk marketing systems in the inner city zone, Addis Ababa, Ethiopia.*

Partial efficiency criterion	Marketing system[1]				
	S_1	S_2	S_3	S_4	S_5
Mean price (Eth. cents/litre)	89.10	75.14	83.07	85.22	100.00[a]
(standard deviation)	(8.23)	(7.85)	(3.09)	(4.88)	(0.00)
Mean % butterfat	3.87	2.87	3.30[a]	NA	2.50[a]
(standard deviation)	(0.92)	(0.15)	(0.00)[a]		(0.00)
Mean % total solids	12.36	12.69	11.30[a]	NA	10.81[a]
(standard deviation)	(1.21)	(0.75)	(0.00)		(0.00)
Degree of unreliability[2]	0.0	1.0	0.0	0.3	0.0

1. S_1= direct sales by neighbourhood producers.
   S_2= sales by *kebele* shops/DDE sales outlets.
   S_3= sales by itinerant traders.
   S_4= sales by small private shops/kiosks.
   S_5= sales by grocery stores/supermarkets.

2. Percentage of purchase occasions when this marketing system was not used because no milk was available.

a. Reported on only one occasion by one consumer.

NA = system not used or absent in the zone.

A total of 94 observations were made covering all systems.

Table 7. *Performance of alternative milk marketing systems in the middle city zone, Addis Ababa, Ethiopia.*

Partial efficiency criterion	Marketing system[1]				
	S_1	S_2	S_3	S_4	S_5
Mean price (Eth. cents/litre)	85.74	73.11	90.00	86.89	95.31
(standard deviation)	(8.85)	(7.01)	(20.00)	(6.14)	(5.44)
Mean % butterfat	3.47	2.32	4.20[a]	2.20	NA
(standard deviation)	(1.05)	(0.59)	(0.00)	(0.96)	
Mean % total solids	11.40	10.04	12.00[a]	9.79	NA
(standard deviation)	(1.71)	(1.95)	(0.00)	(1.40)	
Degree of unreliability[2]	0.0	0.8	0.0	0.8	0.2

1. S_1= direct sales by neighbourhood producers.
   S_2= sales by *kebele* shops/DDE sales outlets.
   S_3= sales by itinerant traders.
   S_4= sales by small private shops/kiosks.
   S_5= sales by grocery stores/supermarkets.

2. Percentage of purchase occasions when this marketing system was not used because no milk was available.

a. Reported on only one occasion by one consumer.

NA = system not used or absent in the zone.

A total of 173 observations were made covering all systems.

Table 8. *Performance of alternative milk marketing systems in the peripheral city zone, Addis Ababa, Ethiopia.*

	Marketing system[1]				
Partial efficiency criterion	S_1	S_2	S_3	S_4	S_5
Mean price (Eth. cents/litre)	86.67	75.83	80.00	86.99	86.00[a]
(standard deviation)	(11.15)	(22.33)	(28.28)	(4.75)	(0.00)
Mean % butterfat	3.85	2.60[a]	NA	2.77	NA
(standard deviation)	(1.03)	(0.00)		(0.23)	
Mean % total solids	12.19	11.26[a]	NA	11.11	NA
(standard deviation)	(1.49)	(0.00)		(0.42)	
Degree of unreliability[2]	0.0	0.7	0.0	0.9	0.1

1. S_1= direct sales by neighbourhood producers.
   S_2= sales by *kebele* shops/DDE sales outlets.
   S_3= sales by itinerant traders.
   S_4= sales by small private shops/kiosks.
   S_5= sales by grocery stores/supermarkets.

2. Percentage of purchase occasions when this marketing system was not used because no milk was available.

a. Reported on only one occasion by one consumer.

NA = system not used or absent in the zone.

A total of 122 observations were made covering all systems.

Marketing systems S_1 and S_3 were least unreliable in all three zones of Addis Ababa, providing milk whenever required. However, in terms of the "least-cost" criterion, the performance of the different marketing systems varies between zones but system S_2 is the most efficient by this criterion.

This evaluation of the relative efficiency of alternative marketing systems on the basis of single attributes simply underscores the fact that the rating of market performance of different marketing systems will vary depending on the criterion used in the performance assessment.

Summary, conclusions and policy implications

This paper presents the results of a study of the relative efficiency of alternative milk marketing systems in Addis Ababa, Ethiopia.

The results indicate that low-income households do not significantly differ from high-income ones in the reasons they cite for choosing to use particular milk marketing system. Nevertheless, they tend to use different marketing systems from those used by high-income households.

An important concern of the study was to assess the relative merits of alternative marketing systems. A number of partial efficiency criteria were established and evaluations based on these formed the basis on which the relative efficiency of the different marketing systems was assessed.

Based on prices charged in relation to the quality of the liquid milk sold, system S_1 (direct sales by producers) was judged to be the most efficient marketing system, with its component subsystem S_{13} (milk sales by producers who keep their cows outside Addis Ababa) contributing most to that level of efficiency. However, on the basis of retail price alone, ignoring quality, *kebele* shops or government sales outlets were the cheapest source of milk for lower-income consumers in all three zones of Addis Ababa.

On the basis of the types and level of services offered to consumers, and considering the consumers' views on the relative importance of these services, system S_1 was judged to be the most efficient in all zones overall. This system was also judged to be the most efficient for all income classes in all zones, except among low-income households in the inner city zone where system S_2 (*kebele* shops/DDE sales outlets) was judged to be the most efficient.

Finally, it was found that the Addis Ababa households surveyed do not rank price highly as a factor that influences their choice of the marketing system from which to purchase milk. However, a major objective of the government marketing policies for liquid milk in Addis Ababa, and in Ethiopia in general, is to provide wholesome milk at reasonably low consumer prices. Further, the results of this study indicate that the Ethiopian government's concern to provide liquid milk at low prices to lower-income families through *kebele* shops and other government sales outlets is only partially met because there are some sources other than *kebele* shops or government sales outlets in every zone of the city which appear to be used more extensively even by the small proportion of lower-income consumers who purchase liquid milk. This occurs despite the fact that the *kebele* shops or the government sales outlets are usually the cheapest source of milk. This suggests that consumers in Addis Ababa do not consider the current milk price levels high, despite the large variation in prices among the different suppliers. This further suggests that consumers in Addis Ababa could still absorb some increases in consumer prices without choking off their demand. This has important policy implications.

Price is an important instrument in the management and implementation of marketing policies. The Ethiopian government, through the DDE, is currently supplying about 15 to 25% of the milk consumed by Addis Ababa households, but it is in most cases the lowest price supplier in the market. It is also worth noting that, although the official retail price for DDE milk at the time of the survey was EB 0.70 per litre, low-income consumers reported paying, on average, 10% more and high-income consumers 25% more than this price at official outlets. This suggests that consumers are paying a substantial premium to ensure a

secure supply. Only about 60% of the milk supplied through *kebele* shops and DDE outlets goes to low-income households and only about 8% of all low-income households in Addis Ababa regularly use these outlets.

The results of the study suggest that there is some scope for a rise in the official retail price of milk at government-controlled sales outlets. Such a price rise might not greatly affect the actual prices paid by customers at these outlets since it might occur mainly at the expense of the unofficial "premium" of 10–25% mentioned above. If the actual retail price did rise, only a small proportion of low-income households in Addis Ababa would be expected to suffer. There are probably just over 200,000 households in Addis Ababa, of whom about 160,000 are "low-income". Of these low-income households only about 9% (i.e. about 14,000) acquire milk at all, while only about 23% of these (i.e. about 3000 families) do so from the official outlets. A 10-cent (14%) rise in the official retail price of a litre of milk would, on average, cost these families about EB 1.00 a month.

Ethiopia is not self-sufficient in dairy products. A rise in the official retail price might have two consequences. It would enable the DDE to make a bigger profit from the sale of reconstituted milk made from raw materials acquired free through food aid and this profit could be invested in dairy development. This would enable higher prices to be paid to milk producers around Addis Ababa, giving them greater financial incentive to produce more milk. However, it is beyond the scope of this paper to predict whether the additional profits by DDE would be usefully invested or how large an effect on milk output a 10 cent per litre rise in the producer price would have.

Both low- and high-income groups of households use other retail sources of milk considerably more frequently than they do the *kebele* shops and other official DDE sales outlets, even though the latter sell milk at lower prices. This, together with the reasons they give for their choice of source, indicates that they are interested in things other than price. A government policy which took these other considerations into account might serve the interests of both income classes. Particular attention might best be directed at customer convenience when collecting the product, regularity and reliability of supply and hygiene and clean premises from which milk is to be sold.

These appear to be the services most sought after by customers. The results of this study clearly demonstrate that no single dairy marketing system gives the best economic performance. A mix of private and government dairy marketing systems appears to perform better than government marketing systems alone.

References

Ariza-Nino E J, Herman L, Makinen M and Steedman C. 1980. *Livestock and meat marketing in West Africa: Vol. 1: Synthesis Upper Volta.* Center for Research on Economic Development, University of Michigan, Ann Arbor, Michigan, USA.

CSO (Central Statistical Office). 1979. *Report on the analysis of the Addis Ababa demographic survey, September 1978.* CSO Statistical Bulletin 22. CSO, Addis Ababa, Ethiopia.

Herman L. 1979. The livestock and meat marketing system in Upper Volta: Summary evaluation of economic efficiency. In: Shapiro K H (ed), *Summary report from the Livestock Production and Marketing in the Entente States of West Africa Project.* Center for Research on Economic Development, University of Michigan, Ann Arbor, Michigan, USA.

Hillman M and Ayele Gebre Mariam. 1975. *A report on the Central Highlands (Ethiopia) livestock market survey.* Livestock and Meat Board, Addis Ababa, Ethiopia.

ILCA(International Livestock Centre for Africa). 1979. Economic trends: Dairy products. *ILCA Bulletin* 4. ILCA, Addis Ababa, Ethiopia.

von Massow V H. 1984. *Dairy imports in sub-Saharan Africa: Development and policies.* LPU Working Paper 4. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Mbogoh S G. 1984. *Dairy development and internal dairy marketing in sub-Saharan Africa: Performance, policies and options.* LPU Working Paper 5. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Mbogoh S G and Negussie Tilahun. 1984. *Results of a pilot survey on household dairy product purchase patterns in Addis Ababa.* Dairy marketing study in Ethiopia, Pilot Survey Phase, Report 1. LPU (Livestock Policy Unit), ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Solomon Bekure, Evangelou P and Chabari F. 1982. *Livestock marketing in eastern Kajiado, Kenya.* ILCA/Kenya Working Document 23. ILCA (International Livestock Centre for Africa), Nairobi, Kenya.

Staatz J. 1979. *The economics of cattle and meat marketing in Ivory Coast.* Livestock Production and Marketing in the Entente States of West Africa Project. Monograph II. Center for Research on Economic Development, University of Michigan, Ann Arbor, Michigan, USA.

Discussion

The discussant, Getachew Asamenew, noted the difficulty of relying on household income data as a basis for sampling in marketing studies in Africa in general, and Ethiopia in particular. He asked for an indication of the likely influence of such factors as family size and age structure (which were not considered in the study) on volume of milk consumed and prices. Clarification was also requested regarding the author's conclusion that Addis Ababa households do not rank price as a major factor in their choice of marketing systems from which to buy milk.

The general discussion focused on the appropriateness of the partial efficiency method in quantifying such variables as convenience of delivery, cleanliness of milk sale premises and consumer tastes, and in allowing policy recommendations of the type made in the paper. Mbogoh's findings show that, at different outlets, there are substantial differences in the prices paid by consumers which are related to several

factors, such as convenience, hygiene, reliability and consumer preferences. Quantifying these variables in terms of an acceptable efficiency index is difficult. However, if market efficiency is to be measured effectively, these variables need somehow to be integrated.

Other observations made in the course of the discussion related to the need for taking account of consumer behaviour and factors underlying it in any study of the choice of milk supply sources and the need to relate the conclusions reached by Mbogoh and Debrah so as to increase market efficiency on both the consumer and the producer side.

Dairy marketing by intra-urban, peri-urban and rural dairy producers near Addis Ababa, Ethiopia

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Abstract

This paper reports on a study conducted on the marketing options and patterns of three categories of dairy producer: intra-urban producers, peri-urban producers and rural producers within an 85 km radius of Addis Ababa, Ethiopia. The range of marketing outlets available to each category of producer was identified, the relative intensities of outlet use and the factors influencing producer choice of alternative market outlets for the different producer groups were analysed. The sample, consisting of 173 dairy producers representative of the three categories of producer, was interviewed on seven consecutive days in March, May and June 1986. Sixty-nine per cent of the total volume of intra-urban producer sales and 96% of that of peri-urban producers was sold to institutions in Addis Ababa despite the higher net prices offered by direct sales to individual consumers. Large producers consider the high labour costs of selling milk directly to individual consumers too high relative to the costs of delivering milk in bulk to the institutions. Rural producers located near fresh milk-collection centres sold almost all their milk at the collection centres. Their proximity reduces the costs of transportation, thereby making the net prices relatively higher than the price they would obtain by transporting their milk for sale in Addis Ababa.

Introduction

Dairy production in sub-Saharan Africa (SSA) can be categorised into traditional and improved production systems. The traditional system includes subsistence, pastoralist and agropastoralist systems. The improved production system

includes intensive smallholder systems and urban/peri-urban, semi-intensive/intensive dairying systems.

Given the diversity of dairy production, and the wide dispersion of consumers in the subregion, the importance of a well-functioning dairy marketing system cannot be over-emphasised. When performing efficiently, the market provides information from consumers to producers who, in turn, respond to price signals by producing commodities in quantities and forms commensurate with prices and costs. An efficient marketing system is therefore beneficial to both consumers and producers.

In SSA, dairy products are marketed through both formal and informal systems. The informal marketing system, which is the more dominant of the two and the most widely practised in the traditional production system, involves sales direct from producers to final consumers or indirect sales through market intermediaries. The formal marketing system, which usually serves the urban/peri-urban clientele, involves organised milk collection, processing and distribution. These activities are often government controlled and prices are officially sanctioned. Examples of such formal dairy marketing systems in SSA are the Kenya Cooperative Creameries (KCC), the Dairy Development Enterprise (DDE) of Ethiopia, the Dairy Produce Board (DPB) of Zambia and the Union Laitière de Bamako (ULB) of Mali.

Both the formal and informal dairy marketing systems in SSA are allegedly inefficient. The former is charged with the exploitative practices of the large-scale parastatal organisations while the informal market is allegedly inefficient because of redundant activities by the numerous middlemen in the dairy trade. These allegations have not been adequately studied, hence the merits and demerits of the alternative dairy marketing systems remain unclear.

This paper reports on a study conducted on the marketing options and marketing patterns of three categories of dairy producer: intra-urban producers, peri-urban producers and rural producers within an 85 km radius of Addis Ababa, Ethiopia. The range of marketing outlets (markets of first sale) available to each category of producer was identified, the relative intensities of outlet use (estimates of throughput of each outlet) and the factors influencing producer choice of alternative market outlets were analysed.

The dairy marketing system in Ethiopia

In Ethiopia fresh milk is marketed through both formal and informal channels. The informal channel involves direct and indirect sales to consumers. In direct transactions, producers sell directly to final consumers at the farm gate, in their immediate neighbourhoods or in the city of Addis Ababa or nearby towns. Milk is transported by people on foot, by horse, by donkey or by public or private transport. Producers also sell indirectly to consumers through itinerant traders.

The formal marketing channel is dominated by the Dairy Development Enterprise (DDE), which functions as a milk collector, processor and distributor. The DDE has processing facilities with capacities of 60,000 litres a day in Addis Ababa and 7000 litres a day in Asmara. Milk-collection centres are located within a 120 km radius of Addis Ababa. It is estimated that DDE collects 59% of its daily total from state farms, 11% from peri-urban dairies and 30% from its milk-collection centres; these are situated along the principal routes leading to the city and are served by about 2700 small producers (Debrah and Berhanu Anteneh, 1990). Unlike in the highlands of Peru, where the milk-collection centres restrict suppliers to a 30-litre daily minimum delivery (Mosley, 1982), DDE has no quantity limits. Fresh milk presented for sale at the collection points is however, tested for quality. Producer prices are fixed at Ethiopian birr (EB) 0.50/litre (US\$ 1 = EB 2.07) year-round and payments are made to suppliers once a month.

The study area

The survey was conducted in the Shewa administrative region in central Ethiopia. Shewa has a population density about 75 people/km^2, compared with an average of 32 people/km^2 for the rest of Ethiopia. The region is home to 21% of the country's 26 million cattle and is considered the region with the greatest potential for dairy production in Ethiopia. Three-quarters of Shewa region lies in the Ethiopian highlands, ranging in altitude from 1500 m to 3500 m. Both agropastoral and urban/peri-urban production systems are represented. The remainder of the region lies in the lowlands (at less than 1500 m) where pastoral dairy production predominates. The principal routes leading into Addis Ababa, on which the DDE milk-collection centres are situated, are in the study area.

Conceptual framework

Dairy production in the study area is widely dispersed. The markets for dairy products are similarly scattered, although there is a high concentration of consumption of fresh milk and other dairy products in and around the capital city of Addis Ababa. Dairy producers in the study area thus have a wide range of market outlets through which to market different dairy products.

In a well-functioning marketing system, producers are free to market their products through the outlets of their choice. The decision to market a given product through a particular market outlet is a function of producer price and the cost of transfer from the site of production to that market outlet. According to Fetter (1924), the boundary between two competing markets for the same product is a locus of points so situated that the site prices (market price net of transfer cost) for shipments made to the competing markets are equal.

Consider markets A, B, C and D in Figure 1, which compete for fresh milk in a producing area. Let the Ts represent the transfer costs (terminal costs such as handling and packaging plus transport costs) of shipping fresh milk from the production site to the respective markets. Suppose producer prices for fresh milk are represented by P_a, P_b, P_c and P_d, then the site price (SP) in each of the markets is defined as the difference between the Ps and the Ts, and corresponds to the producer's net price. If the SPs are equal, producers will be indifferent as to the choice of market, otherwise they will select the market with the highest SP. Note that the decision involves only market prices and transfer costs since the production costs are unaffected by the market selection.

Figure 1. *Criteria for choice among competing markets for a single product.*
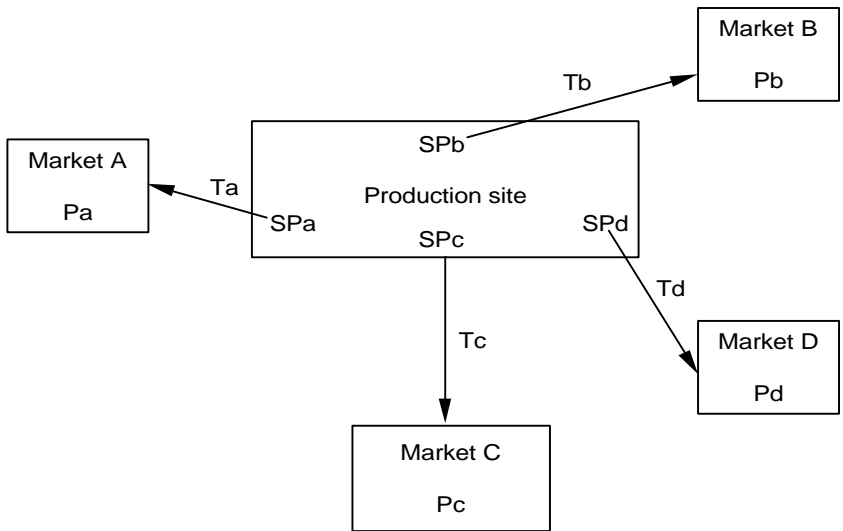
Site-price in relation to markets

$$SPa = Pa - Ta$$
$$SPb = Pb - Tb$$
$$SPc = Pc - Tc$$
$$SPd = Pd - Td$$

If $Spa = SPb = SPc = SPd$ then indifference,
else select market providing biggest SP

Study hypothesis

The guiding hypothesis of the study was that producers, irrespective of their category, behave similarly in their choice of marketing outlet by selecting outlets that result in the highest site prices for their dairy products.

Sampling procedure and data collection

The sample, consisting of 173 dairy producers representative of the intra-urban, peri-urban and traditional production systems, was purposively selected in a manner permitting the analysis (across different producer categories) of the spatial dimension of the dairy trade. The selection was done in three stages. In the first stage, a primary sampling unit represented by three broad categories of producer was selected within an 85 km radius of Addis Ababa. In the second stage, city zones, in the case of intra-urban producers, or groups of villages, in the case of peasant producers, were selected. In the third stage, individual households were randomly selected for interview.

The sample included 50 intra-urban producers. These were randomly selected from a list of about 2000 registered dairy producers obtained from the Central Statistical Office. The sample was subdivided into large- and small-producer categories, with the small producers keeping between one and three milking cows and the large producers keeping four or more cows. There were 18 registered large-scale producers within 20 km of Addis Ababa, located on the Jimma road south-west of the city, and all were included in the peri-urban sample. In the third category, 105 peasant producers located within 85 km of Addis Ababa on the Gojam road were selected from lists provided by the chairmen of the peasant associations in the selected villages. The peasant sample was further classified into two broad categories according to whether they were within 20 km of Addis Ababa or between 20 and 85 km from Addis Ababa. Then within each subcategory two groups were defined according to whether or not they were located within 3 km of a milk-collection centre. Figure 2 shows the allocation of the sample within the seven subcategories.

The survey was carried out between February and July 1986. Both cross-sectional and longitudinal survey designs were used. The cross-sectional survey was a one-shot interview of the household and was designed to elicit information on the respondents' normal dairy marketing patterns, as represented by the recall year (1985). This technique was useful in the absence of long time-series data, which would be more appropriate for analysing general trends in marketing pattern. The longitudinal survey used the same sample but data were collected from each household over seven consecutive days, during which dairy marketing activities were monitored. This was designed to verify producer adherence to, or deviations from, marketing described as "normal" in the one-time survey. Data collected included types and quantities of dairy products

Figure 2. *Classification of dairy sample, Addis Ababa, Ethiopia.*
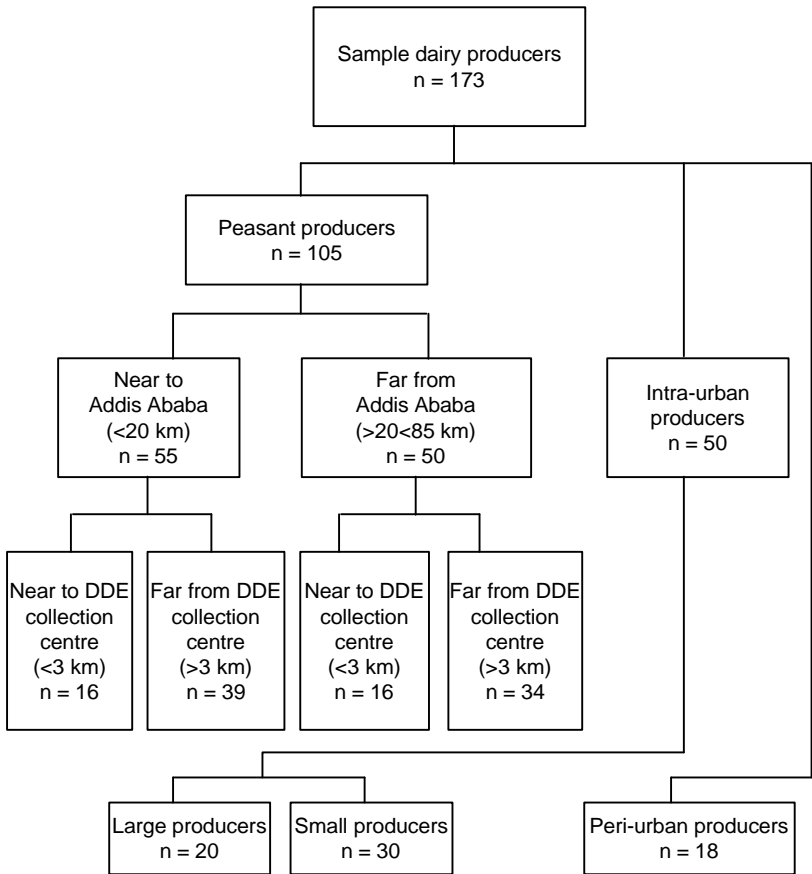
marketed, total sales, sale outlets, transportation and associated costs and prices.

Results

In general, responses on the dairy marketing patterns from the cross-sectional and longitudinal surveys were similar, giving an indication that respondents did not deviate much from their normal patterns of marketing during the subsequent

survey. The results reported here are based on the responses from the subsequent survey. The results for the urban producers are presented first, followed by those for the peri-urban producers and the rural producers.

Intra-urban producers

Market outlets and intensity of use

The intra-urban producers sold neither butter nor cheese during the survey period. Although they could sell milk directly to the Dairy Development Enterprise (DDE) at a fixed price of EB 0.50/litre year-round, none of them reported selling to DDE. Instead they sold through three principal sale outlets:

Producer–consumer (P–C) outlet: direct sales to individual consumers, including transactions at the farm gate or deliveries to individuals' homes or business premises.

Producer–catering institution–consumer (P–CI–C) outlet: deliveries to catering institutions such as coffee houses, hotels and restaurants.

Producer–government institution–consumer (P–GI–C) outlet: sales to government institutions such as the armed forces, schools and hospitals.

The percentage of fresh milk sold through each of the three outlets by intra-urban producers is shown in Table 1.

Table 1. *Percentage market shares of fresh milk sold through alternative sale outlets by intra-urban producers, Addis Ababa, Ethiopia, March 1986.*

	Market share (%) for		
Market outlet[1]	Large producers[2]	Small producers[2]	Whole sample
P–C outlet	19 (9)	90 (24)	31 (33)
P–CI–C outlet	27 (8)	1 (0)	23 (8)
P–GI–C outlet	54 (3)	9 (1)	46 (4)
Total fresh milk sold (litres/day)	480 (20)	75 (25)	555 (45)

About 5% of the sample used multiple outlets. In such cases, only principal outlets were considered.

1. P–C = Producer–consumer.
   P–CI–C = Producer–catering institution–consumer.
   P–GI–C = Producer–government institution–consumer.

2. Large producers are defined as those with at least four milking cows at the time of the survey; small producers are those with three or fewer milking cows.

Figures in parentheses are the number of producers using the outlet as their principal outlet.

The evidence suggests that large producers, who sold on average 24 litres/household per day, find it more convenient to sell to catering and government institutions than to sell directly to individuals. Small producers, on the other hand, with average sales of 3 litres/household per day, mainly sold directly to consumers.

Producer prices received through the alternative outlets

Average prices received through the alternative sale outlets over the survey period are summarised in Table 2.

Table 2. *Average prices for fresh milk received by intra-urban producers at alternative sale outlets, Addis Ababa, Ethiopia, March 1986.*

Market outlet[1]	Average price (EB/litre)[2]	Standard deviation	Coefficient of variation (%)
P–C outlet	0.86	0.08	8.8
P–CI–C outlet	0.74	0.06	7.4
P–GI–C outlet	0.76	0.05	6.3

1. P–C = Producer–consumer.
   P–CI–C = Producer–catering institution–consumer.
   P–GI–C = Producer–government institution–consumer.

2. US$ 1 = EB 2.07.

The P–C outlet gave the highest average producer price. In almost all cases, fresh milk was transported from the production point to the points of sale. The majority of producers, particularly small producers who delivered milk to consumers, delivered milk on foot; others used donkeys or private or public transport. Since no accurate costs of transportation by foot or donkey could be obtained, approximate costs were estimated by asking respondents how much they would be willing to pay to have milk delivered over similar distances.

The estimated average costs of transportation, weighted by the frequency of use of the modes of transportation, were EB 0.11/litre, EB 0.11/litre and EB 0.10/litre for the P–C, P–CI–C and the P–GI–C outlets, respectively. Applying these to the unit prices received through the alternative outlets, the site prices (sale price less transport costs) were EB 0.75/litre, EB 0.63/litre and EB 0.65/litre, respectively. These site prices are higher than the EB 0.39/litre that the intra-urban producers would have received if they had sold their milk to the DDE at EB 0.50/litre.

Peri-urban producers

Market outlets and intensity of use

The peri-urban producers sold the bulk of their fresh milk in the city of Addis Ababa through the P–CI–C and the P–GI–C channels. About 4% of their total volume marketed was sold to individual consumers in Sebeta (place of production) and to itinerant traders. Neither butter nor cheese was sold. The percentage shares of fresh milk sold and average prices received through the alternative outlets by peri-urban producers is shown in Table 3.

Table 3. *Percentage market shares of fresh milk sold and average prices received through alternative sale outlets by peri-urban producers, Addis Ababa, Ethiopia, May 1986.*

Market outlet[1]	Market share (%)	Average price (EB/litre)[2]
P–C outlet in Sebeta	2.5 (2)	0.59
P–CI–C outlet in Addis Ababa	53.9 (8)	0.73
P–GI–C outlet in Addis Ababa	42.2 (6)	0.69
Itinerant traders in Sebeta	1.4 (1)	0.59
Total fresh milk marketed (litres/day)	1308 (17)	

1. P–C = Producer–consumer.
   P–CI–C = Producer–catering institution–consumer.
   P–GI–C = Producer–government institution–consumer.

2. US$ 1 = EB 2.07.

Figures in parentheses are the number of producers using the outlet as their principal outlet.

Producer prices received through the alternative outlets

The peri-urban producers sold an average of 77 litres of fresh milk a day. Prices ranged from EB 0.59/litre when sold in Sebeta to EB 0.73/litre when sold to catering institutions in Addis Ababa. Fresh milk was transported to Addis Ababa using private and/or public transport at an estimated cost of EB 0.14/litre. The site prices at Sebeta are estimated at EB 0.59 and EB 0.54, respectively, when sold to catering and government institutions in Addis Ababa.

Rural producers

Market outlets and intensity of use

Rural producers were categorised into two groups, those within 20 km of Addis Ababa and those between 20 and 85 km from Addis Ababa. They were further

classified according to their proximity to a DDE milk-collection centre. As a group, rural producers sold on average 1 litre of fresh milk, 0.127 kg of cooking butter and 0.258 kg of cottage cheese per household per day.

A breakdown of average daily sales by rural dairy producers is shown in Table 4. Regardless of distance from Addis Ababa, rural producers near to a DDE milk-collection centre sold more fresh milk and less butter and cheese than those farther from milk-collection centres. Similarly, rural producers within 20 km of Addis Ababa sold less fresh milk and more butter and cheese than their counterparts farther from the city.

Table 4. *Average daily sales of dairy products by rural producers, by distance from Addis Ababa and from milk-collection centres, Ethiopia, July 1986.*

Distance from milk-collection centre (km)	Dairy product	Distance (km) from Addis Ababa	
		0 to 20	20 to 85
	Milk (litres)	2.3	3.2
0–3	Butter (g)	172.2	7.0
	Cheese (g)	392.5	0.0
	No. of households	16	16
	Milk (litres)	0.3	0.1
3–10	Butter (g)	183.2	96.9
	Cheese (g)	522.2	11.3
	No. of households	39	34

About 90% of the total fresh milk produced by the rural producers was sold to the DDE at EB 0.50/litre. The other 10% was sold to individual consumers in Addis Ababa at an average of EB 0.71/litre.

The main outlets for cooking butter for rural producers near to Addis Ababa were (i) restaurants in Addis Ababa and surrounding areas that serve local foods, (ii) itinerant traders and (iii) individual consumers or butter wholesalers in Addis Ababa. Sales to restaurants accounted for 36% of total sales, while those to itinerant traders accounted for 33% and sales to individuals and those to wholesalers in Addis Ababa accounted for 31% of sales. Rural producers far from Addis Ababa sold 54% of their cooking butter to individual consumers in neighbouring towns, 31% to consumers in Addis Ababa and 15% to itinerant traders.

Prices for cooking butter ranged from EB 6.27/kg to EB 7.11/kg depending on the sale outlet. Producers within 20 km of Addis Ababa received on average EB

6.63/kg, while those more than 20 km from the city received EB 6.42/kg on average. Near to Addis Ababa, producers received the highest price of EB 6.81/kg by selling to individuals in the city, while far from Addis Ababa producers received the highest price of EB 7.11 by selling to itinerant traders.

Conclusions

Sixty-nine per cent of the fresh milk marketed by intra-urban producers and 96% of that produced by peri-urban producers was sold to government and catering institutions in Addis Ababa. Neither the intra-urban nor the peri-urban producers sold fresh milk to DDE. Adjusting for costs of transportation, the most profitable sale outlet for fresh milk in the city is sales to individual consumers, through which a net profit of EB 0.75/litre could be made, compared with a net profit of EB 0.39/litre if the milk was sold to the DDE plant. The corresponding net profits from sales to catering and government institutions were EB 0.63 and EB 0.65/litre, respectively.

Notwithstanding the higher net profits of EB 0.10/litre on average that could be made by selling to individual consumers rather than to institutions, large-scale producers in the city and in peri-urban areas generally sold to institutions. They claimed that not only were institutions reliable buyers but also that it was more convenient to deliver large quantities of milk to a few large buyers than to sell small quantities to a large number of individuals. Thus this category of producer considers the risk of financial loss (in case they are unable to sell all their milk to individual consumers) perhaps more important than the extra profit they could obtain from that outlet.

Clearly, with the large quantities they offer for sale, the cost of direct sales to individual consumers in terms of labour time becomes higher than delivering in bulk either to institutions or to the DDE plant. Given the choice of delivering milk either to government institutions or to the DDE plant, large-scale producers by-passed DDE to take advantage of the higher net prices they obtain from selling to institutions in Addis Ababa.

The small-scale producers in the city almost exclusively used the individual consumer outlet, which paid the highest net prices for fresh milk in the city. The rural producers located near to a DDE milk-collection centre sold almost all their fresh milk at the collection centres. Being close to a collection centre minimises transport costs and the need for preservation, hence the net prices at these centres are higher than that obtained by transporting small quantities of milk to Addis Ababa for sale. Rural producers located far from milk-collection centres find it more profitable to produce and sell cooking butter and cottage cheese than to sell fresh milk.

References

Debrah S and Berhanu Anteneh. 1990. *Dairy marketing in Ethiopia: Markets of first sale and producers' marketing patterns.* ILCA Research Report 19. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 21 pp.

Fetter A. 1924. The economic law of markets. *Quarterly Journal of Economics* XXXVI(3):520–529.

Mosley P. 1982. Marketing systems and income distribution: The case of milk producers in highland Peru. *Food Research Institute Studies* XVIII(3):275–291.

Discussion

The discussion centred around two main issues: (i) the adequacy of the criterion of the highest site-price (market price minus transfer cost) to evaluate producers' choice of market outlets and (ii) the importance of such producer studies in identifying marketing constraints and drawing policy implications. In analysing dairy marketing efficiency in the African context (where markets are segmented and heterogeneous) there is a need to look carefully at the measure of efficiency used. The criterion of the highest site-price used in the study omits such important factors as convenience of delivery to consumers and consumer satisfaction with quality of milk delivered. Debrah's conclusion that direct producer sales are not profitable in terms of time, transport and other risks because of the small quantities of milk involved was questioned. Concern was raised about the tendency to view middlemen as inefficient. Debrah noted that their role was recognised but that there was a need to see if they were doing their job properly, at least in terms of cost, and to study the notion that "the shorter the distance, the more efficient the marketing system".

Kenya's dairy industry: The marketing system and the marketing and pricing policies for fresh milk

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Background

The development of the modern dairy industry in Kenya dates back to the beginning of this century when exotic dairy bulls were imported into the country with a view to upgrading the indigenous cattle through crossbreeding. The first attempts at commercial dairying by European settlers in Kenya were made between 1901 and 1910 and were riddled with problems of disease and the difficulty of finding dairy breeds that could withstand the climatic and ecological conditions in the settled areas.

Following initial investigations by the Veterinary Farm at Naivasha in Kenya, some breakthroughs were made, and commercial dairying can be said to have taken off by the beginning of the 1920s, culminating with the formation of the Kenya Cooperative Creameries Limited (KCC) in 1925. The KCC was incorporated on 22 August 1925 and its first milk processing factory was opened on 12 April 1926.

Commercial dairying in Kenya was initially in the hands of the European settlers, who were typically large-scale farmers. African farmers in Kenya started venturing into commercial dairying only after the 1954 Swynnerton Plan for Intensification of African Agriculture. Typically, the African farmer was and has remained a small-scale farmer. Officially, "small-scale farmer" implies a farmer whose individual land holding does not exceed 20 hectares (CBS, 1979). However, for our purposes, small-scale dairy farmers are taken as those individuals who keep fewer than 20 dairy cows per family landholding.

Kenya's agricultural sector comprises the small-scale farming subsector, the large-scale farming subsector and the pastoralist subsector. The pastoralist subsector depends primarily on livestock production and is based in the arid

and semi-arid areas. Most large-scale and small-scale farms are in the highlands (primarily high potential agricultural areas) but some are located in the medium- to high-potential coastal lowlands. According to available records, pastoralists own nearly 50% of all livestock in Kenya, which they keep mainly for meat production (USAID, 1982). Production of milk in Kenya is concentrated in the small-scale and large-scale farming subsectors. Currently, land devoted to milk production alone is believed to constitute 46% of all the land devoted to farming in Kenya.

Milk produced in Kenya derives from cattle, sheep, goats and camels, depending on the agro-ecological zone, but cattle are the main source of milk. Camels are important only in the more arid areas of the country. Milk produced in the arid and semi-arid areas is primarily consumed within the producing households. Commercial dairying is based on grade dairy cattle, i.e. either pure-bred exotic dairy cattle (mainly Friesian/Holstein, Ayrshire, Guernsey and Jersey breeds) or the crosses of these with the local East African Zebu breed.

Prior to independence in 1963, commercial dairying was largely confined to large-scale farms owned by European settlers. (Stotz, 1980). However, dairying in Kenya was transformed into a predominantly smallholder activity, in terms of both milk production and volume of sales, by 1977 and the small-scale farmer is now the major producer of milk in Kenya. About 90% of the grade dairy cattle are found in mixed or ley farming areas in Kenya's highlands.

Available records indicate that the dairy cattle herd in Kenya has been growing steadily over the years despite droughts and diseases. Official records suggest that the dairy cattle population in Kenya increased from 0.8 million head in 1960 to about 2.5 million head by 1989.

In broad terms, Kenya has been self-sufficient in milk in the past couple of decades, except during droughts. In the 1980s, the country experienced milk shortages only during the 1984/85 drought, which forced the Government to import a total of about 16,000 tonnes of skim-milk powder and about 2500 tonnes of butter oil (World Bank, 1989). Milk production in Kenya is currently estimated at about 1.6 billion litres per annum, having risen from 0.96 million litres in 1971 (World Bank, 1989). Milk production increased by 2.3% a year from 1971 to 1980 and by 2.75% a year from 1980 to 1987.

Milk production in Kenya has continued to grow over the years, primarily due to growth in the dairy herd, commercialisation of dairying and expansion of milk collection and processing facilities. Commercialisation of milk production has meant a gradual reduction in home consumption in favour of sales, while the expansion in milk collection and processing facilities or capacity has attracted more milk into the marketing system. However, there is evidence that the marketing system is not efficient enough or is inadequate to promote increased milk production in the country.

According to the World Bank (1989), much more milk is being consumed at source than would be the case if the marketing system were efficient. The Integrated Rural Survey undertaken by the Central Bureau of Statistics in Kenya between 1975 and 1979 indicated that nearly 60% of all the milk produced by smallholders in 1979 was actually consumed within the producing households. Further, no effort has been made either to organise a system for collecting the seasonal surplus of milk in the pastoral areas or to encourage pastoralists to convert this excess to products (such as ghee) that can be stored. Marketing is thus believed to be one of the major constraints to increased milk supply in Kenya.

Organisation of the dairy industry and the marketing system in Kenya

Organisational aspects

Milk is classified as a scheduled commodity in Kenya, i.e. its pricing and marketing are subject to government regulation and control. Government control and influence over the dairy industry in Kenya are, by law, delegated to the Kenya Dairy Board (KDB), a statutory agency that was established under the Dairy Industry Act (Chapter 336 of the Laws of Kenya) of 1958.

As originally stipulated, the KDB was set up to "organise, regulate, and develop efficient production, marketing, distribution and supply of dairy produce in Kenya". Hence the KDB has broad powers over the organisation of the dairy marketing system in Kenya, including the regulation and control of milk quality and prices of milk and milk products. However, owing to lack of funds and other resources, the KDB is now primarily involved in the regulation of businesses involved in processing and distributing dairy products. The other functions it is supposed to carry out are undertaken by other government departments.

Milk marketing and the marketing system in Kenya

Marketed milk accounts for only about 40% of the estimated annual milk production in Kenya. Most of the milk marketed is handled by Kenya Cooperative Creameries Limited (KCC), which has both a virtual monopsony over purchases of raw milk at the farm level and monopoly power over the sales of processed milk, particularly in urban areas. Despite the Government's Rural Dairies Development Programme, which is encouraging dairy cooperatives in areas far from KCC dairy plants to establish their own milk processing facilities, the KCC still remains the main recipient of milk for processing from both small-scale farmers, through their cooperative societies (FDCS), and large-scale farmers.

Some inefficient FDCS have broken up, resulting in the formation of milk marketing groups and requests to the KCC by some small-scale farmers to be allowed to supply milk individually and not through cooperatives (e.g. in Nyandarua and Kericho Districts). A major problem for those who supply milk through cooperatives is delayed payments, and one may expect the number of requests to KCC by small-scale farmers to supply milk as individuals rather than through cooperatives to increase with the intensification of dairying and the need to have regular income to service dairying activities (World Bank, 1989).

As noted earlier, the KDB is empowered to (and is supposed to) license any form of trade that involves processing and distributing milk and milk products in Kenya. Further, it is supposed to enforce regulations to ensure that certain areas (usually specified or "zoned" towns or urban centres) are supplied with milk only by licensed dealers. Despite these legal requirements, which define what shall be referred to as the formal dairy marketing subsystem, trade in milk (and milk products, to some limited extent) still occurs without formal licensing by the KDB in some parts of the country, especially in the rural, milk-producing areas. Trade in milk and milk products that occurs without formal licensing by the KDB is referred to as the informal marketing subsystem.

The formal milk marketing subsystem

KCC handles most of the marketed milk that is not sold and consumed in the rural areas. Since its incorporation in 1925 and until the licensing of the Meru Central Farmers Cooperative Union (MCFCU) and the Kitinda Dairy Farmers Cooperative Society (KDFCS) as dairy processors in 1983 and 1986, respectively, the KCC was virtually the only player in the formal marketing of milk and milk products in Kenya.

Before 1983, any license to process and distribute milk and milk products in Kenya issued to an agency was issued on the implicit understanding that it was a member of the KCC, e.g. Kilifi Plantations Limited at the coast, which is a private member of the KCC and which has been licensed to pasteurise, package and distribute milk to the Mtwapa, Malindi and Watamu areas "on behalf of the KCC".

The KCC has two types of members, namely the private members (individual but large-scale dairy farmers or companies) and cooperative members (primarily the dairy farmers' cooperative societies, consisting of small-scale dairy farmers). Such members own some shares in the KCC, so that the KCC can be said to be a farmers' organisation. As the key player in the formal marketing of milk and milk products, the KCC plays a major role in the development of the dairy industry in Kenya.

The licensing of MCFCU and KDFCS as processors independent of KCC constituted a new concept in the improvement of dairy marketing through the formal marketing subsystem in Kenya. Both plants were established through the

Rural Dairies Development Programme. This promotes the formation of rural dairy cooperative societies and provides financial support to any such societies that prove that they can organise themselves and collect sufficient amounts of raw milk from their members to warrant the establishment of a dairy plant to facilitate the processing and distribution of their members' milk and milk products. To ensure coordination and orderliness in the marketing system, the areas recommended for establishment of rural cooperative dairy plants under the Programme must be remote from the milk catchment area of an existing KCC dairy plant.

However, the MDFCS dairy plant and the KDFCS dairy plant have had little effect on the role of the KCC as the main dairy marketing organisation within the formal sector. Whereas the two rural dairy plants had a combined raw milk intake of about 2.4 million litres in 1988, the KCC had a total raw milk intake of about 340 million litres in the same year.

Like the KCC, the rural dairies are expected to serve their members by assisting in the collection, processing and distribution (i.e. marketing) of milk and milk products. Initially, both the MCFCU and the KDFCS dairies started as milk collection centres as well as informal market outlets for fresh milk and were free to deliver to the nearest KCC plants any raw milk that could not be sold locally. The two dairies are now equipped with modern processing and packaging facilities, through government and donor aid, and are producing ultra-heat treated (UHT) milk with a minimum shelf-life of 14 days.

A major role of the KCC is to receive, process and distribute fresh milk (as pasteurised milk) on a daily basis. However, the KCC also produces UHT milk for distribution to more remote areas and also for distribution to primary schools under the School Milk (Feeding) Programme. In addition to this, the KCC also produces some other processed milk products, ranging from sour milk (*mala*) to skim-milk powder and including butter, cheese, ghee, cream and yoghurt.

To facilitate collection, processing and distribution, the KCC has established a network of collection centres and dairy processing plants throughout high-potential milk-producing areas of Kenya. It now has a network of 10 collection centres and 11 factories.

Even though the KCC is currently being restructured to better serve the interests of its members, it should be noted that, by law, the KCC is actually licensed to undertake dairy processing and distribution as a private enterprise and should thus be under the control of the KDB. However, owing to its size and importance the KCC has so far assumed an independent and statutory role in its activities in the dairy industry in Kenya.

As suggested earlier, the main role of the KDB presently is in licensing trade in milk and milk products and in the enforcement of regulations to ensure that the 'zoned areas' are supplied with milk only by licensed dealers. Since the KCC is

the main dealer in urban areas, the KDB has been seen by most dairy producers and other interested parties as a protector of KCC interests and as acting to suppress the efforts of private and cooperative dairies. This adverse image needs to be addressed.

The informal milk marketing subsystem

As defined, the informal milk marketing subsystem deals with marketed milk that does not enter the formal marketing subsystem. This implies that the parties involved in this subsystem do not operate under the licensing and blessing of the KDB, or as the agents of a licensed dealer such as the KCC. This subsystem involves sales of raw milk by producers to consumers or by producers' agents to consumers. It may also involve hawking of milk from home to home in the rural areas by itinerant traders who do not usually need or seek licenses to do such business.

Marketing of raw milk and milk products through the informal marketing subsystem is permissible and tolerated in areas that have not been 'zoned-off' by the KDB. Hence the informal milk marketing subsystem is especially important in rural areas. However, it also operates in "zoned" (urban) areas, even though the parties involved know that the transactions are illegal.

Most small-scale dairy farmers market their milk through their farmers' dairy cooperative societies (FDCS). These serve two main functions:

- collection of milk from their members, who often are widely dispersed and

- delivery of that milk to their customers.

Most FDCS find it advisable or necessary to join the KCC as cooperative members. And this is where the formal and the informal marketing subsystems become intrinsically linked.

FDCS close to KCC dairy plants (or collection centres) normally sell their members' milk to these plants or centres, but they are not bound to and are free to sell their milk where they wish. However, such choice is often limited in the milk-surplus areas and in those areas where only the KCC or its agents are licensed to sell or distribute milk and milk products.

The FDCS may be viewed as an important medium that facilitates the sale of small-scale farmers' milk through both the formal and the informal subsystems. Even though individual large-scale dairy farmers could participate in the informal marketing of milk (and some do, to a limited extent), the nature of their operation forces them to become private members of the KCC so that they can sell their milk to it.

The milk marketing system in Kenya: A synthesis

The preceding account of the operations of the formal and informal milk marketing subsystems in Kenya has suggested that the two subsystems are interlinked, particularly because:

- the very existence of the informal subsystem reflects the existence of small-scale milk producers and

- small-scale milk producers often depend on FDCS for marketing their surplus milk, and such FDCS often depend on the formal marketing subsystem to dispose of milk that they cannot sell to local consumers.

Almost all the milk marketed in Kenya is from small- and large-scale farmers. Very little milk is sold by pastoralists outside their production areas. Since it is estimated that the KCC handles over 90% of the milk marketed in Kenya, the amount of milk taken in by the KCC from the different types of producers is indicative of who the significant contributors to marketed milk production are. Available records (GOK/WB/DDWG, 1984) suggest that, of the raw milk received by the KCC at its various plants:

- 34% is from large-scale producers

- 54% is from small-scale producers, through cooperatives, and

- 12% is from individual small-scale farmers who supply KCC directly.

The account of the marketing system for liquid milk in Kenya points to a highly centralised system of processing and distribution. Generally, there is sufficient information on the marketing system at the farm, processing and distribution levels, but the system is least understood at the consumer level. The general consensus is that the system is still not well organised at both the farm and the consumer levels. Inefficient milk collection is largely responsible for the large proportion of milk that is retained by producers for home consumption.

Marketing and pricing of milk in Kenya: Policy issues and options

Marketing issues

Farmers' dairy cooperative societies (FDCS) in Kenya have played and continue to play an important role in the collection and channelling of milk to the formal marketing system. However, as suggested in the preceding sections of the paper, the marketing system still needs to be restructured to better serve both producers and consumers.

Payments to producers for milk delivered are often late. Farmers commonly receive payment up to two months after delivering milk to their FDCS. Dairy farmers have thus often found themselves unable to plan for efficient use of their resources. Delayed and/or irregular payments also make milk production expensive and risky.

Given the dominant role of the KCC in the marketing of milk and milk products in Kenya, there is a general consensus that the KCC has not been aggressive enough in its marketing strategies. KCC has continued to have stockpiles of powdered milk, which tie up capital, without devising measures to exploit fully the local market or seeking external markets for Kenyan milk (World Bank, 1989).

A recent study on agricultural growth prospects and strategy options in Kenya recommended:

- strengthening the management capabilities of FDCS

- encouraging the organisation of milk marketing groups where and if desirable

- allowing more private-member deliveries of milk to the KCC, provided the private member can deliver a specified minimum amount of milk daily to a predetermined location

- encouraging more individual collection and retailing of milk

- increasing the number of bulk milk cooling and collection centres

- devising ways of reaching the urban poor as potential milk consumers

- that KCC deal directly with FDCS rather than through unions when making milk payments (a union is usually formed by several FDCS)

- increasing the number of direct farm deliveries to the KCC to reduce the number of intermediaries in the milk delivery and payment transactions

- that the KCC and other processing plants make more use of and improve their management of overdraft facilities to reduce payment delays and

- that major institutional consumers of milk who get milk from the KCC on credit make prompt payments to KCC.

More-aggressive marketing strategies that fully exploit the local market and that seek external markets for Kenyan milk are also needed (World Bank, 1989).

Pricing issues

As explained elsewhere in this paper, the milk marketed through the formal marketing subsystem is subject to government price controls, at both producer and consumer levels. Both producer and consumer prices for milk (and milk

products) are reviewed and determined annually through the government price review process.

Milk producer price is announced early in the calendar year. Even though the announced producer price only prevails in the formal subsystem, it nonetheless serves as a point of reference for prices in the informal subsystem.

The milk pricing mechanism in Kenya is used by the Government to both encourage increased production and safeguard consumers. Milk price controls have often been justified for the above reason, particularly because the KCC has virtual monopsony and monopoly over the dairy industry in Kenya, and there is no close substitute for milk in the Kenyan market at present (World Bank, 1989).

References

CBS (Central Bureau of Statistics). 1979. *The integrated rural survey 1977.* CBS/IRS, Nairobi, Kenya.

GOK/WB/DDWG. 1984. *Dairy Development Working Group Report 1.* Ministry of Agriculture/Ministry of Livestock Development, Nairobi, Kenya.

Stotz D. 1980. Grade dairy cattle, an attractive innovation for small-scale farmers in the highlands of Kenya. *Quarterly Journal of International Agriculture* 19(2):147–160.

USAID (United States Agency for International Development). 1982. *USAID/USDA Dryland Cropping Systems Research Project (Kenya): Joint interim evaluation report.* USAID, Nairobi, Kenya.

World Bank. 1989. *Kenya: Agricultural growth prospects and strategy options (draft reports).* World Bank, Regional Mission Office, Nairobi, Kenya.

Discussion

The discussant, Nankumba, requested clarification about the Government of Kenya's role in dairy product price determination, in balancing producer and consumer welfare, in correcting the problem of delayed payments to farmers and in providing dairy producers with extension services and information on alternative marketing possibilities. Mbogoh explained that the Government attempts to balance consumer and producer welfare in determining prices by involving various representatives in the price-setting exercise. Minimum and maximum prices thus determined take the form of price guidelines rather than fixed prices. In addition to using extension staff, information on alternative marketing options is disseminated to farmers through an extensive network of farmers' cooperative societies.

The general discussion focused on the issues of KCC performance and efficiency, the Government's emphasis on increasing the involvement of private marketing agents and some of the political realities of introducing change in government price setting. While generally arguing the Kenya

Cooperative Creameries' (KCC's) viability, the authors acknowledged the greater efficiency of farmers' cooperatives over shorter distances. Further explanation was given about KCC's pricing policy. Although prices are geographically uniform, dry-season premiums are offered to producers as a means of smoothing out seasonal fluctuations in supply. Finally, the point was made that the existence of a strong, unregulated market for dairy products suggests that the Government's price-setting process is not functioning well and that there is a need for research in the area of prices and market equilibrium.

Dairy farmers and markets in rural Zimbabwe

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Introduction

Zimbabwe's agricultural industry is characterised by marked differences in the modes of production between the commercial and peasant sectors. This dualism is particularly pronounced in the case of dairying, where an efficient and well-established commercial sector of some 525 farmers milking exotic animals produce about 250 million litres of milk a year and supply the urban market, while an unquantified number of smallholder farmers milk indigenous animals seasonally for home consumption and local sales.

The market too is as diverse, with the urban population consuming some 68 litres per person annually while rural consumption averages around 16 litres a year, 10 litres of which are from local production.

It is within this context that the Dairy Development Programme (DDP) was launched to widen the production base and bring the peasant farmer into the modern dairy industry, thereby making more milk available to the rural population, while at the same time making a real contribution to rural development.

A key element in this process is marketing. For the smallholder farmers to achieve the greatest returns and for milk to be available where there is the demand, milk has to be marketed locally. This presents a number of problems and obstacles that have to be overcome; this paper attempts to highlight these within the context of dairy development in Zimbabwe while, it is hoped, pointing to areas that need research and analysis.

Background

Zimbabwe is not naturally suited to milk production and commercial milk production is based on the conservation of fodder and on compound feeds.

Production based on rainfed pastures is only possible for about six to eight weeks of the year. For the remainder of the year, rainfed pastures barely provide for the maintenance requirements of dairy cows let alone the production of milk. Regional climatic differences, susceptibility to drought and erratic rainfall patterns all combine to make milk production a somewhat hazardous business.

Nevertheless, the commercial dairy farmers, with extensive state intervention over the past 70 years, have achieved notable success and the dairy industry can be compared to that of any European or American country.

The commercial dairy farmers keep some 118,000 exotic dairy animals, predominantly Holstein–Friesians. Of these, about 65,000 cows complete lactations annually and produce 250 million litres of milk, almost all of which is sold to the Dairy Marketing Board (DMB), 80% through the Bulk Milk Collection scheme.

A milk recording scheme operates, with some 20% of farmers participating, representing about 22% of the national dairy herd. The average yield for a 300-day lactation for all cows on the scheme was 5242 kg in 1987, with the top herd producing an average of 8532 kg over 140 lactations, with butterfat of 3.57%. The estimated average for all commercial herds is some 4000 kg, which it is felt gives some considerable room for improvement.

In contrast, there are some 800,000 or more peasant farmers, about half of whom own cattle. These peasant farmers milk indigenous, multipurpose cows on an extremely seasonal basis. Lactation length is usually not more than 180 days, with a yield of one to two litres above calf offtake. Not surprisingly, many farmers choose not to milk their cows and, while a few sell milk to neighbours, most taken only what they need for the household. Were this potential to be exploited however, an estimated 150–200 million litres could be produced annually in this sector, depending on the rainfall.

Although most peasant farmers are in marginal, more-drought-prone and often degraded areas, it is expected that yields could be considerably increased with crossbreeding and increased availability of feed resources.

Despite the dualism highlighted above, the two sectors should not be seen as inherently antagonistic: indeed they can be usefully complementary. The large-scale commercial sector can offer the embryonic small-scale sector an array of services often lacking in developing countries attempting to foster small-scale indigenous milk production. In particular, it can provide training and be a source of breeding stock. The large-scale sector has available to it a sophisticated array of production inputs, some of which will be useful in the development of small-scale dairying systems. Furthermore, the range of state services that have hitherto supported the large-scale sector (veterinary services, research, dairy services) are now turning their attention to the small-scale sector. Policy statements of the Government of Zimbabwe on the production of milk

within the small-scale sector place special emphasis on this complementarity between the two systems.

At Independence, the Dairy Marketing Board (DMB), the parastatal charged with collecting, processing and marketing milk, was faced with a milk deficit caused by a relatively low consumer price and a sharp increase in real wages following the implementation of minimum-wage legislation. Various steps were taken to respond to this situation, including a substantial rise in the producer price, the introduction of bulk milk collection to increase the efficiency of the large-scale commercial sector, and the reconstitution of donated EEC milk powder and butter oil.

The increased producer price had quick and very positive results and soon DMB found itself with a surplus. From 1983 on no further imports of milk powder were necessary and DMB instigated the Rural Distribution Service (RDS) in an attempt to sell the surplus in the hitherto unserviced rural market. DMB was also in this way responding to the Government's call for parastatals to fulfil a more social role in society. In the same spirit, a plant producing sterilised milk was built in Chipinge and later UHT production commenced in Harare. Though these products were destined for the rural market, they ended up costing considerably more than the regulated (and subsidised) price of whole milk in the urban areas because of transport and production costs and an unregulated (and unsubsidised) sales price.

The myth of Zimbabwe having a surplus of milk is destroyed when consideration is given to unsatisfied demand in the rural areas. This is estimated to be of the order of 160 million litres a year. The DDP envisages meeting this rural demand through local marketing of milk, thus keeping prices down for the rural people while at the same time avoiding for Zimbabwe the expensive and foreign-exchange-intensive transport–processing–packaging–transport cycle which presently characterises the RDS.

Government policy

The policy of the Zimbabwe Government towards dairy development is clearly stated in the National Dairy Development Strategy of 1987.

With an overall objective of "developing dairying so as to ensure there is a broad based, viable production of sufficient wholesome milk and its derivatives to meet the national needs at an affordable cost," the specific aims are:

1. To continue to improve and consolidate the viability of the established dairying sector.

2. To continue the expansion of the national dairy production base to the small-scale, communal and resettlement farming sectors, not only to

increase the supply of milk but also to stimulate a wide range of development activities to the benefit of the whole community.

3. To maintain and improve effective and strict statutory control over the production, processing and marketing of dairy products.

4. To promote an increase in consumption of milk and dairy products amongst all sectors of the population and to develop export markets where this is in the national interest.

In order to coordinate the country's dairy activities the Dairy Programme Coordinating Committee (DPCC) was appointed in early 1987 by the Ministry of Lands, Agriculture and Rural Resettlement. The Committee includes representatives of all sectors of the dairy industry: research, extension services, producers, marketing organisations, veterinary services and the development agency, DDP. It serves as a forum in which the various parties involved present their positions and plans so as to most-efficiently develop the industry as a whole.

Government policy is supportive of dairy marketing, as is evident from the activities of DMB and DDP. DMB, the marketing parastatal, is subsidised by the Government, which controls pricing, while the DDP was set up by the Government to help smallholders produce and market their milk.

The Government, however, has to control the industry and in particular implement the regulations governing the production, processing and marketing of milk through the Dairy Act and Dairy Produce and Marketing Act.

Stringent conditions for dairy facilities, milking parlours, milk rooms etc are prescribed, and while it is recognised that quality must be maintained these conditions do mitigate against the smallholder's entry.

The cost of a milking shed is about Z$ 1000, a considerable barrier to a small farmer whose annual income is likely to be much less than that. The cost of a milk centre is out of the reach of most rural communities and it is therefore necessary that assistance be given by the Government or donor organisations to establish collective facilities.

For producers of milk to sell to DMB they first require inspection and approval by the Government. The same conditions apply to producers wishing to sell milk directly to consumers but, in addition, the DMB has to approve the issue of a licence. Additionally, the main urban centres are "prescribed areas" and no liquid milk may be marketed other than that pasteurised and sold by DMB. This effectively controls the market and while no smallholder scheme has been denied a producer/retailer licence the provision exists.

To this end, it is being proposed that the issuing of such licences be the responsibility of the DPCC in the future.

The market chain

The dominant agency in the chain from producer to consumer in the formal marketing sector is the Dairy Marketing Board.

Over 80% of commercial farmers' milk is collected by the Bulk Milk Collection Scheme currently managed by DMB which delivers the milk to six factories, most of which are situated in the largest urban centres. The remainder of the milk is delivered to the factories by the farmers themselves. DMB statistics show that total intake by DMB steadily increased from 1981 to 1989. There is a moderate variation in monthly deliveries, with the highest intakes during December and January. However, monthly variations in milk intake by DMB seem to be increasing as total intake increases.

DMB processes and markets milk and a wide range of products through a network of depots in both urban and rural areas.

Pasteurised milk is sold in plastic sachets or bottles (urban) and a door-to-door delivery service operates in the main towns. While all factories (bar Chipinge) pasteurise milk, other products such as cheese and ice-cream are more factory-specific. The Chipinge factory manufactures long-life sterilised milk which is distributed country-wide.

DMB estimates that some 15% of sales are to the rural areas and that, while there is considerable demand, the distances involved and controlled prices plus an inadequate and ageing fleet of vehicles undermine the cost-effectiveness of its rural delivery service.

The rural market is characterised by poor roads and communications; considerable distances to be covered in limited time, particularly if the cold-chain is to be maintained; seasonal demand, i.e. less demand in summer when local milk is available; low buying power; competition from either commercial powdered milk or, as a food, from vegetables and meat; and finally the whim of the consumer—milk products are, to some extent, impulse-purchase items, even in the rural areas. Nevertheless, DMB is currently expanding the rural delivery service and its network of depots.

There are currently 10 smallholder schemes, five of which are producing and marketing milk. Two of the schemes are part of the formal system while the rest operate independently, save for the possibility of delivering surplus milk to DMB at times.

Data for five milk schemes for 1988/89 are given in Table 1. Of the five schemes at present being implemented, three are far from any DMB collection route or factory and hence cannot sell surplus milk to DMB; processing options will have to be considered in the future.

Table 1. *Characteristics of five smallholder milk schemes, Zimbabwe, 1988/89.*

	Scheme				
	Chikwake	Marirangwe	Tsonzo	Nharira	Rusitu
Type of farmer	Communal	SSCFA[1]	SSCFA	Communal SSCFA	Resettle-ment
Average production (litres)	38,264	327,439	244,352	13,090[2]	649,266
No. of producers	10	18	17	9	244
Market channel	Local	DMB[3] (96%)	Local (90%)	Local	DMB

1. SSCFA = small-scale commercial farming area.

2. July–December.

3. DMB = Dairy Marketing Board.

To a large degree the constraints facing commercial exploitation of the rural market are the same for the smallholder, albeit on a much reduced scale, with the addition of extreme seasonality of supply and inexperience. The measures needed to overcome these constraints and market milk profitably are an important area for research and planning. While some attempts being made by DDP are highlighted below, there is much still to be developed in this field.

Consumption and demand

Markets and consumption

The main market for milk and milk products has been and remains the urban and peri-urban areas of the country. Prior to 1980, DMB's main market segment was the "low density areas" (LDAs) of mainly white suburbs and little marketing effort was made in the more populated "high density areas" (HDAs). Since then the trend has been a rapid increase in demand for liquid milk in the HDAs, followed by:

- inability to meet demand

- producers responding to price incentives, plus importation of skim-milk powder and anhydrous milk fat

- marketing thrust into the HDAs by DMB

- consumer price increase of 40%

- saturation of (somewhat reduced) urban demand

- emphasis on rural deliveries and

- sourcing of export markets.

Table 2 indicates how the milk supply has been utilised by DMB in response to market demand and what it has done with the surplus. From 1982/83 to 1987/88 sales of fresh pasteurised milk declined steadily, while sales of sterilised milk, which requires no refrigeration, and lacto, an acidified cultured milk product used as a food, increased.

Table 2. *Milk utilisation by the Dairy Marketing Board, Zimbabwe, 1982/83–1987/88.*

	1982/83		1983/84		1984/85		1985/86		1986/87		1987/88	
	litres	%	litres	%	litres	%	litres	%	litres	%	litres	%
Intake	172.5	–	181.1	–	187.9	–	202.0	–	223.9	–	236.2	–
Market milk	112.0	65	107.0	59	92.7	49	85.5	42	82.7	37	90.5	38
Lacto	5.4	3	22.3	12	32.7	17	39.1	19	39.1	17	42.7	18
Sterilised milk	7.9	4	10.1	6	13.7	7	17.3	9	11.5	5	16.9	7
Other liquids	2.9	2	2.3	1	2.8	2	3.2	2	4.1	2	4.0	2
Total liquids	128.2	74	141.9	78	141.9	76	145.1	72	137.4	61	154.1	65
Cheese	15.2	9	13.8	8	14.3	8	11.6	6	13.3	6	15.9	7
Milk powder	0.0	0	4.6	2	11.8	6	22.0	11	57.3	26	42.8	18
Processed milk	29.1	17	21.0	12	19.9	11	23.6	11	16.1	7	23.0	10

In 1984, urban milk consumption was estimated at 68 litres per person annually, compared with between 16 and 22 litres in rural areas. Consumption levels in the rural areas are indicative of supply rather than demand and an estimated rural (suppressed) demand of the order of 45 litres per person per year was arrived at.

DMB has reacted to the three factors of ever-increasing supply (at 7% a year), urban saturation (4% annual growth) and rural demand by increasing its capacity to produce long-life liquid milk, milk powder, butter and cheese.

While the costs of the rural delivery service were previously prohibitive, with the steady rise in consumer prices and a soon-to-be-refurbished delivery fleet, a fairly high growth of sales in the rural market is anticipated.

At the same time it is expected that the development programme working with small farmers will meet as much of the rural demand as feasible through local

sales of milk. It is important that small farmers be seen as producers and reap the benefit there from, rather than mere consumers of milk from large-scale commercial farms.

Estimates of milk production Zimbabwe indicate that production is likely to have increased from 289 million litres in 1990/91 to 533 million litres in 1999/2000. If this is compared with an estimate of demand based on a static urban and rural per caput consumption, population growth alone is projected to increase demand to over 800 million litres a year, an impossible target to meet without a substantial contribution from the peasant sector.

Milk and dairy products in the diet

Milk plays an ever-increasing role in the diet of the majority of Zimbabwe's population. Traditionally, milk products, particularly soured milk, formed an important part of the diet. Often naturally soured, the milk coagulates and a thick curd called *amasi* is the resultant product. *Amasi* is most often eaten with *sadza* (thick maize porridge). Fresh milk was and is still seldom drunk alone, except perhaps by herd boys.

Changing eating habits, such as the growing importance of bread and tea in the diet over the last 30 years, have increased the consumption of liquid milk as a tea whitener and it is now this use that accounts for the major share of milk consumed. In the urban areas there has been a steady increase in the consumption of more "western" milk products—yoghurt, ice-cream and cheese. In the rural areas a recent market study showed a high awareness of dairy products and a wish to purchase more. It is in this sector that the major proportion of milk powder is used, again as a tea whitener. As in many African countries, lactose intolerance is quite common.

Foods other than milk are cheaper sources of protein and fat, and the conversion of dietary energy into milk by the cow is relatively inefficient. This being so, there has been some debate in Zimbabwe as to whether the Government should seek to provide for greater consumption of dairy products by the poorer sections of the population. Whatever the argument, the Government takes the view that increased consumption of dairy products will improve health and nutrition and hence actively promotes the production and consumption of more milk.

Price and profitability

Formal sector

Milk is considered a strategic food item by the Government and hence both producer and consumer prices are set and controlled by the Government. This has an inevitable effect on profitability and the achievements of the DMB.

Milk prices are set by the Government in consultation with the farmers organisation (NADF) and the DMB. Currently, the aims of the pricing policy are to maintain producer viability while at the same time reducing the subsidy to the consumer and lowering DMB's deficit. The current agreement between all parties is that for every cent awarded to the producer the retail price goes up 3¢ over the year in question.

Table 3 gives the pattern of pricing since 1980 and the corre sponding deficit incurred by the DMB. It is recognised that price is not the only factor influencing the deficit but it plays a major part. Of particular note is 1983 when for some time the producer price was higher than the consumer price and, later in the year, consumer price was increased by almost 50% over night.

Table 3. *Producer and consumer milk prices, Dairy Marketing Board (DMB) milk intake and DMB operating deficit, Zimbabwe, 1980/81–1989/90.*

Year	Producer price (¢/litre[1])	Consumer price (¢/litre)	Intake (million litres)	Deficit/subsidy ($ million)
1980/81	20.54	26.67	146	10
1981/82	25.22	26.67	151	18
1982/83	30.38	26.67	172	35
1983/84	33.43	26.67/40	181	38
1984/85	38.12	40/48	188	46
1985/86	40.88	48/52/56	202	55.6
1986/87	40.88	56/60	224	49.3
1987/88	44.00	66/70/78	237	51.3
1988/89	46.63	82/90	241	52.3
1989/90	48.80	94/98	256	NA

1. Aggregate figure for the year (does not include quality premium of approximately 4¢).

NA = not available.

Producer viability declined steadily from 1983 to 1987 (Figure 1). The current agreement has resulted in a slight increase in producer viability.

Traditional sector

Milk prices in the traditional sector tend to be influenced by seasonal and market forces. Milk is sold raw or soured in various sized cups or, more commonly, a

Figure 1. *Historic and current return on variable costs ($), Zimbabwe, 1981/82-1990/91.*

750 ml bottle. Prices vary considerably. A 1988 study commissioned by DMB gave an average of 20–30¢ for a 750 ml bottle (27–40¢/litre) but prices of 50–60¢/litre were reported in some parts of the country.

Smallholder scheme pricing

Where dairy development projects sell to DMB the producer price is the same as that paid to large-scale commercial farmers—there is no incentive price of any kind.

The dairy associations that market their milk locally are free to set the price they pay their members. The tendency, however, is for the price to be based on the national price. The retail price charged is usually an attempt to balance the needs of producers and consumers who, after all, are members of the same community and who might be producers one year and consumers the next. To an extent, within the stipulated limits laid down by the Government, market forces apply.

Local milk is price-competitive with DMB milk, but is not packaged and can sometimes meet resistance because of an assumed quality difference. In other circumstances it is in demand because it "tastes better and sours properly".

Having registered as a producer-retailer, a dairy association tries to sell its milk at a price between the controlled prices so as to cover its operational costs and still give producing members a reasonable price.

The average milk collection centre costs about Z$ 80,000 to build and equip. Centre running costs plus the cost of the monitoring team come to about Z$ 30,000 per annum. Most milk centres based in the communal areas handle about 40,000 litres of milk a year, which is insufficient to cover all costs incurred. Break-even milk intake is estimated at 78,196 litres a year if capital costs are not taken into consideration. If the capital costs are spread evenly over a period of, say, seven years then break-even production will be 94,481 litres a year. At this level of through-put milk centres run into the same problems that a larger plant has in terms of distribution costs, transport availability, refrigeration, consumer purchasing patterns etc.

New developments

For the formal market system the future is clearly defined as the need to increase its capacity to produce and market long-life products: sterilised milk for the local market, UHT milk for the rural market and powdered milk, butter and cheese for export.

In the smallholder sector the future has to consider basic processing and product development while strengthening marketing skills in all existing and potential

projects. A steady expansion of projects is envisaged, with at least two in each of the eight provinces by 1992, while another 30 or so areas will be developing at their own pace. It is important that rural demand be met as much as possible by rural production.

The objective in all dairy schemes is to attain financial independence, at least once the initial infrastructure is established. While an element of subsidy is inevitable in the start-up stages with only a few active producers, self-sustainability is the desired objective. One such scheme has reached that stage and is now operating independently of all save the normal government service agencies.

Finally, an unusual proposal is currently being considered, that of a cooperative combining large-scale and smallholder farmers which will collect and market milk in the provincial capital, Masvingo. Currently some 15 commercial farmers send their milk 160 km to Gweru, where it is processed and sent back to Masvingo for sale. A smallholder scheme has already been proposed for the province and the intention is to combine all the producers and cut out the very expensive transportation of milk.

Smallholder rural marketing

The traits of the rural market have already been covered: what follows is the DDP's attempts to work with smallholder dairy associations to help them market their milk.

Collection

The original concept was for producers to milk their animals in an individual or group milking shed and carry the milk to the milk centre themselves. In practice, despite relatively high population densities, this is only feasible for people living close to the centre or those who have transport and/or labour available. This has particularly affected those potential producers with an indigenous cow giving two litres of surplus milk a day: it is not worth their while carrying this amount 5–10 kilometres.

Bulking the milk has not been successful as yet and the only other alternative is to operate a collection route. An analysis by DDP of types of vehicle that could be used on a collection route showed that motorised transport, whether truck or tractor, is not viable even if the vehicles were donated to the farmers as they would be unable to cover running costs. While subsidy is acceptable in the early stage it is felt that establishing reliance on a motorised collection system that is not sustainable by the farmers would be a grave mistake and so, despite a certain amount of opposition, animal-drawn transport is being tried.

Reception, testing and storage

When milk is delivered to the milk centre a simple organoleptic test is carried out and the specific gravity of the milk is measured. The milk is then weighed, filtered and run over a surface (ripple) cooler and placed in cans immersed in a cold water bath/ice bank. The milk centres are each also equipped with a small bulk tank. The equipment and the process used require electricity and currently all projects are connected to the national grid. Alternative cooling and storage systems that do not require electricity are being investigated.

The milk centres are managed by the farmers themselves through their dairy associations. While in the initial stages costs are partly met by the DDP, a gradual exchange of responsibilities is implemented, with the farmers covering all costs once volumes reach a prescribed level.

Sales and distribution

Local marketing takes the form of:

- sales from the milk centre

- vendors on bicycles selling on commission

- sales points in local business centres and at bus stops and

- bulk deliveries to schools and other institutions.

In all cases milk is sold raw into consumers' own containers. Volumes purchased are often very small and erratic.

As in collection, volumes do not warrant using motorised transport except perhaps motorcycles. These, however, are difficult to obtain and maintain. Bicycles can only cover short distances and often are unsuitable for the roads and terrain. Animal-drawn, lightweight carts are currently being tried.

Processing and product development

In order to widen the market, provide a greater variety of products and cope with seasonality of demand and production, work is being started on development of appropriate products and processing technologies.

Packaging is another possible constraint, in that currently only consumers with containers at hand are purchasing milk. Work is needed to identify appropriate packaging to avoid dependence on expensive, imported packaging materials and machinery.

Conclusions and areas for study

The concept of smallholder producers marketing milk is new in Zimbabwe. There is much that is not known and the farmers and their organisations are going through a learning process in an attempt to find the best and most cost-effective methods for their situation.

Areas that require further investigation include:

- rural demand and consumption patterns
- suitable transport methods and systems for both collection and distribution
- appropriate processing technologies
- suitable packaging and
- the economics of rural marketing in general.

This list is not exhaustive but includes those aspects that are considered important in terms of improving the effectiveness of milk marketing in the rural areas for the benefit of the producers.

Discussion

In view of the stringent Zimbabwean Government rules for milk producers, suggestions for alternative ways of encouraging smallholders into dairying were sought. Would it, for example, be reasonable to set different standards for smallholders than for commercial producers? Henson argued that it was not possible to have dual standards for small- and large-scale producers but that it was possible to bend the rules slightly by, for example, cutting individual costs by encouraging group facilities like milking sheds. Asked to comment on the contradictory objectives of satisfying rural demand and promoting exports, Henson noted that Zimbabwe was in desperate need of foreign exchange and that the dairy board deliberately exported milk products to purchase imported products for milk manufacture. There was some concern over the author's figures showing that consumer prices had increased faster than producer prices while the milk marketing board's deficits had continued to increase. Part of the explanation is that, while the price deficit per litre decreased, milk intake increased. The observed consumer–producer price differences being fairly recent, there was some hope that the increase in consumer prices would not be as rapid in the future. Henson indicated that he was in no position to answer the question about the implications of a change in government policy for trade liberalisation since government policy and practice were often contradictory.

An overview of current milk marketing systems in Tanzania: Successes and problems

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Abstract

The main thrust of this paper is to explain the major milk marketing systems in Tanzania. The dairy marketing system comprises formal and informal subsystems. The formal marketing subsystem mainly caters to urban centres while the informal subsystem operates in the rural areas. The efficiency of the formal marketing subsystem is limited by a number of technical, infrastructural, managerial and financial constraints. To ease this burden, the paper suggests the expansion of the role of the private sector in milk marketing. Such a decision, however, needs to be backed by sound marketing research results.

Introduction

The primary objective of the livestock policy with respect to dairy development in Tanzania is to increase liquid milk production, increase the income of dairy farmers, reduce dependency on milk imports, achieve national self-sufficiency and create employment opportunities. The policy therefore emphasises development through increased local production, processing and marketing of milk and milk products.

In spite of the fact that the bulk of local milk production originates from traditional zebu cattle and the fact that there is a potential for increasing milk production from this source, little investment has been made in this sector. The government has in the past put great emphasis on the development of large-scale farms. Recently, however, the Ministry of Agriculture and Livestock Development (MALD) has embarked on an ambitious programme to increase milk production

to levels of self-sufficiency by the year 2000. There is a clear emphasis on the improvement of the traditional herd in this programme.

To achieve sustainable smallholder dairy development, it is imperative that efforts to increase milk production be accompanied by sound pricing policies and developments in market infrastructure to facilitate marketing of surplus milk. However, because of the remoteness of many of the traditional cattle areas and the large seasonal fluctuations in supply, most of the milk is consumed within the area of production.

The purpose of this paper is to describe the current milk marketing methods in Tanzania. It starts with a brief outline of the background to the dairy industry and a description of the present production and utilisation of dairy products in Tanzania. This is followed by a description of the growth of commercial marketing and processing. The paper also briefly reviews past pricing policies in terms of their impact on the production and marketing of dairy products. It then discusses the main problems encountered in dairy marketing. The last section draws attention to priority areas for research and offers suggestions for improved milk collection, processing and marketing.

Background to the dairy industry

The livestock sector in Tanzania accounts for 25% of agricultural gross domestic product (GDP) and is the most important source of animal protein. Dairying was not an area of major emphasis during the colonial period and the keeping of grade cattle by peasant farmers was actively discouraged. The 1984 livestock census estimated the number of cattle in Tanzania at 12.5 million, of which 143,000 were grade dairy cattle. More than 99% of all cattle are kept by small livestock owners, who account for 80% of the milk produced in Tanzania. The traditional cattle are of the indigenous zebu type characterised by low productive capacity, long calving intervals (18–24 months) and short lactations (3 to 4 months). Under traditional management the traditional cattle produce up to 140 litres per lactation, in addition to the requirements for the calf.

The commercial sector accounts for 20% of milk production in Tanzania. Most of the grade cattle are confined to areas of higher rainfall where grass growth and crop wastes are abundant and where tsetse infestation is less of a problem. These are the cool and semi-temperate areas of the northern and southern highlands of Tanzania, those in Arusha, Kilimanjaro, Usambaa, Iringa and the Mbeya highlands and parts of the West Lake Region. In the course of implementing the 1983 Tanzania Livestock Policy, smallholder dairy production in these areas and on the periphery of urban centres such as Dar es Salaam was intensified to supply milk to urban dwellers. Most of the large-scale dairy farms are run by the Tanzania Dairy Farming Company (DAFCO), Mkonge Livestock Company (MLICO), National Agriculture and Food Company (NAFCO) and the

Prisons Department. A number of private dairy farms already exist in parts of the Kilimanjaro region.

The MALD is responsible for the overall planning, monitoring and coordination of livestock development activities. A number of tasks have been delegated to specialised parastatals and regional authorities. The main institutions engaged in dairy development include the Livestock Development Division of MALD, DAFCO, the Tanzania Dairies Limited (TDL) and the Tanzania Animal Feed Company (TAFCO).

Present situation in milk production and consumption

The indigenous herd

Traditional dairying in Tanzania is a secondary enterprise complementing food- and cash-crop production. All owners of indigenous cattle use them to satisfy their family's needs for fresh and sour milk. Those within reach of markets sell surplus fresh milk, while others not so favourably situated produce sour milk and ghee for sale when the opportunities arise.

Total annual milk production from the indigenous national herd, fluctuates widely from year to year depending on the amount and distribution of rainfall and on the occurrence and severity of disease outbreaks.

Using the 1984 livestock census and the National Herd Model proposed by the Marketing Development Bureau of MALD, the amount of surplus milk available for human consumption was estimated at 219.6 million litres (Table 1). At the 1988 population level of some 23.3 million people, average annual availability per head would be 9.4 litres.

Table 1. *Parameters used to estimate the amount of milk available for human consumption from the indigenous herd, Tanzania.*

Total mature females	In calf (%)	Still born/ aborted (%)	Calf mortality (%)	Total lactating females	Individual animal surplus (litres)
4,808,566	66	20	27	2,196,168	100

Source: MDB (1988).

Improved dairy cattle

Milk production from improved dairy cattle in 1984 was estimated at 78.88 million litres (Table 2). Allowing for calf rearing requirements of 300 litres per calf, milk available for human consumption could have been 72.96 million litres.

Table 2. *Parameters used to estimate the amount of milk available for human consumption from improved dairy cattle, Tanzania.*

Mature females	Calving percentage	Lactating females	Heifer calves	Heifers	Lactation average (litres)
57,323	68.8	39,438	19,724	28,037	2000

Source: MDB (1988).

Assuming that the number of lactating females has increased by 5% since 1984 and that calving and production levels have remained unchanged, annual milk production for human consumption in mid-1990 would have been approximately 97.77 million litres. At the mid-1990 population figure of 24.6 million people, this equates to 4 litres per person.

The contribution of the commercial sector to total milk production fluctuates between 20 and 30%. However, to date most of the large-scale farms where these animals are kept are performing far below their capacity due to lack of essential infrastructure and other technical, managerial and financial constraints. For example, based on the evaluation of agricultural parastatals in Tanzania, Michael Carrol and Associates (1990) reported that the gradual deterioration of DAFCO's resources over the years has had a significant impact on the Company's production levels (Table 3).

Table 3. *Indicators of the performance of dairy herds belonging to the Dairy Farming Company, Tanzania.*

Indicator	Unit	Highest level achieved	Current level	Variation (%)
Total herd	head	5592	4166	-25
Cow herd	head	2617	1897	-27
Milking cows	head	1694	1115	-34
Calving rate	%	84	62	-26
Milk yield	'000 litres	4570	2518	-45
Milk yield	litres/cow	7.5	6.2	-17

Source: Michael Carrol and Associates (1990).

Supply and demand for milk and milk products

In most parts of Tanzania, supplies of liquid milk and manufactured dairy products are insufficient to meet consumer demand. The shortfall is more significant in the urban areas. Tanzania experienced relatively low growth in dairy production in the past two decades. Liquid milk production grew at an average

rate of 1.9% per annum between 1970 and 1987 while average population growth rate was estimated at 2.8% per annum. Thus growth in domestic milk production has not kept up with the increase in demand. For example, in 1981 milk production stood at 390 million litres while consumption was estimated at 420 million litres. Production and consumption are projected to increase to 761 and 882 million litres, respectively, by the year 2000 (MALD, 1989).

This imbalance between supply and demand has led to milk imports, obtained mainly as aid and donations from the World Food Programme (WFP) and the European Economic Community (EEC). These have been in the form of skim-milk powder and butter oil which are recombined to make standardised milk in processing plants under Tanzania Dairies Limited (TDL). Data from MDB (1988) indicate that Tanzania imported a total of 49,915 tonnes of milk products (equivalent to 499.2 million litres of milk) between 1976 and 1987. The Livestock Development Study conducted by Agroprogress Kienbaum International GMbH (1988) found that more than 80% of TDL's revenues are derived from the sale of standardised pasteurised milk, of which approximately 90% comes from recombined raw materials. The milk output of TDL, however, represents less than 5% of the total milk supply in the country.

Milk consumption varies markedly among regions, reflecting the uneven distribution of the cattle population. Milk supply levels are, with the exception of some wet-season surpluses, well below demand. Only small quantities of milk are processed. Even more important is the variation in milk consumption with changes in income. Raikes (1987) contends that, in the late 1970s, the lower-income half of the population of mainland Tanzania consumed only 9% of all livestock products, whereas the 7.6% of the population with the highest household incomes consumed 63% of all livestock products.

Marketing of dairy products in Tanzania

The dairy development and marketing systems in most countries of sub-Saharan Africa have one common feature: the dairy economy is dominated by a relatively underdeveloped dairy marketing subsystem in the traditional livestock subsector. Most countries in the region have both a formal dairy marketing subsystem, which caters primarily to urban consumers, and an informal marketing subsystem, which operates in the rural areas. There is some evidence that the informal marketing subsystems tend to be low-cost operations and that they are in a position to pay higher prices to producers (Mbogoh, 1984).

Government-controlled prices operate in the formal marketing subsystem, while prices in the informal marketing subsystem operate under the influence of supply and demand and can be as high as double the official price. Mbogoh (1984) reports that the ratio between the traditional and official market prices in Tanzania fluctuates between 3:2 and 2:1.

Although most of this section will be concerned with milk marketing through TDL, due to lack of adequate information about other sales, it is however important to note that this accounts for only a minor proportion of total milk production. However, to arrive at a better evaluation of the dairy market in Tanzania a review of the traditional marketing systems is necessary.

Traditional marketing systems

The fact that only a small proportion of the milk produced in Tanzania is marketed by commercial enterprises implies that nearly all traditionally produced dairy products are marketed through traditional, informal marketing channels.

To date, where a few cattle owners produce an excess above their own requirements, sales tend to be organised privately by producers or petty traders, who deliver the milk on foot or by bicycle. When the surplus increases beyond what can be sold locally, cooperatives and TDL purchase and process the excess milk and sell the products in towns. Since prices received from official sales are lower than those from local sales, only the surplus over local requirements is sold to TDL.

Most traditional dairy products are marketed through interhousehold sales and exchange, rural trading centres and the common weekly or bi-weekly rural market days. The prices received from the sale of dairy products represent both the producer and retail (market) value of the product, with no intermediate marketing agents involved. This simple marketing channel has the lowest possible cost and, to a large extent, provides maximum returns to the farmer. Most of these traditional marketing systems in Tanzania can be found in the Kilimanjaro/Arusha area, where marketing is done mostly by women. The women also process the milk into various products such as ghee, butter and cheese.

In the rural areas of Musoma, Shinyanga and Mwanza, farmers sell their surplus milk directly to neighbours or to consumers in nearby towns. Ideally, the milk should be inspected by a health officer for adulteration, colour and hygiene before it is sold. However, this is rarely done. Under some circumstances, milk is sold through middlemen who process the milk and sell other milk products. The processing can involve mere pasteurisation or may involve the production of butter and ghee, depending on the amount of milk available. Milk is sold to consumers in half-litre plastic containers. Private traders offer incentives to farmers in the form of advance payments and payment for veterinary services. Farmers repay the traders with milk.

The growth of commercial marketing and processing of milk

Milk collection, processing and marketing in Tanzania is geared to supplying milk and other dairy products to the urban centres.

Milk is collected from farms and collection/cooling centres by milk tankers and taken to one of the seven processing plants owned by Tanzania Dairies Limited (TDL). These have a total maximum capacity of 309,000 litres per day. Lakeside Dairies in Mwanza, Uyolo Agricultural Centre (Mbeya), Sokoine University of Agriculture (Morogoro) and the Highland Dairy Company in Iringa each have small milk processing facilities. However, most of these operate very marginally, if at all.

The processed milk and milk products are sold to the urban population through established distribution channels including direct delivery to hotels and institutions and sales through kiosks and agents.

Milk collection

TDL has, since 1975, been collecting milk from producers through a network of collection routes on village feeder roads established by each plant. These routes have collection centres, some of which have cooling facilities. Milk is supplied both by large-scale farms, such as those belonging to DAFCO, prison farms and private large-scale farms, and by small-scale farms.

The effectiveness of milk collection is affected by the availability of adequate and suitable transport, road conditions and the operation of the cooling machines at the collection centres. Less milk has been collected over the past few years because roads have deteriorated and vehicles and cooling machines have broken down frequently.

MDB (1989) and recent TDL annual reports show that the amount of milk collected has dropped from 14.3 million litres in 1979 to 5.3 million litres in 1988 (Figure 1). Over the same period producer prices increased from Tanzanian Shillings (TSh) 6.20 to TSh 44.00 per litre. The proportion of milk collected to the total volume of milk processed dropped from 30% in 1979 to 19% in 1987 (Table 4). Furthermore, of the estimated 458 million litres of milk produced in 1987 only 5.4 million litres (1.2%) were collected for processing.

Milk processing

Milk processing has thus far been carried out mainly by TDL. TDL operates seven dairy plants which process local milk and recombine skim-milk powder and butter oil. Most of the processing plants are in the urban centres and serve the urban population. The processing capacity of existing facilities is over 100 million litres per year but only 30% of that capacity is currently utilised. The maximum volume of milk processed was 42.3 million litres in 1983. The total volume of milk processed has ranged from 25.7 to 42.3 million litres (MALD, 1989).

Figure 1. *Milk deliveries to TDL and producer prices 1979–1989.*

Deliveries (litres x 10⁶)   Producer price (TSh/litre)

——— Milk deliveries

- - - - Producer price
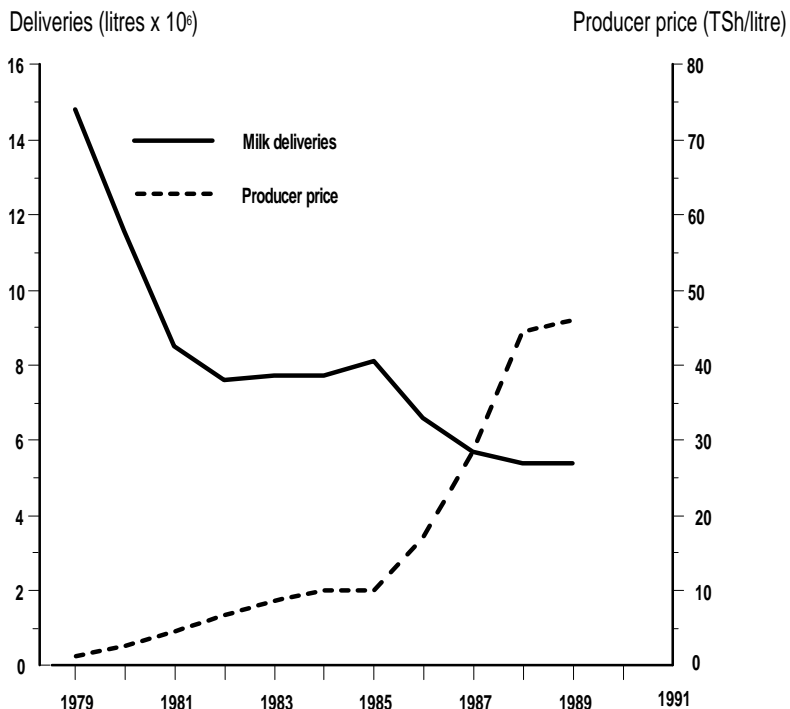
Source: Adapted from MDB (1989).

The main TDL products are standardised pasteurised milk, ultra-heat treated (UHT) milk, sour milk, yoghurt, butter and ghee, cheese and ice-cream. Fresh milk sold in the urban centres is the main product.

The skim-milk powder and butter oil recombined to form standardised milk come as food aid from WFP and EEC. The reconstituted milk is sold by TDL at a price equivalent to the factory-gate price of locally produced milk. The imported milk powder and butter oil are used mainly by the Dar es Salaam and Arusha plants, which have low milk intakes. Other necessary inputs in processing operations include packaging materials, laboratory equipment and chemicals, which must be imported from abroad. The availability and price of packaging materials have affected production. Coupled with the current poor condition of the processing machinery, the situation is not very promising.

Table 4. *Intake of locally produced milk by processing plants of Tanzania Dairies Limited, 1979–88.*

Year	Local supply ('000 litres)	Reconstituted milk ('000 litres)	Total ('000 litres)	Per cent local milk
1979	11,308	25,843	37,151	30
1980	11,346	28,968	40,314	28
1981	8,307	28,559	36,667	23
1982	7,359	34,393	41,752	18
1983	7,570	34,748	42,318	18
1984	7,468	28,804	36,272	21
1985	7,955	26,215	34,170	23
1986	6,775	25,902	32,676	21
1987	5,457	20,314	25,771	21
1988	5,464	23,217	28,681	19

Milk prices have increased in response to demands from farmers for higher producer prices. This has resulted in a decline in the volume of sales and processing operations have been limited to production of volume that could be sold, hence processing capacity has been underutilised. In consequence, overhead costs have exceeded the revenue generated, creating serious liquidity problems for the company.

Milk marketing by TDL

Formal marketing arrangements are found only in urban areas. The distribution and retail sale of milk involves TDL kiosks, direct delivery to institutions and households and sales to retailers. Products such as ghee and butter are often transported to major market centres. Ice-cream, which is only produced in Arusha, is sold from ice-cream carts by vendors who buy their supplies from the plant.

Often the market for these products is at a considerable distance from the plants, resulting in high marketing costs. Deliveries are irregular because of frequent breakdown of vehicles. No refrigerated vehicles are available.

Another serious problem is the lack of packing materials because of a shortage of foreign exchange. As a result milk has been distributed in plastic pails and is liable to contamination and adulteration. This led to a drastic drop in sales. Increases in producer prices have pushed the retail price of processed products beyond the reach of the ordinary wage earner. Other notable problems include

lack of variety in the products and insufficient market research and product promotion by TDL.

According to estimates by MALD (1989), milk sold through kiosks amounts to 25% of total sales. Direct delivery to hotels and institutions represents 5% of total sales and other retailers and vendors account for the remaining 70%.

Milk pricing policy

The Department of Livestock Development has been responsible for establishing producer prices for milk sold to the processing plants. Consumer prices were set by the National Price Commission on a country-wide basis.

The Government has recently decided to abandon pan-territorial pricing and decentralise milk pricing to the regional authorities, so that local circumstances can be taken into account. The new procedure requires the dairy production units (for example, the DAFCO farms) to prepare a cost-of-production proposal following major cost increases. In addition to actual production costs, a 15% profit margin is included in the calculations. Based on this pricing system DAFCO farms received an average of TSh 55.1/litre of milk in 1989 (Michael Carrol and Associates, 1990).

The primary objective of the new milk pricing policy is to regulate prices according to supply and demand in different localities. While the producer prices are intended to provide an incentive to increase production, the consumer prices are set at a level that covers the processing costs and provides a reasonable profit for the processing plants. Most producers, other than the state dairy farms which are obliged to supply TDL, sell their milk on the open market. Prices vary from region to region depending on supply and demand.

Financial returns from sales of milk and milk products

To get some idea of the profitability of dairy farming a comparative account of the performance of large-scale and small-scale farms is provided. The DAFCO farms are used as an example of large-scale producers. The smallholder perspective focuses on Hai district where small-scale milk production, processing and marketing have been practised for a long time.

Large-scale farms

DAFCO operates six dairy farms and two heifer breeding units, spread throughout Tanzania.

Between 1985 and 1989 the DAFCO farms made profits totalling TSh 19.9 million (Michael Carrol and Associates, 1990). The four most successful dairy farms

(Ruvu, Rongai, Ihimbu and Kitulo) accounted for 70% of all the profits earned by the farms.

Among the six farms that made profits in 1989, the profit-to-sales ratio averaged 17%, ranging from 11% for Kitulo to 38% for Ihimbu. The farms differed markedly in profitability per milking cow. Ihimbu achieved the highest profit per milking cow (TSh 48,400 for 1989 and TSh 53,781 for 1985–89). Excluding Iwambi, which lost money during both periods, Kitulo had the lowest profitability figures (TSh 10,122 in 1989 and TSh 4285 for 1985–89). While not conclusive, the five-year profitability figures indicate that smaller farms performed better than larger farms. It is, however, worth noting that profitability figures reported here are after deduction of joint production and marketing costs. A specific account of marketing costs for individual farms was not available.

Smallholder farms

Comprehensive studies on the costs and profitability of milk production and marketing for smallholder farmers in Tanzania are lacking. Unpublished marketing studies done under the auspices of the Sokoine University of Agriculture by Mshana (1987) and Assey (1988) have provided some insights into this area but their results can at best be considered indicative.

Mshana (1987) reported gross margins in the region of 48% of the average price of milk for smallholders in Hai district of Kilimanjaro region. Transport was the biggest component (31%) of all the marketing costs. Assey (1988) reported that benefit-to-cost ratios for smallholder milk processing were 2:1 for cheese and ghee and 3:1 for butter.

While these studies imply that smallholder milk marketing and processing are profitable, more comprehensive studies are necessary to reach meaningful conclusions. Comparative studies for large-scale milk processing and marketing will undoubtedly strengthen the validity of the proposed research programme.

Problems of milk marketing systems

Efforts to boost collection, processing and marketing of locally produced milk have been hampered by financial, technical and policy constraints. This section gives a brief account of the major problems.

Shortage of foreign exchange and local funds for the purchase of essential spares for the processing and cooling machines, chemicals, cultures and packaging materials has long limited milk processing capacity. Poor roads, leading to breakdown of vehicles and difficulties in collecting milk during the rainy seasons when more milk is available for collection, result in low milk intake and

high collection costs. Inadequate milk collection vehicles and lack of spares for maintenance have compounded this problem.

The processing facilities have long been underutilised because of low milk intake, power supply problems, water problems and machinery breakdowns. This has resulted in low income generation, leading to lack of a surplus for capital investment.

Fragmented and scattered production units increase collection costs. Lack of coordination in dairy development with regard to the appropriate location of processing plants has also contributed to high milk collection costs. Even the establishment of parastatals has failed to solve this problem. Michael Carrol and Associates (1990) contended that the impact of parastatals in Tanzania has been less debilitating in the livestock sector than in other sectors. This is because livestock are so widespread and producers are so many that the parastatal organisations have relatively little influence.

The decline in productivity on DAFCO farms is a result of inadequate support and extension services and lack of inputs.

Government intervention policies, including control of producer and retail prices have reduced both supply and demand, contrary to their objective of protecting both producers and consumers. This is due to the fact that the government paid more attention to consumer interests than to producer interests when setting prices.

Conclusions and recommendations for an integrated milk marketing system

To strengthen the existing dairy industry, involvement of cooperatives in provision of farm inputs, credit facilities and milk collection networks needs to be considered. Joint-venture undertakings with the dairy processing companies need to be explored.

Facilities for testing milk need to be provided to the collection/cooling centres. Most of the milk currently traded in Tanzanian towns is adulterated, whether by farmers, middlemen or TDL distributors. Milk collected should be graded and sold to the processing plants. Immediate cash payments and appropriate record keeping need also to be instituted. Transportation of milk from collection centres to the plants should be improved.

The processing plants need to be rehabilitated to increase their local milk intakes.

A mini-dairy concept needs to be adopted where there is surplus milk. Simple processing and packaging methods can result in lower consumer prices or an increase in the producer price. Furthermore, simple methods of processing

suited to smallholder dairying can be rapidly transferred by appropriate training programmes and would allow smallholders to benefit more from their seasonal milk surplus (O'Mahony and Peters, 1987; Kerven, 1987).

Regarding marketing systems and prices, Mbogoh (1984) correctly noted that there is a lack of data on prices and costs that would facilitate a systematic appraisal of official and traditional marketing systems. He suggests that country-specific case studies be undertaken to appraise the performance of the different markets. In Tanzania, these research efforts should first concentrate on high-potential areas where both types of market co-exist and compete more vigorously.

References

Agroprogress Kienbaum International GMbH. 1988. *Livestock development study: Report submitted to the Ministry of Agriculture and Livestock Development.* Ministry of Agriculture and Livestock Development, Dar es Salaam, Tanzania. 31 pp.

Assey E J M. 1988. *Smallholder milk processing and marketing of milk products in Kilimanjaro highlands: A case study of selected villages in Hai district.* BSc thesis. Department of Rural Economy, Sokoine University of Agriculture, Morogoro, Tanzania. 73 pp.

Kerven C. 1987. The role of milk in pastoral diet and economy: The case of South Darfur, Sudan. *ILCA Bulletin* 27:18–27. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

MALD (Ministry of Agriculture and Livestock Development). 1989. *Livestock development programme, main report: Subsector summaries.* MALD, Dar es Salaam, Tanzania.

Mbogoh S G. 1984. Dairy development and dairy marketing in sub-Saharan Africa: Some preliminary indicators of policy impacts. *ILCA Bulletin* 19:8–16. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

MDB (Marketing Development Bureau). 1988. *Preliminary review of ruminant livestock industry.* Ministry of Agriculture and Livestock Development, Dar es Salaam, Tanzania. 31 pp.

MDB (Marketing Development Bureau). 1989. *Tanzania Dairies Limited: Milk marketing report.* Ministry of Agriculture and Livestock Development, Dar es Salaam, Tanzania. 12 pp.

Michael Carrol and Associates. 1990. *Tanzania: Evaluation of agricultural parastatals. Preliminary draft report, volume II.* DAFCO Report submitted to the Ministry of Agriculture and Livestock Development. Ministry of Agriculture and Livestock Development, Dar es Salaam, Tanzania. 23 pp.

Mshana S S. 1987. *A description and analysis of distribution channels for dairy products in Hai district of Kilimanjaro region, Tanzania.* BSc thesis, Department of Rural Economy, Sokoine University of Agriculture, Morogoro, Tanzania. 70 pp.

O'Mahony F and Peters K J. 1987. Smallholder milk processing in sub-Saharan Africa. *ILCA Bulletin* 27:2–17. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Raikes P L. 1987. *Livestock development and policy in East Africa.* Centre for Development Research Publication 6, Scandinavian Institute of African Studies, Uppsala, Sweden. 254 pp.

Discussion

After summarising some of the issues addressed in the paper, the discussant (S. Mbogoh) raised a number of questions regarding the authors' use of nominal rather than real prices in their evaluation of milk deliveries to TDL; their assertion that both large- and small-scale dairy farms are profitable; and ways of stimulating greater involvement of the private sector.

While admitting the error of using nominal prices, Ashimogo indicated that prices were not the only factor affecting milk deliveries to TDL. With regard to profitability, Ashimogo explained that his figures for large-scale farms were aggregates and that some of the cost items used in his calculations might have been underestimated. Options identified for milk marketing and processing in Tanzania included going public (i.e. issuing shares), forming cooperatives and stimulating participation of private entrepreneurs. Although greater involvement of the private sector is desirable, it was felt that a first priority was more market-oriented research looking at changes in consumer preferences and at the operation of public and private processing plants in order to establish whether these were in competition or operated in entirely different areas.

A major topic of discussion related to the authors' conclusion that supply was unable to meet demand in spite of the fact that several indicators they cite indicate the opposite. That prices increased substantially while incomes decreased in real terms, that there appears to have been a forced change in consumer preferences, that consumers lack access to dairy products and that adulteration of fresh milk is common, all suggest that demand falls short of supply.

The remainder of the general discussion focused on sanitation and hygiene-related issues that can hardly be backed by evidence. It was suggested that a survey by a public health institution to determine the occurrence of brucellosis and tuberculosis among consumers of dairy products would be important before deciding to limit marketing of unpasteurised dairy products. Even if these two diseases were present, the question still remains as to whether it is in the public's interest to solve hygiene-related problems by means of expensive processing, as this would, if enforceable, clearly reduce milk consumption. While it is thought that many consumers do boil their milk, an information campaign may be in order to educate consumers about the possible dangers of unboiled or unpasteurised milk and encourage them to boil unpasteurised milk. The general opinion was that, although there is little proof that smallholder milk is of lesser quality than milk from large-scale

producers or processing plants, in many cases hygiene loomed as an important factor in consumers' choice of directly delivered milk.

The dairy industry and the smallholder farmer in Malawi

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Introduction

The national livestock development policy of Malawi aimed among other things at self-sufficiency in all livestock products and profitable export of any surplus that may arise. Dairy production is one of the avenues explored by the Malawi Government in its endeavour to achieve self-sufficiency in food supplies and to provide nutritious food to the expanding population of the country. The Government developed three strategies for dairy development: (1) establishment of state-owned and parastatal farms such as Katete, Ndata and Mikilongwe; (2) promotion of medium-sized farms, most of which are commercial, e.g. Bwemba and Chitedze; and (3) introduction of smallholder dairy development schemes in all three administrative regions of the country. The last-mentioned strategy is the main focus in this paper.

To ease management, dairy production in Malawi had been organised into three milkshed[2] areas: around Lilongwe in the Central Region, around Blantyre in the Southern Region and around Mzuzu in the Northern Region. Within these milkshed areas smallholder dairy farmers, who are usually members of bulking groups[3] and within a radius of 8 km of a cooling centre, deliver milk twice daily to their nearest cooling centre or collection point. The milk is collected daily or every other day from these centres by bulk tankers or churn lorries and taken to

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2. Radius within which farmers are allowed to produce milk to sell to the Malawi Dairy Industries Limited (MDI). MDI is a parastatal body charged with buying, processing and marketing milk in Malawi.

3. Individuals who pool their milk and sell it as one supplier.

the nearest processing plant. Some larger estates deliver their milk directly to the plant.

Farmers were encouraged to form bulking groups mainly for the administrative convenience of extension workers and Malawi Dairy Industries (MDI). Regional associations of bulking groups such as the Shire Highlands Milk Producers Association (SHMPA) for Blantyre and the Central Region Producers Association (CREMPA) for Lilongwe have been formed to guide and direct the activities of the bulking groups. During the study period (1988/89) there were more than 4000 milk producers, including 1687 with improved dairy cattle, organised into 46 bulking groups and three regional producers' associations.

However, Malawi was still not self-sufficient in milk products by 1988. Paucity of data on the livestock industry was thought to be a major constraint to increased production of dairy products in Malawi. A review of literature indicated a paucity of data on the social, economic and technical problems facing dairy farmers in Malawi (Nzima, 1985).

In view of the limited work on dairy production, a study on socio-economic constraints to smallholder dairy production and marketing was proposed. This research included a general review of the dairy industry and a survey of 100 dairy farmers selected at random in the Lilongwe milkshed area. This milkshed area stretches over the Kasungu and the Lilongwe Agricultural Development Divisions (ADDs), but for administrative convenience the study was restricted to three rural development projects in the Lilongwe ADD (LADD): Lilongwe North East, Lilongwe and Thiwi/Lifidz. There were a total of 75 smallholder dairy farmers in the Lilongwe ADD, owning a total of 1011 dairy cattle.

The dairy industry in Malawi

The dairy industry, as laid down by the Government, has been geared towards supplying milk to the population of the major cities and to "bringing prosperity to the surrounding areas". High-yielding European dairy cattle were first imported into Malawi in the 1920s, mainly to produce milk for markets created by successful plantations in the Southern Region. The Government of Malawi established modern dairy farms and processing facilities in Blantyre and at Mikolongwe in 1969. The New Capital Dairy was established in Lilongwe in 1973, and in 1980 an expanded Blantyre Dairy came into being. Mzuzu is the most recent milkshed area (Empson, 1983).

Between 1979 and 1983 three modern dairy farms were established by the Malawi–Canada Dairy Cattle Development Project (MCDCD). By 1988 these accounted for 30% of the raw milk supply to the dairy industry.

Before 1987 milk collection processing and distribution were carried out by the Malawi Milk Marketing Board (MMMB), which was under the Department of

Animal Health and Industry. In 1987, the MMMB and MCDCD were merged to form Malawi Dairy Industries Limited (MDI).

Smallholder dairying

Smallholder dairying is relatively new to Malawi. Each farmer taking part in the Smallholder Dairy Development Scheme starts off with two halfbred Friesian–Malawi zebu cows which may be obtained for cash or with credit. Training is an important component of the schemes and prospective farmers are given short courses before receiving their cows and are closely supervised thereafter. Before getting his cows a farmer must prove his interest by building a thatched *khola* and a milking shed with a hard floor and planting at least 1.21 ha of pasture. The pasture must be fenced if the farm is in an area where East Coast Fever is prevalent.

Having done this from his own resources the farmer is then eligible to obtain on credit:

- two dairy cows
- one hand-operated spray pump
- 5 litres of approved acaricide
- two rolls of barbed wire for fencing and
- insurance premium for the first year.

The dairy cows are bred at the Veterinary Department livestock centres and issued by extension staff in the designated milkshed areas through which milk-collection runs are made (Table 1). Farmers are encouraged to form bulking groups to facilitate milk collection, to enable farmers to pool their milk at collection centres, to allow them develop a spirit of communal work and self-help, to provide them with a medium for distribution of feed, medicines and equipment and to help farmers receive extension and artificial insemination services. A price

Table 1. *Bulking groups, farmers and farms with crossbred dairy cattle by milkshed area, 1987.*

Milkshed area	Radius (km)	Bulking groups	Average number of farmers in groups	Farmers with crossbred cows
Lilongwe	60	20	15	298
Blantyre	65	19	34	650
Mzuzu	20	5	19	97

premium in the form of quantity bonus is offered to farmers who form a bulking group. Each bulking group has a chairman, a secretary and a treasurer.

Repayment of credit is done by deduction from farmers' monthly cheques at a fixed proportion of his income until the credit is repaid. The current rate of repayment is 50% of the monthly value of milk sales (Lines and Luteijn, 1988).

Milk marketing: Field experiences

Dairy farmers have a wide choice of markets for their milk. Malawi Dairy Industries Limited (MDI) enjoys a large market share. Other buyers include middlemen, villagers within the village of the dairy farmer grocers and Indians.

Over 95% of the farmers selling milk are located within 10 km of the market to which they sell, with nearly half (49.5%) within 3 km of the market.

Over 80% of the farmers preferred to sell their milk to MDI, principally because it offered better prices. The other important reason was that MDI offered direct cash payment at the end of each month. The major reason given for not selling to MDI was lack of an MDI collection centre nearby.

Nearly 95% of dairy farmers in the Lilongwe milkshed delivered milk to the cooling centres on foot or by bicycle. Motorised transport was not used because of its expense. A major problem faced by farmers was frequent breakdowns of the cooling machines at the cooling centres, with consequent spoilage of the milk. When this occurred, farmers were not paid for any milk they had delivered.

Malawi Dairy Industries Limited favours bulking groups because making individual payments each month to the smallholder suppliers entails a lot of administrative work and costs. Payment to a single entity, the bulking group, reduces administrative costs.

Of the 100 dairy farmers interviewed in the Lilongwe milkshed area, 85 were members of bulking groups. The main reason given for not joining a bulking group was absence of MDI services in the farmers areas. It thus appears that, without MDI, farmers may not be interested in forming bulking groups.

Conclusions

The dairy industry in Malawi has been geared towards supplying milk to the population of the major cities. The involvement of smallholder farmers in the production and marketing of dairy products has the objective of bringing prosperity to the areas surrounding the cities. However, this has faced difficulties. Lack of efficient transport and storage systems and delayed payments discourage producers from selling their milk to MDI through bulking groups.

Loss of milk due to breakdown of machinery at the cooling centres should be the liability of MDI, not the farmers. Expecting the farmers to absorb the losses is likely to reduce sales to MDI and discourage formation of bulking groups.

References

Empson J. 1983. *The organisation and planning of the dairy industry of Malawi.* Draft report on UNDP/FAO Project: MLW/80/002. Assistance in the Establishment of a Milk Marketing Board. FAO (Food and Agriculture Organization of the United Nations), Rome, Italy.

Lines D and Luteijn H M. 1988. *The smallholder dairy scheme in Malawi.* Assistance to Livestock Development; FAO Project MLW 75/020. Extension Aids Branch, Lilongwe.

Nzima J. 1985. *An economic evaluation of the main constraints of animal health and production of smallholder dairy cattle in Malawi.* MPhil thesis, University of Reading, Reading, UK.

Discussion

According to the discussant, G.C. Ashimogo, the main constraints limiting dairy development in Malawi are lack of data relevant to the industry and elements of mismanagement on the part of the national dairy marketing board. The major problems in the formal market channel appear to be related to farmers' payments and souring of collected milk. Some of the points raised for further explanation and discussion included: the representativeness of Nankumba's study on Lilongwe for planning dairy development at national level; and information on farmers' credit repayment, terms of borrowing and costs of alternative marketing channels. Nankumba expressed his belief in the representativeness of his study and indicated that his results could be extended to other areas of the country since Malawi's national herd was more or less homogeneous and shared similar production parameters and management problems. He noted that the default rate on farmers' credit repayment was low because credit is repaid monthly by automatically deducting 50% of the value of farmers' delivered milk and applying this to their outstanding loan balance. The author acknowledged that the Malawi Smallholder Dairy Development Project's requirement that a farmer set aside 1.21 ha of grazing land for two half-bred cows was very stringent. The requirement, which was based on the free-range grazing system prevalent in Malawi (where pasture establishment is not common), was due for revision following suggestions made at the first national livestock workshop in 1988.

Review of dairy marketing and processing in a semi-arid pastoral system in Ethiopia

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Abstract

Studies were conducted among pastoralists on the Borana Plateau in 1986–89. Household surveys described seasonal milk production and allocation, marketed supply of dairy products, incidence of calf morbidity and mortality and human consumption of dairy products and grain. The efficiency of butter-making was measured. Dairying among the Borana is controlled by the women. Overall, 69% of milk produced was used as fresh milk and the remainder was soured for direct consumption or butter processing. Butter-making is efficient, as 85% of the fat in whole milk was recovered as butter. The amount of milk sold was greatest in the wet seasons and wealthy families close to markets sold the largest quantities, consisting of fresh milk and butter. Poor families sold much less, mostly fresh milk. Dairy income was relatively more important for the poor, who used the money to purchase grain at the expense of calf welfare and balanced human nutrition. Dairy marketing is a dynamic process that varies with climate and population pressure. Policies that facilitate market access and increase the trading value of dairy products would improve food security. Technical interventions to improve milk processing are largely irrelevant at the current population density because milk surpluses are becoming smaller as a result of growth in the human population exceeding that of the cattle population.

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Introduction

Pastoral societies in sub-Saharan Africa have traditionally relied upon milk as the major component of their diet (Jahnke, 1982). However, this pattern is being increasingly affected by demographic, ecological and economic development processes. As human populations continue to grow, and livestock numbers are limited by periodic drought and resource scarcity, the ratio of animals to people decreases. This may result in a number of stress responses of pastoralists to declining wealth, including change of diet to include more non-pastoral foods, involvement in cultivation, seeking urban employment and herd diversification (Evangelou, 1984). In addition, the reduced per caput availability of livestock as a source of cash income and the growth of urban markets in drier areas has led to a more recent perception that sales of dairy products have also become more important to pastoralists (Kerven, 1987b; Grandin, 1988).

This paper attempts to synthesise results from several studies of dairy marketing and processing that were undertaken on the semi-arid Borana Plateau during 1986–89. The study area is home to semi-settled Borana pastoralists and is described elsewhere (Cossins and Upton, 1987). The objectives of the work were to: (1) describe traditional milk processing practices in terms of what is produced and the efficiency of some aspects of production; (2) the role of dairy marketing in income generation; (3) effects of distance to market, season and family wealth on marketed output; and (4) implications of the sale of dairy products for the nutrition of people and calves. The final objective of this paper is to discuss these findings with respect to designing more appropriate development strategies to improve food security and household welfare among pastoralists in the southern Ethiopian rangelands.

Methods

Dairy processing

Studies of household milk allocation and processing were conducted during 1986–88. Seasonal patterns of milk production and use were quantified for two households at each of four encampments in the Melbana, Medecho and Did Hara regions. One enumerator lived in each encampment and collected data for the two households for seven consecutive days during each of the four main seasons (long rains, cool dry, short rains and warm dry) of each year. Research was conducted during a time of average rainfall (i.e. 600 mm per year). The seasons and climate are described by Cossins and Upton (1987; 1988).

Daily data collection consisted of interviews and measurements to establish the major pathways of milk allocation. These included consumption, sale and storage. Milk was typically stored to produce *ititu* (in Borana Oromigna or *irgo*

in Amharic), which is a generic term for either: (1) short-term (5-day) fermented milk for consumption or making butter; or (2) longer-term (up to 90-day) fermented milk particularly kept for guests. Data were also collected on the use of stored products including production and use of butter and skim milk. Seasonal allocation patterns were standardised on a gross energy (GE) basis (where 1 kg of fresh whole milk = 3.3 MJ; 1 kg of fermented milk = 3.9 MJ; and 1 kg of butter = 29.8 MJ (ENI, 1980; Nicholson, 1983)).

Efficiency of traditional butter production was measured for 28 instances in which soured milk was churned by women in 20 households. This involved the use of pear-shaped, woven containers (*gorfa*) for milk storage and souring as well as churning. *Gorfa* used in different seasons vary in capacity from 6 litres (for rainy seasons when milk production is high) to 1.5 to 2 litres (for dry seasons). Before being filled with fresh milk a *gorfa* may be scrubbed with water and leaves of *Endostemon tereticaulis* or *Ocimum hadiense* and then smoked with burning wood chips of *Acacia nilotica, Cordia gharaf, Cordia ovalis* or *Combretum molle*. Smoking likely has a sterilisation effect and helps seal the inside of the container. Sterilisation helps obtain an appropriate rate of fermentation. In cases where containers are limited and/or people need to sour fresh milk daily, the *gorfa* may be re-used without scrubbing or fumigating. Other milk containers and their use among the Borana are described in Ephraim Bekele and Tarik Kassaye (1987).

Data collected on butter processing included: (1) milk temperature before and after churning; (2) churning time; (3) fat content of whole milk and buttermilk; (4) milk acidity (lactic acid content); and (5) butter yield. Analytical chemical methods followed those described by O'Mahony and Ephraim Bekele (1985a) and included titration of milk with sodium hydroxide (for acidity) and the Gerber test (fat content). Work was largely conducted during the cool dry season (July to October) of 1986, a season of reduced milk production.

Dairy marketing

The role of dairy marketing in the household economy and its possible effects on animal production were the focus of several studies reported in Holden (1988) and ILCA (1990); several papers are in preparation. The wealth stratification of households evident in Negussie Tilahun (1984) served as a basis for designing an analysis of effects of per caput livestock wealth, distance to market and season on the quantity of dairy products sold per person per day.

Holden (1988) selected a sample of Borana households from within a 30-km radius of the market towns of Dubluk (pop. 500) and Mega (pop. 3000), located within 40 km of each other on the main tarmac road that runs south to Moyale. The 2800 km^2 study area surrounding each market town was divided into three concentric sub-areas (i.e. 0–10, 11–20 and 21–30 km from market). Six encampments were randomly selected within each sub-area using compass

coordinates. One family from each of the "wealthy", "intermediate" and "poor" wealth classes was selected by the senior male leader (*aba olla*) in each encampment and interviewed, for a total of 54 from each market area. Wealth was measured in terms of lactating livestock units (1 LLU = 250 kg liveweight) while people were scored as adult African male equivalents (AAME; ILCA, 1981).

Data were also collected in different seasons. Data were collected from all families using a one-time questionnaire that recorded reported dairy sales for the current "dry" period of August/September 1987 and that reported for the "wet" and "intermediate" seasons in the previous 12 months. The senior woman (i.e. the manager of dairy marketing) in each household was asked to recall: (1) maximum and minimum sale volumes per market trip per season (calibrated using local containers); (2) frequency of market trips; (3) number and type of livestock milked per day in each season; (4) daily milk offtake; and (5) income from dairy sales and uses of the money. Income from livestock sales and other domains controlled by men was reported by the husband.

Dependent variables were calculated on a seasonal or time-weighted annual basis and included the daily quantity of dairy products sold per AAME and dairy income as a percentage of reported total income. Dairy products were expressed in litres of fresh milk equivalents derived from the GE content described previously. Independent variables were distance to market (km), wealth class, season and market site. A four-way ANOVA calculating least-squares means with repeated measures was used to analyse the data (SAS, 1987). The ANOVA of dairy income as a percentage of seasonal cash income had to employ two, rather than three, distance categories because of empty cells due to some reports of zero income. Simple linear regressions were used to analyse marketing behaviour by correlating: (1) frequency of marketing or (2) quantity of dairy products sold per market trip with (1) annual dairy sales per AAME, (2) wealth or (3) distance to market. More details are available in Holden (1988).

Dairy marketing and the welfare of humans and calves

Data from 15 encampments in the Dubluk marketing area (Holden, 1988) were combined with information on calf morbidity and mortality (Mulugeta Assefa, 1990) to assess the risks of milk marketing for calf management in households of varied wealth. The hypothesis was that poorer families living closer to a market town would be most affected by the opportunity to sell dairy products, and that this would intensify competition between people and calves for milk, with negative implications for the vigour and health of calves. In addition to the data collection and scaling reported above, one woman per household was asked to report the quantities of milk and grain consumed by themselves and one child under the age of four during the previous 24 hours; these were then converted to metabolisable energy equivalents (Holden, 1988). Quantities were estimated by calibrating local containers.

As part of another questionnaire on livestock production that was similarly set up to measure variability due to wealth and distance from market, the perceived daily milk yield, daily milk offtake and calf performance (births, deaths, morbidity) were recorded for offspring of up to six randomly selected lactating cows in each of 45 households (five per wealth and distance class). The 233 cows were evenly divided into "good", "average" and "poor" milking classes, with milk offtake ranging from 2.3 litres per day over nine months to 1.5 litres per day over seven months (Mulugeta Assefa, 1990).

Calf morbidity and mortality were reported only for animals that were unweaned, and rates were calculated based on two samples of calves born in the three years before the survey. These years had "normal" rainfall. A calf was considered to have experienced morbidity if it had recovered at least once from a life-threatening ailment related to nutrition or health management. Respondents had no difficulty reporting such information, and data were cross-checked with other family members.

Effects of wealth class and distance to market on human food intake were analysed using a two-way ANOVA. Milk offtake per lactating cow was analysed using a "split-plot", three-factor design with families as the "main plot" with the two factors of wealth and distance to market; cows were "sub-plots" within the factor cow class. Binomial data for calf mortality and morbidity were analysed using a "maximum likelihood" logistic analysis for the same three factors using PROC CATMOD procedures in SAS (1987).

Results

Milk processing

Review of traditional practices

The Borana system for milk processing was first described by Ephraim Bekele and Tarik Kassaye (1987). Cows are the main source of milk, and it is cows' milk that is the focus of processing. Milk from other livestock species plays little or no role in processing here. Milk from small ruminants or camels may occasionally be added to top-up a larger volume of cows' milk when it is to be sold or consumed, and thus some of this milk probably gets processed. Although camels produce large quantities of milk, the Borana consider it unsuitable for making quality butter.

Milk is consumed fresh in the household on a daily basis. Surplus milk may be given to relatives and neighbours or it may be stored and soured as the first step in processing (Ephraim Bekele and Tarik Kassaye, 1987). After a minimum of one day of fermentation, the milk in the *gorfa* is ready for churning to make butter. Soured milk is usually churned in the morning during warm weather, as the

Borana appreciate the role of lower temperatures in butter production. The *gorfa* (filled to 50 to 70% capacity) is cradled by a woman who rocks it firmly back and forth. Pressure in the *gorfa* is occasionally released by removing a small wooden plug in the centre of the lid. This also releases a small drop of milk, which when rubbed between the fingers indicates whether butter grains have formed. The presence of butter is also indicated by a change in the churning sound. Churning usually takes less than one hour. Butter is removed from the *gorfa* using a wooden spoon.

Butter is used as a cosmetic for skin and hair by both sexes, for roasting coffee beans and as a food. It may also be sold. The buttermilk that remains after churning may be consumed by children or adults, used for rinsing other milk containers, or given to calves, lambs, kids, dogs or cats. Butter may also be melted in a clay saucepan over a fire, with fresh leaves and stems of *Ocimum basilicum* or *Ocimum hadiense* added for flavour, to make dehydrated butter (ghee). The moisture is driven off and before the liquid clarifies a handful of maize, sorghum or other cereal flour is added along with some clean, fresh grass and a pinch of salt. The mixture is then poured into a cattle horn or a small wooden container with a tight lid. This product is reported to keep for up to one year. The long shelf-life may be due to the hygienic handling of the milk, the low moisture content of the ghee and/or the addition of salt (Ephraim Bekele and Tarik Kassaye, 1987). Ghee can be used in the dry season to prepare a grain-based porridge, or is consumed alone or with coffee or tea.

For the long-term fermented milk, surplus fresh milk is poured into a designated large *gorfa* or *amuyou* container each day. As the curd coagulates serum is removed by a woman using a wooden pipette (Ephraim Bekele and Tarik Kassaye, 1987). The serum is drunk. This process is repeated until the container is full of curds and all of the serum has been removed. The curds and the lid of the container are occasionally checked for mould. When mould forms the surface of the curd is removed and the lid is washed with hot water and scrubbed with leaves and stems of *Ocimum basilicum, Ocimum hadiense* or *Endostemon tereticaulis*. When the lid is replaced some smoke from a charred piece of wood is captured in the container; this is repeated occasionally to help keep the surface of the curds free from undesirable microbes. Long-term fermented milk is a special food usually reserved for guests and has a shelf-life of about 60 days. Before consumption, the curd must be stirred to liquefy it. More details are available in Ephraim Bekele and Tarik Kassaye (1987).

Seasonality and milk allocation for processing

The average milk offtake per AAME per week ranged from an average of 5.5 litres in the warm dry seasons to 11.5 litres during the long rains. Over eight consecutive seasons the average offtake was 7.3 litres/AAME per week.

Considered overall, 69% of total offtake was variously used as fresh milk, 24% was stored and soured to make butter, 6% was used otherwise as short-term soured milk and 1% was used as long-term soured milk. Seasonal means indicated that the amount of milk allocated for fermentation and processing (y) was positively related to milk offtake and thus the potential surplus (x) by the equation:

$$y = 0.484x - 1.152$$
$$r^2 = 0.91; P< 0.01; df = 6$$

Seasonal patterns suggested that when there was surplus milk butter-making took precedence over other uses of short-term fermented milk, which in turn took priority over the production of long-term fermented milk.

The long rains and warm dry periods of 1987 provided the best contrasts of the seasonal quantities and uses of milk products. Daily milk offtake ranged from 14.7 litres/AAME per week in the long rains to 7.5 litres/AAME per week during the preceding long dry season. Daily use of fresh milk in each season was 8.4 and 5.6 litres/AAME per week, respectively. Despite this difference in the amount of fresh milk used, the relative allocation of fresh milk in each season was dominated by daily consumption (67%), followed by that given away or traded among relatives or neighbours (20%), milk that was marketed (2%) and "other" miscellaneous or undocumented uses (11%).

Quantities of short-term soured milk ranged from 1.62 litres/ AAME per week in the long rains to 0.3 litres/AAME per week in the warm dry season. Relative allocation shifted slightly between seasons. In the long rains use was dominated by consumption (46%), followed by storage to make butter (29%) and that given away or traded (25%). In the warm dry season the proportion consumed was similar (43%), but relatively more (50%) was allocated to butter-making while less (7%) was given away or traded.

Butter-making efficiency

Details reported here in the text are means ± SE (n= 28). *Gorfa* (1.7 litre volume) were filled to about 60% of capacity with milk, and this was soured for 1.8± 0.18 days. Prior to churning, the milk had a temperature of 20.0± 0.42°C and an acidity of 1.06± 0.03%. The milk was churned for 40.0± 2.5 minutes and afterwards the temperature of the buttermilk was 23.7± 0.32°C. The sour milk contained about 46.8 g of fat, compared with 7 g of fat in the buttermilk after churning. Thus some 85% of the butterfat was extracted by churning. Butter yield was 66.9± 5.6 g but moisture content of the butter was not determined.

Dairy marketing

Effects of distance to market, wealth and season

The 108 sample families reported in Holden (1988) averaged 3.6 AAME per family and the mean annual ratio (mean ± SE) of LLU:AAME ranged from 2.0± 0.1 (wealthy) to 1.1± 0.1 (intermediate) and 0.5± 0.1 (poor) overall, with the ratio increasing during the wet and transition periods relative to dry periods. Over 90% of the LLUs were cows.

The ANOVA for daily dairy sales per AAME revealed a significant (P= 0.0024) three-way interaction with no influence of market site (Figure 1). The interaction was caused by differences between wealth classes in supply response due to interrelated effects of season on milk production and distance on marketing behaviour. Averaged across all distances to market, wealthy households sold six times as much as poor households in the wet season (0.56 vs 0.09 litres/AAME per day), but this difference increased another eightfold in the dry season. When distance to market was reduced from over 20 km to under 10 km, the dry-season effect ranged from nil within poor households to a fourfold increase in middle-class households and an 18-fold increase in wealthy households.

Calculated across seasons and distances, wealthy families marketed about twice as much dairy products (0.26 litre/AAME per day) as middle-class households (0.14 litre) and seven times as much as poor households (0.04 litre). Across all wealth classes and distances, sales in wet periods (0.28 litre/AAME per day) were over twice and five times as much as those of transition (0.12 litre) or dry (0.05 litre) seasons, respectively. Sales within a market radius of 10 km averaged 0.32 litre/AAME per day overall, which is over three times as great as that for the 11 to 20 km radius (0.10 litre) and 16 times that for the 20 to 30 km radius (0.02 litre). These main effects were highly significant (P< 0.001).

Linear correlations revealed several important features of marketing behaviour. Considered across all households, the total annual quantity of dairy products sold was positively correlated with the total annual frequency of sales (r^2= 0.90; P< 0.0001; n= 95). The total annual frequency of sales was negatively correlated with distance (r^2= -0.60; P< 0.0001; n= 95). On an annual basis, households within 10 km of market sold dairy products twice a week on average, whereas those more than 20 km from a market sold only once a month. The quantity of products sold appeared to remain constant across distance overall, but as families became wealthier they tended to sell more per market trip (r^2= 0.60; P= 0.0001; n= 95).

Dairy income as a percentage of total annual income was highly variable. Total average annual income was Ethiopian Birr (EB) 93 for poor households (n= 37), EB 445 for intermediate households (n= 39) and EB 784 for wealthy families

Figure 1. *Reported dairy sales (litres of milk equivalents on an energy-content basis) per reference individual (Adult African Male Equivalent—AAME) per day for pastoral households of varied wealth, at various distances from market and in different seasons, southern Ethiopia, 1987.*
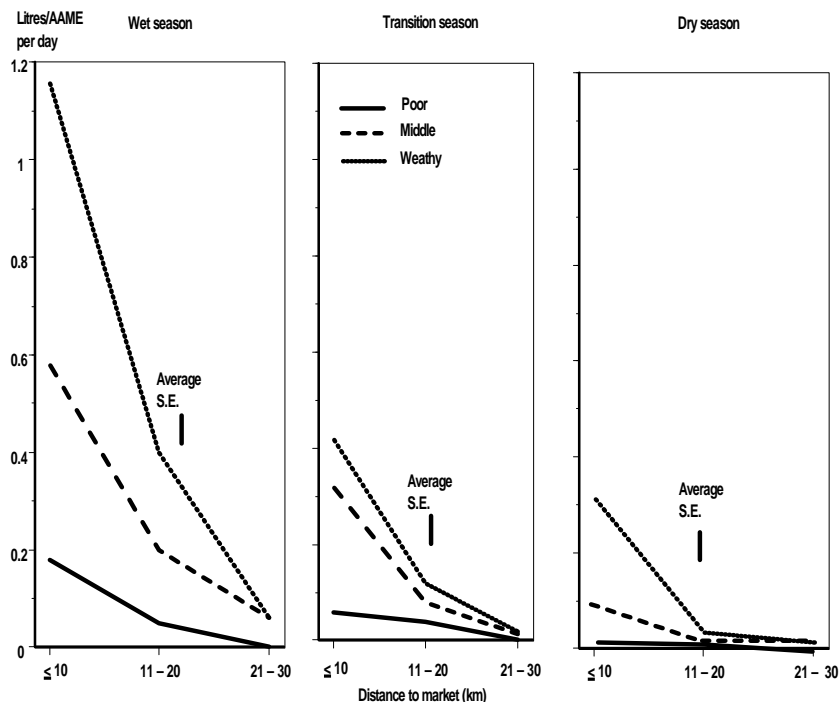
(n= 19). Distribution of results for poor and middle-class households was sharply divided into those that derived a minor (< 10%) proportion of their income from dairy marketing and those that derived a major (> 80%) part of their income from dairy sales. The ANOVA revealed a significant (P= 0.002) main effect of distance on dairy income as a percentage of total income; the proportion increased from 10% (21 to 30 km) to 17% (11 to 20 km) and 30% (< 10 km) across all wealth classes throughout the year. Although not significantly different (P> 0.05), calculations suggested that the different wealth strata derived different proportions of their annual income from dairy sales. The poor derived 24%, while the wealthy and middle class derived 16 and 17%, respectively. Overall, the average was 20%.

The contribution of dairy sales to seasonal cash income showed a significant (P= 0.007) interaction between wealth and season which occurred because the poor and middle class appeared to rely more on dairy sales throughout the year

than did the wealthy. The poor derived 58, 56 and 24% of their income from dairy sales in the wet, transition and dry season, respectively. The corresponding figures were 67, 21 and 12% for the middle class and 38, 24, and 11% for the wealthy. Across all households dairy sales contributed 57, 35 and 16% of budgets in the wet, transition and dry season, respectively.

Income from dairy sales belonged to the women and appeared to be their only regular source of money (Holden, 1988). All women, but especially the poor, used some of this money to buy grain. Overall, purchase of grain tended to be higher in the dry season than at other times of the year. Purchase of non-food items was more pronounced for the wealthy and middle-class women than for the poor. A greater milk supply allowed wealthier women more discretionary use of dairy income.

There were also interactions of wealth and distance to market on the types of dairy products sold and some main points are summarised here. To illustrate the overall pattern using some extreme examples, poorer households closer to market tended to sell relatively more fresh milk, while wealthier households far from market tended to sell relatively more butter. This is for reasons of product shelf-life and household surplus. Families tend to sell more butter if they live over 20 km from market because it will not spoil during the 2-hour walk to town and this means less marketing risk; butter is also easy to sell at a good price. This is not the case for fresh milk. Because butter-making requires the accumulation and storage of about 2 litres of soured milk for up to five days, the production and sale of butter is more common among wealthy and middle-class families who have daily surpluses. In contrast, the poor may be forced to sell fresh milk because their milk supply may be insufficient for daily subsistence and must be traded for a greater supply of energy as grain. Terms-of-trade patterns were such that about 3.5 kg of grain (providing 52.5 MJ GE) could be purchased from the sale of one litre of fresh-milk equivalent (i.e. 3.3 MJ GE) in the dry season. Poor families close to town can sell fresh milk every day if necessary; this may be an important reason for the poor to reside closer to market centres.

Dairy marketing, human welfare and calf management

Milk offtake and calf welfare: Across all families the average rate (mean $\pm$ SE) of milk offtake per cow was $41 \pm 2.5\%$ (n= 45) with 5.2 cows for each family. Significant (P$\leq$ 0.02) main effects on milk offtake rate were revealed for wealth class (n= 15 each), cow class (n= 77 each) and distance to market (n= 15 each). The poor had a relatively higher rate of offtake (53%) than the middle class (36%) or wealthy (34%). The most productive cows had higher rates of offtake (54%) than average cows (49%), which in turn had higher rates than cows rated as poor producers (20%). Across all wealth strata and cow classes, offtake rates were

higher within 5 km of market (44%) than within 6 to 10 km (40%) or 11 to 15 km (37%).

There were no significant effects of any factors on rates of calf mortality ($P \geq 0.56$). Overall annual mortality averaged 18%. In contrast, there were significant ($P \leq 0.05$) main effects of wealth and distance to market on calf morbidity rates, which were based on an average of 17 calves per family over three years for a total of 750 observations. Morbidity rates were higher in wealthy (28%) and poor (25%) households than in middle-class (16%) households; and were higher in households less than 10 km from market (24%) than in those between 11 and 15 km from market (17%). Only the main effect of cow class approached significance ($P = 0.09$).

The three-way interaction of wealth x cow class x distance was significant ($P = 0.01$), which indicated that the incidence of morbidity increased among calves of lower-producing cows held by poorer households as distance to market decreased to less than 10 km (Figure 2). Overall morbidity rates averaged 23%.

Human welfare: The reported daily intakes of dairy products by women or young children were not significantly affected by distance to market ($P > 0.05$) but they were affected by wealth class ($P \leq 0.03$), with no interactions. With each increase in wealth level (n= 18 each) intake of dairy products rose 120% for women and 45% for children, but only wealthy families were significantly different from the others in their consumption patterns.

In contrast, grain intake for women was significantly affected ($P = 0.001$) by distance to market, as women residing within 5 km of town reportedly consumed about 50% more grain than those living further away. Intake of grain energy as a proportion of total energy intake showed no significant effects among children (mean= 16%; $P \geq 0.56$) and only the main effect of wealth was significant among the women ($P = 0.035$). Poor, middle-class and wealthy women respectively took 97, 92 and 87% of their energy intake as grain, and only the poor and wealthy differed significantly ($P = 0.01$).

Discussion

Milk processing

On the Borana Plateau the processing and marketing of dairy products is under the control of the women. This has been commonly reported elsewhere in African pastoral and agropastoral systems (Dahl and Hjort, 1976: p. 159; Kerven, 1987a; Kerven, 1987b; Grandin, 1988; Waters-Bayer, 1988).

The amount of milk available for processing in Borana households varies seasonally. When milk supply exceeds daily household requirements, such as

Figure 2. *Per cent morbidity of unweaned calves from the lowest producing dams held by pastoral households in three wealth classes and residing at various distances to a market, southern Ethiopia, 1988.*
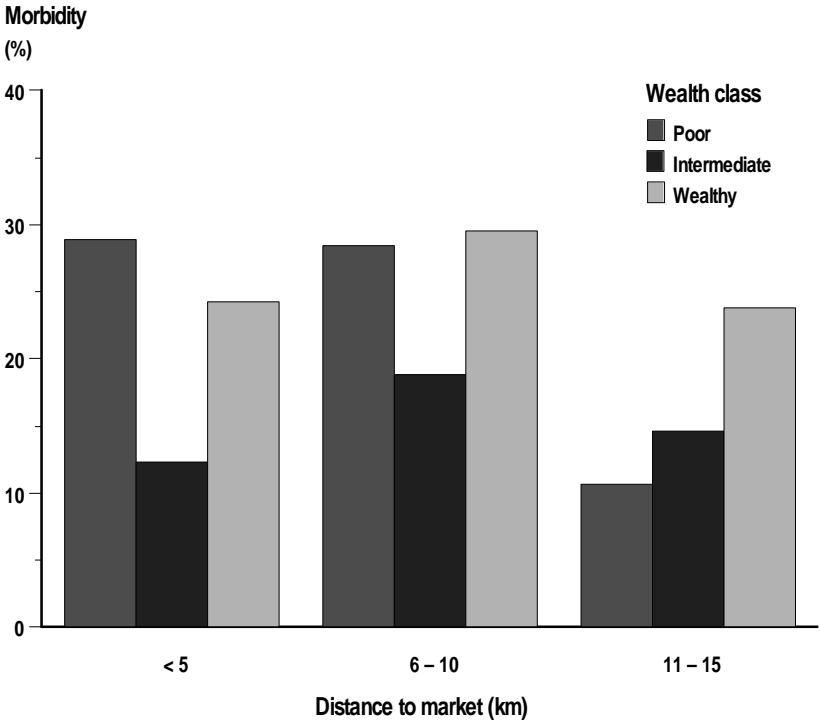
during and soon after extended rainy periods, secondary commodities such as butter, ghee or long-term fermented milk are most likely to be produced. This is also consistent with the literature (Dahl and Hjort, 1976: pp 159–160; Galvin, 1985; Nestel, 1985; Kerven, 1987b). This situation obtains also when considering wealth differentiation in these societies. Wealthier families, which have more lactating cows per person, will more commonly have a larger surplus during favourable periods and this will persist for a longer time. This implies that wealthier families probably produce such products as butter or ghee for a longer period each year than do poorer families. Kerven (1987b) reported that, in Sudan, poorer pastoral women processed and sold milk for about five months from when the rains started, while wealthier women were able to do so for an additional three months. It logically follows that wealth classes should also differ in the dominant dairy product they sell (fresh milk or butter) depending on the distance of households to market and the availability of surplus milk.

The basic milk-processing practices observed in Borana, such as churning soured milk to make butter, dehydrating butter to make ghee and removing whey to better regulate milk fermentation, are all common traditional practices in pastoral, agropastoral and mixed-farming systems in Africa (O'Mahony, 1988). In addition to these products, farmers in the Ethiopian highlands make a cottage cheese (*ayib*) by heating buttermilk, which precipitates the casein and some of the remaining fat. However, this is not produced by the Borana nor do they express much interest in doing so. This is probably because *ayib* has a relatively short shelf-life, can require a large volume of buttermilk to make (O'Mahony, 1988) and urban demand on the Borana Plateau is low. Cheese-making by pastoralists reportedly also does not occur or is rare in northern Kenya (Dahl and Hjort, 1976: p. 160; Galvin, 1985) and Sudan (Kerven (1987b).

Ghee provides the Borana with a high-energy food that has an excellent shelf-life given the difficult ambient conditions. However, quantities of ghee stored per household are small and relatively unimportant for food security during dry seasons (Coppock, personal observation). Since production of ghee is related to accumulation of milk surplus, informants report that it is produced much more often by wealthier families.

Butter is important both as a cosmetic and for cooking. The storage stability of butter, while not comparable to ghee, is still on the order of four to six weeks. This gives butter a distinct advantage over fresh milk in terms of more temporal flexibility for household use and marketing. Butter collected in Borana markets can even be taken by traders to the southern highlands via the public transport system. Finally, even when slightly rancid, butter still has a market value in Ethiopia. Urban consumers of highland origin use butter for making traditional *wots* that are eaten with bread-like *injera* made from *teff* (*Eragrostis tef*). A degree of rancidity is actually desired to improve the flavour of *wot*. In sum, it is apparent that butter has outstanding features as a marketable commodity in semi-arid areas of Ethiopia.

In contrast to butter, fresh milk may go bad within one day. Consequently, it can be sold only by families close to markets. These are usually poor families that cannot store enough sour milk to make butter.

Milk processing and technical interventions

The milk-fat recovery rate of 85% found for butter production here is higher than the 77% noted for smallholders processing larger volumes of milk in the Ethiopian highlands (O'Mahony and Ephraim Bekele, 1985b). Both the milk acidity and the temperature observed in Borana were conducive to efficient milk-fat recovery (O'Mahony and Ephraim Bekele, 1985a). This high efficiency, in conjunction with pervasive social constraints such as the sharing or exchange among households in encampments of up to 25% of fresh milk and the projected diminishing of surplus due to a gradual reduction in the ratio of cattle to people

(see below), do not offer much hope for technical interventions to enhance milk processing. At best, such interventions as the improved butter churn (O'Mahony and Ephraim Bekele, 1985b) might be applicable to the small segment of wealthy herd-owners who reside near markets to assist their processing of milk in wet seasons. Indeed, such concepts may have been more applicable 25 years ago when the Borana reported larger per caput cattle holdings and larger milk surpluses.

Dairy marketing patterns and welfare of humans and calves

Market access is a critical factor in the participation of pastoral women in dairy marketing. Households closer to market are able to sell dairy products more frequently, reflecting the opportunity cost of women's time travelling to market. This marketing cost has an influence on net returns (Askari and Cummings, 1976). Effects of distance varied with household wealth, and wealth has been found elsewhere to be a critical factor in pastoral dairy marketing (Kerven, 1987b; Grandin, 1988). Very low levels of milk supply in poor households during dry seasons precluded them from increasing marketed output in response to a reduction in distance. In contrast, during the wet season poor households had a larger milk supply and a greater marketing response over distance. The pattern was somewhat similar for other wealth classes, but they had greater flexibility in supply and could be more responsive over distance regardless of season.

Compared with poor households, wealthy households sold greater absolute quantities of dairy products but on average retained four times as much milk for household and calf consumption. It also appeared that when household milk supply increased, either because of effects of wealth or season, people increased their consumption of dairy products in preference to maximising sales. This may be in contrast to smallholders having crossbred cattle in the highlands who may prioritise milk for sale.

Wealthy households had greater milk surpluses and thus used dairy income more for discretionary purchases, as observed elsewhere (Nestel, 1985; Kerven, 1987b; Waters-Bayer, 1988). In contrast, the poor seemed to be compelled to buy grain because their levels of milk offtake were commonly below their subsistence requirements. The cash from the sale of one litre of milk would buy 3.5 kg of grain in the dry season, which provided nearly 16 times as much energy. This illustrates that a milk surplus is not a prerequisite for dairy marketing to be important. Indeed, the reverse is more likely true for a pastoral society.

Despite their lower absolute volume of dairy sales, income from dairy sales provided 37% of the annual income of poor households close to market, compared with 22% for wealthy householders. The poor, with few animals to sell without greatly endangering their herd capital (Behnke, 1987), had no viable alternative but to sell milk. As long as the lives of unweaned calves are not

endangered, dairy marketing would generally contribute to the food security of poor households. This is from the direct effect of providing cash income and the indirect effect of delaying sales of animals for some other crisis in the future.

Field data supported some, but not all, elements of the hypothesis that poorer households closer to market would be relatively more affected by the trade in dairy products. Improved access to market appeared to reduce only the proportion of milk allocated to calves in poorer households. As there was no clear effect of proximity to market on intake of dairy products by women or young children, the increase in milk offtake by poor households closer to town is probably best attributed to increased dairy sales.

The nutritional consequences of trading dairy products can be illustrated for poorer families by assuming that: (1) such households comprise 3.5 AAME and have 3.8 lactating cows (evenly distributed among the three production classes); (2) milk contains 3.3% crude protein (CP) and 3.7 MJ gross energy (GE) per kg (Roy, 1980; Nicholson, 1983); (3) maize grain has 15 MJ GE and 7.4% CP on a dry-matter basis (Cossins and Upton, 1987); and (4) nutritional requirements are in accordance with guidelines for a 55-kg "average" adult male (Cossins and Upton, 1987) as recommended in FAO (1973) and NAS (1974).

If this family resides far from town and sells no milk, the daily milk offtake rate of 48% (1.8 litres) found for the average poor family could provide about 39% of the daily total CP requirements (154 g) and 18% of its GE requirements (37 MJ). This implies that the family must receive more food from their social network, collection of bush foods or relief grain. If the family increases milk offtake to 63% (2.3 litres), about 49% of their CP requirements and 23% of their GE requirements are met but this is still short of needs. However, if the increment of 15 percentage points of increased offtake (0.5 litre) is sold for 1.75 kg of maize (Holden, 1988), about 125% of the CP requirements and 87% of the GE requirements are met. This illustrates that proximity to market and favourable terms of trade are especially important for poor families. However, a chronic pressure to trade even more milk could compromise the nutritional status of people by leading them to forego vitamins or amino acids in milk that are absent in grain (Nestel, 1985; Shrimpton, 1985). A balance of grain and milk is more desirable (Nestel, 1985).

It was not confirmed, however, that poorer families closer to town had more grain in their diets. Informants reported that it is "common knowledge" that poor people close to town sell milk daily and live on purchased grain, often to the detriment of their children. A significant effect of wealth on consumption of dairy products by women and children was observed, however, and this is unlike patterns observed for Maasailand where all wealth classes have similar intakes (Grandin, 1988). This difference may have been due to the extreme poverty of many of the Borana and/or the lingering effects on herd-level milk production of the 1983–84 drought.

The overall calf mortality of 18% and milk offtake of 41% were consistent with other findings for an "average" rainfall year in the study area (Cossins and Upton, 1987). Despite the more restricted milk diets of calves in poor households, this did not appear to affect mortality at this time.

Paradoxically, calf morbidity rates were reportedly highest in both wealthy and poor households, despite their differences in milk offtake. One hypothesis is that morbidity of calves in poor households was due more to nutritional stress from milk restriction, while that for calves in wealthier households was due more to health management problems that arose as a result of more calves being concentrated in one area and receiving less individual management attention (Mulugeta Assefa, 1990).

The increase of 15 percentage points in milk offtake for cows of poorer households closer to market may be equivalent to 150 ml per calf per day in the dry season. This is 28% of the calculated intake for calves of poor families at this time, and represents a substantial decrement that could reduce vigour and increase the loss of calves to nutritionally mitigated diseases.

Dairy marketing in a wider perspective

Some of the literature on pastoralism suggests that dairy marketing is symptomatic of increasing poverty (Dahl and Hjort, 1976: p. 181; Toulmin, 1983; Waters-Bayer, 1988). This is illuminated further by the contention that the Borana used to have taboos against dairy sales but have had to sell dairy products out of necessity (Dahl and Hjort, 1976: p. 181).

If pastoral poverty is defined as a decline in per caput milk production and livestock holdings, then it could be anticipated that the long-term trend would be for the Borana to become poorer because of steady human population growth and periodic heavy loss of cows in droughts, as in 1983–84 (Cossins and Upton, 1988). This implies that drought would periodically exacerbate poverty. If it is assumed that a primary reason for selling dairy products now is to buy grain because of a lack of milk, this all suggests that there will be a gradual increase in the percentage of families involved in dairy marketing (at least from the pool of encampments within walking distance of towns), and that increased dairy marketing activity could be expected during the early stages of a drought and the first few years of drought recovery, when there is sufficient milk to sell but not enough to sustain the household. The degree of marketing therefore is likely to vary from year to year.

Holden (1988) noted that about 30 of 105 households reported that sales of dairy products were more important than consuming milk directly. However, the fact that the study reported by Holden (1988) was carried out in 1987, only three years after the end of the 1983–84 drought, may imply that a period of particularly high

dairy marketing was witnessed in view of the drought-recovery scenario proposed above.

As early as 1991 the number of milk cows may be close to pre-drought numbers in some areas (Cossins and Upton, 1988), but they would have to supply milk to a human population that had grown by 16% since 1982, even with the conservative assumption of no net population growth during 1983–84. This recovery in livestock numbers would also be limited by a possible reduction in the milk production per cow, as herd-owners reported in 1990 that milk yields were down; this was probably due to overcrowding and heavy grazing. On the one hand, it could be expected that dairy marketing would continue to be important under these moderately stressful conditions. However, the advent of widespread farming probably amends this prediction. People residing in drier regions, where it is too risky to cultivate, will probably continue to sell dairy products if they are close to a market. People living in better-watered locations, which are now extensively cultivated, would likely reduce dairy sales because they have solved their grain problem by growing it themselves.

Dairy marketing and relevant interventions

Dairy marketing benefits women and children in Borana in terms of enhanced food security and thus is an important framework for addressing benefits of animal production in relation to gender issues. Although selling too much milk to buy grain could compromise their nutrition, the survival imperative outweighs this consideration. The need to sell milk to survive and the consequent risk to the well-being of young calves (i.e. future capital) are most acute for the poor. Assuming that an underclass of the Borana has increasingly emerged as a result of drought and competitive interactions within the society, policies that facilitate the steady flow of grain from the highlands to the lowlands would most likely have the greatest positive effects on the welfare of these households by further improving the terms of trade.

Actions in support of recent strategies aimed at developing service cooperatives that facilitate the exchange of butter and grain would also be most beneficial, especially to those families far from markets. The only feasible means of reducing risks to calf survival of increased milk offtake is improved calf feeding management, which is reviewed elsewhere (Coppock, 1990a). Improved feeding may also allow households to take more milk from the calf, either for human consumption or sale. The only other realistic way to increase milk availability is through health measures such as prescribed burning and use of acaricides to reduce the threat of tick-related ailments that harm cow udders (Coppock, 1990b).

Thus, it is evident that the best chances for technical interventions in processing dairy surpluses have likely passed many years ago and aspects of policy and

marketing facilitation are more relevant now given increased populations and the need for buffering through better regional linking of commodity markets.

References

Askari H and Cummings J. 1976. *Agricultural supply response: A survey of econometric evidence*. Praeger Publishers, New York. 443 pp.

Behnke R. 1987. Cattle accumulation and the commercialisation of the traditional livestock industry in Botswana. *Agricultural Systems* 24:1–19.

Coppock D L. 1990a. Water and forage development interventions: More benefits to pastoral women or their calves? *ILCA Newsletter* 9(1):3–4 & 9. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Coppock D L. 1990b. Bush control: Opportunity for resource management and pastoral income generation? *ILCA Newsletter* 9(3): 10–11. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Cossins N J and Upton M. 1987. The Borana pastoral system of southern Ethiopia. *Agricultural Systems* 25:199–218.

Cossins N J and Upton M. 1988. The impact of climatic variation on the Borana pastoral system. *Agricultural Systems* 27:117–135.

Dahl G and Hjort A. 1976. *Having herds: Pastoral herd growth and household economy*. Stockholm Studies in Social Anthropology. University of Stockholm, Sweden. 335 pp.

ENI (Ethiopian Nutrition Institute). 1980. *Ethiopian traditional recipes.* Ethiopian Nutrition Institute, Addis Ababa, Ethiopia. 41 pp.

Ephraim Bekele and Tarik Kassaye. 1987. Traditional Borana milk processing—efficient use of subtle factors needs further research work. *ILCA Newsletter* 6(4):4–5. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Evangelou P. 1984. *Livestock development in Kenya's Maasailand: Pastoralists' transition to a market economy*. Westview Press, Boulder, Colorado, USA. 309 pp.

FAO (Food and Agriculture Organization of the United Nations). 1973. *Energy and protein requirements. Report of a Joint FAO/WHO Ad Hoc Expert Committee.* FAO Food and Nutrition Series 7. FAO, Rome, Italy.

Galvin K. 1985. *Food procurement, diet, activity, and nutrition of Ngisonyoka Turkana pastoralists in an ecological and social context.* PhD thesis, Department of Anthropology, State University of New York, Binghampton, New York, USA. 379 pp.

Grandin B. 1988. Wealth and pastoral dairy production: A case study from Maasailand. *Human Ecology* 16:1–21.

Holden S J. 1988. *Dairy marketing and pastoralism: Implications for development in the southern Ethiopian rangelands*. MSc thesis, Department of Agricultural Economics and Management, University of Reading, Reading, UK. 67 pp.

ILCA (International Livestock Centre for Africa). 1981. *Introduction to East African Range Livestock Systems Study/Kenya.* ILCA/Kenya Working Document 23. ILCA, Nairobi, Kenya. 71 pp.

ILCA (International Livestock Centre for Africa). 1990. *ILCA Annual Report 1989.* ILCA, Addis Ababa, Ethiopia. 144 pp.

Jahnke H E. 1982. *Livestock production systems and livestock development in tropical Africa*. Kieler Wissenschaftsverlag Vauk, Kiel, Federal Republic of Germany. 253 pp.

Kerven C. 1987a. Pastoral dairying in Africa: Some research and development implications. *ILCA Bulletin* 26:29–35. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Kerven C. 1987b. The role of milk in a pastoral diet and economy: The case of South Darfur, Sudan. *ILCA Bulletin* 27:18–27. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Mulugeta Assefa. 1990. *Borana cattle herds: Productivity, constraints, and possible interventions.* MSc thesis, Department of Range Science, Colorado State University, Fort Collins, Colorado, USA. 154 pp.

NAS (National Academy of Sciences). 1974. *Recommended dietary allowances.* Eighth edition. National Research Council, Food and Nutrition Board, Washington, DC, USA. 128 pp.

Negussie Tilahun. 1984. *Household economics study in Borana.* JEPSS (Joint Ethiopian Pastoral Systems Study) Research Report 15. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 39 pp.

Nestel P S. 1985. *Nutrition of Maasai women and children in relation to subsistence food production.* PhD thesis, Nutrition Department, Queen Elizabeth College, University of London, London, UK. 261 pp.

Nicholson M J L. 1983. *Calf growth, milk offtake, and estimated lactation yields of Borana cattle in the southern rangelands of Ethiopia.* JEPSS (Joint Ethiopian Pastoral Systems Study) Research Report 6. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

O'Mahony F. 1988. *Rural dairy technology: Experiences in Ethiopia.* ILCA Manual 4. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 64 pp.

O'Mahony F and Ephraim Bekele. 1985a. *ILCA Rural Dairy Husbandry and Technology Course Manual.* ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 101 pp.

O'Mahony F and Ephraim Bekele. 1985b. Traditional butter making in Ethiopia and possible improvements. *ILCA Bulletin* 22:9–14. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Roy J H B. 1980. *The calf.* Fourth edition. Butterworths, London, UK. 442 pp.

SAS (Statistical Analysis System). 1987. *SAS/STATÒ Guide for Personal Computers, Version 6 Edition.* SAS Institute, Inc., Cary, North Carolina, USA. 1028 pp.

Shrimpton D H. 1985. Factors influencing the consumption of milk and milk products. In: Smith A J (ed.), *Milk production in developing countries.* Proceedings of the conference held in Edinburgh from 2 to 6 April 1984. Centre for Tropical Veterinary Medicine, University of Edinburgh, Edinburgh, UK. pp. 15–24.

Toulmin C. 1983. *Economic behaviour among livestock keeping peoples: A review of the literature on the economics of pastoral production in the semi-arid zones of Africa.* Development Studies Occasional Paper 25. School of Development Studies, University of East Anglia, Norwich, UK. 117 pp.

Waters-Bayer A. 1988. *Dairying by settled Fulani agropastoralists in central Nigeria: The role of women and implications for dairy development.* Farming systems and resource economics in the tropics 4. Kieler Wissenschaftsverlag Vauk, Kiel, Federal Republic of Germany. 328 pp.

Discussion

In commenting on the presentation, the discussant (Getachew Asamenew) inquired about the relevance and possible contribution of the study to livestock production in pastoral systems; the terms of trade

between pastoralists and farmers; and whether there is a need for government intervention in pastoral systems. Coppock's reactions were sought on the potential for development among the Borana for either meat or milk production. Coppock was also asked to comment on the improvement of marketing facilities and development priorities suggested by institutions such as the World Bank and ILCA. Coppock stated that livestock development among pastoralists was really a question of delivery (provision of goods and services), opportunism and facilitation. He suggested that it is unlikely that there will be an increasing milk surplus from the Borana pastoral system in future because human populations are increasing faster than livestock populations. Coppock was, however, unclear about whether there were demographic or economic differences between pastoral systems which made dairy development more appropriate in some situations than in others.

Dairy marketing in Madagascar

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Introduction

The overall annual production of milk from dairy herds in Madagascar is estimated at 60 million litres, about 10% of which is marketed in the formal sector. It is believed that the bulk of this production is marketed through an informal system operated by individuals locally known as cycling milkers (trayeurs-cyclistes).

In the plateau regions, favourable climatic conditions and a relatively regular feed supply from crop residues, and wheat-, paddy- and cotton-processing byproducts have favoured the development of milk production. On the other hand, the extensive livestock production system in the coastal areas is more appropriate for beef production, although some peri-urban dairy enterprises exist in these areas which regularly supply major population centres with fresh milk.

In most cases, milk production is developed on farms using zebu cows crossbred with European sires. These crossbreds account for 5% of the national cattle herd and constitute the dairy stock supplying marketed milk to both the formal and informal sectors of the plateau region. It should be noted that, where fresh milk production is profitable, zebu cows are, in spite of their low milk yields, milked regularly and their milk sold directly to consumers in towns and hamlets.

Very few studies are available that allow an objective assessment of the economic efficiency of the dairy sector. This study relies on location-specific surveys conducted two or more years ago to assess the efficiency of the dairy marketing system in Madagascar.

Dairy marketing channels

Towns, hamlets and villages offer a ready market for fresh milk and dairy products. This accounts for the expansion of dairy production in their immediate

vicinity and justifies the exploitation, by producers in these areas, of all available resources, including local zebu breeds for milk production.

Depending on the region and on consumer demand, producers deliver either fresh or curdled milk. Sales are made daily to subscribing customers or, periodically, on market days.

In intensive milk production areas with organised collection channels, producers deliver their milk to collection centres operated by dairy plants, or sell to middlemen on bicycles who collect fresh milk from several farms.

Direct sales to consumers

Direct sales of fresh milk to consumers take place in towns, where prices are determined both as a compromise between demand and producers' desired earnings. The usual practice in this marketing system is for producers to deliver fresh milk directly to consumers, at a price negotiated by both parties and payable on delivery or at the end of the month.

Where supply exceeds demand, producers sell from door to door or attempt to sell at the market place. Occasionally, milk is also sold in front of certain institutions, notably hospitals, where there is some demand for fresh milk by families who need to supplement the diet of relatives who are patients.

In southern Madagascar, where there is an old tradition of curdled milk consumption, producers have a ready market for their milk, which they sell daily to consumers coming to shop at the market. This is almost an organised structure where milk producers can sell directly to consumers without any intermediaries being involved. However, in some cases, producers sell their curdled milk to retailers in the market.

Sales to middlemen

When direct sales to consumers are not possible, producers are forced to resort to middlemen which include cycling milkers, small-scale butter and cheese producers, collection centres and dairy plants.

In all cases, the producers are not in a position to impose a price. Rather, they accept the prices proposed to them by retailers or collectors based on their transportation and handling costs.

Cycling milkers

This is a common marketing system which is still important for the supply of fresh milk to towns in spite of the increasing availability of processed dairy products from dairy plants. In fact, many consumers, rightly or wrongly, are convinced that

fresh milk is better than pasteurised milk, which they believe has a lower milk fat content on account of its being reconstituted from powdered milk.

Cycling milkers are experienced milkers who hire out their services to producers who are too busy to do their own milking. They always move around on bicycles (hence their designation as cycling milkers) and take this opportunity to collect milk which they then sell in the towns. Every morning, and sometimes in the evening, they go to farms that usually belong to small-scale producers with one or two cows. Their labour cost for milking is often included in the purchase price of the milk. The milker is usually paid during collection or, occasionally, after the milk is sold.

Small-scale butter and cheese producers

Producers often sell their milk to local small-scale butter and cheese processors. Milk is either delivered to the processing unit or collected by the processors themselves. Since the quantities needed by the latter are limited by the production capacity of their small traditional processing units, the collection price remains slightly lower than that prevailing in the organised channel. But these small-scale manufacturers have an advantage over other milk collectors in that they process the milk in the production area, thereby reducing their transportation and handling costs.

Manufactured dairy products of this kind are sold to retail stalls in the towns at some cost to the manufacturer. Some products such as yoghurt and ice-cream are sold by pedlars.

Collection centres

These are installations with refrigerated milk tanks with a capacity of between 400 and 600 litres each, where fresh milk is collected and stored before delivery to dairy processing plants.

Only producers located close to these centres deliver their milk to them. The price paid for milk is the same at all collection centres.

Evaluation of middlemen

In whatever capacity they intervene in the fresh milk marketing chain, middlemen earn most from milk production. This is why producers prefer to sell their milk directly to consumers when they can.

Cycling milkers maximise their profits by selling unprocessed fresh milk directly to consumers. Their profit margin is quite high since the consumer price of milk is often as much as twice its producer price. Thus, cycling milkers gain not only

enough to cover their transportation and maintenance costs, but they also make substantial profits.

Small-scale butter and cheese manufacturers incur labour and material costs in processing milk. In most cases, they use equipment made by themselves using family labour. Given the high prices of butter, cheese or yoghurt in the towns, these small-scale manufacturers always make a profit. Their products are targeted to middle-income urban dwellers.

Dairy processing plants use sophisticated equipment and employ skilled personnel. These plants largely depend on imported products such as milk powder and butter oil to compensate for shortfalls in local fresh milk supply. According to a survey conducted in July 1988, of an estimated 74,700 litres of milk processed daily, 13,700 litres or 18.34% was in the form of fresh local milk and 61,000 litres or 81.65% was reconstituted milk. World market prices determine whether dairy plants are prepared to develop local milk collection and invest in extension services.

The products of these enterprises are purchased by customers in the high income bracket, particularly expatriates. However, as these consumer categories cannot exhaust the whole supply, dairy plants must also target their sales to middle-income consumers. In doing so, they are obliged to adjust their prices downwards and limit their expected profits. In any case, the added value of these products is high.

The total processing capacity of existing dairy plants, in terms of fresh milk, is over 200,000 litres/day. However, the marketable fresh milk potential is only slightly more than 40,000 litres/day or 20% of total capacity. As a result, dairy plants will need to import milk products for some time in order to operate at full capacity.

Financial viability of existing dairy processing and marketing systems

Dairy processing plants are faced with numerous problems which affect their profitability. They often operate below capacity due to an inadequate supply of fresh milk. Some parastatal units, which rely exclusively on fresh milk, operate at only 40% of their capacity during the peak season (2000 litres/day of delivery for a capacity of 5000 litres), and at 16% of their capacity during the off-season. Furthermore, collection involves logistics which are costly to maintain. The fact that all the processing plants obtain supplies from the same production areas puts those which depend exclusively on fresh milk at a disadvantage and condemns them to operate at below their break-even point. Consequently, the State has to partially subsidise the operating costs of these plants.

Private units, on the other hand, can operate at full capacity by using imported products. Locally collected milk in these units is only used for the production of products the sale of which is not restricted by consumer prices.

Dairy policy

In November 1988, the responsible ministry formulated a policy aimed at developing milk production in Madagascar. In its strategy, the policy recommends the promotion of livestock producer associations which would gradually take charge of their own development work. These associations would eventually be responsible for the provision of their own inputs and the implementation of measures aimed at improving milk production, by paying for the required technologies for animal health, artificial insemination, animal nutrition etc. In time, they should also organise fresh milk collection, manage dairy plants and distribute dairy products.

But the difficulty lies in implementing protective measures to encourage local production of fresh milk in the face of the currently prevailing trade liberalisation policy. In fact, no tax regulations exist which envisage the adjustment of powder milk and butter oil prices to local fresh milk prices. As a result, price differentials arise, which do not encourage large dairy units to develop a collection system especially when world dairy prices are falling.

Finally, resources allocated to dairy development are not renewable. There are no regulations governing the supply of funds generated from taxes or other sources for dairy development. Such funds generally come from the national budget in the form of compensatory payments within the framework of limited-term projects. However, some dairies have been able to secure funds from the World Bank as part of a dairy plant extension programme.

Dairy product demand analysis

A study conducted in January 1987 allows us to assess more accurately the demand for dairy products in three large towns in Madagascar, namely Antananarivo, the capital, Toamasina, on the east coast and Fianarantsoa, in the plateau region.

The results of this study, which can be extrapolated to the country as a whole, showed important differences in demand for dairy products between age groups and occupational categories.

According to this study, milk is consumed by the younger age groups in Antananarivo, while elsewhere it is consumed by older people, in the 35- to 54-year age group. Strangely, the results for yoghurt were the opposite, i.e. yoghurt was consumed more by older people in Antananarivo, but mainly by

young people (0–14 years old) in Fianarantsoa and Toamasina. Cheese and butter are consumed equally by young and old. The same was true for condensed milk except in Fianarantsoa where it is preferentially consumed by the young (0–14 year olds).

With regard to occupational groups, milk and condensed milk are mainly consumed by locals, while other products such as cheese and butter are generally consumed by expatriates who have higher incomes than the nationals.

Quantified demand in the three towns is summarised in Table 1.

Table 1. *Milk demand in three towns.*

Product type	Antananarivo	Fianarantsoa	Toamasina
Milk (million litres)	55	9	12
Yoghurt (million jars)	100	20	34
Cheese (tonnes)	600	59	288
Butter (tonnes)	1600	174	600
Condensed milk (tonnes)	4700	456	1500

The analysis confirms that the demand varies with the population of towns and that milk consumption is inversely proportional to family size.

A survey carried out in April 1989 in 27 large towns of Madagascar estimated annual demand for all types of available dairy products at roughly 62 million litres of milk. In theory, this demand could be met by local production if low cost collection schemes were organised. Unfortunately, it would be very difficult to make such a scheme profitable, given the high transport and handling costs resulting from the long distance between the existing processing plants and the absence of an adequate road network.

The cost of milk and the marketing of dairy products through different distribution systems

The following discussion relies on surveys and assessments of the market for fresh milk and dairy products. In fact, no study deals specifically with this aspect.

Cycling milkers

By selling fresh milk directly to consumers, cycling milkers maximise their profits. The expenses incurred by these sellers essentially involve the transportation cost of milk over a variable distance of 15 to 25 km on a bicycle.

In practice, cycling milkers buy milk from producers at a price ranging from 300 to 350 MGF/litre, and resell this milk to urban consumers for 600 to 725 MGF/litre. These prices are similar to those of dairy plants and large farms which often are the basis for determining the fresh milk prices charged by cycling milkers to their subscribing customers. The costs of collection are estimated at 25 MGF/litre, which would allow an appreciable profit of about 300 MGF/litre to cycling milkers. Unfortunately, the carrying capacity of their bicycles limits their operations to collecting one or two 20-litre containers a day.

Small-scale processors

These are semi-industrial milk processors who are supplied by collectors or collect milk themselves to process it into yoghurt, butter, fresh cream and cheese using simple equipment. Favourable urban prices for dairy products have encouraged small-scale milk processing in recent years.

According to a study carried out in January 1987 by Mr Weber, a professor at the Institut Polytechnique de Lorraine and Mr Lambert, an FAO expert, the cost of processing milk and dairy products can be estimated as given in Table 2.

Table 2. *The cost of processing milk and other dairy products.*

Expenses	Pasteurised whole milk		Plain yoghurt		Butter	
	MGF/kg	%	MGF/kg	%	MGF/kg	%
Milk purchase and transportation	300	69.3	38	40.9	3000	77.8
Processing cost	80	18.5	22	23.6	450	10.0
Packaging cost	15	3.5	26	28.0	100	2.2
Margin (factory)	38	8.7	7	7.5	450	10.0
Factory-gate price	433	100.0	93	100.0	4500	100.0

Consumer prices cited for this same period in the town of Antsirabe, which serves as a reference, were as follows:

Pasteurised milk in 1-litre pack	350–430 MGF
Raw milk in bulk (litre)	275–400 MGF
Plain yoghurt (125 cl jar)	50–110 MGF
Yoghurt in bulk (litre)	550 MGF
Butter (kg)	5800–8000 MGF
Hard cheese (kg)	4000–5000 MGF
Full-fat hard cheese (kg)	5000–6500 MGF

The maximum profit margin is 25%. In reality, it tends to lie between 5 and 7% for small-scale manufacturers and between 12 and 15% for retailers.

Constraints to marketing efficiency and infrastructural development

Constraints to marketing efficiency are due partly to the low price of fresh milk at collection and partly to the absence of specific regulations providing incentives for increased local production.

The production cost of milk is estimated at between 295 and 300 MGF/litre. Hence, the margin expected by a producer faced with a collection price of 300 to 400 MGF, is relatively low i.e. 50 to 100 MGF/litre. Increased production would entail additional costs, in terms of feeding and managing the herd, which may not be recovered from milk sales. Furthermore, feeder roads are generally in poor condition or non-existent and collection costs have continued to rise with fuel and spare parts price increases. These costs are estimated at between 40 and 50 MGF per litre of milk collected. Finally, ready access to imported products which are heavily subsidised in their country of origin does not encourage local milk collection.

With regard to control measures, imports are not subject to any specific regulations that would protect local production. The subsidisation of the dairy sector in Europe does not allow the development of local milk production in Madagascar without some price adjustment mechanism such as, for example, the introduction of import duties which will need to be constantly revised.

Another constraint is the low purchasing power of consumers, which limits the amount of fresh milk consumed and practically prevents consumption of highly priced processed dairy products. Among the constraints cited, this one would seem to be the most limiting insofar as the market for milk and dairy products is made up of a small, and exclusively affluent, part of the population.

Market structure and performance

There are currently nine dairy processing plants of varying importance and 15 private smaller processing workshops producing pasteurised milk, cheese, yoghurt, butter, ice-cream etc. Except for one very small unit, all of them are located in the plateau region which has a tradition of milk production as well as being best suited to milk production.

The processing capacity of these plants is estimated at 209,000 litres of fresh milk per day. They currently operate below capacity as local milk collection rarely exceeds 12,300 litres/day or 6% of their current capacity. In any case, the estimated quantity of marketable milk, which amounts to 40,000 litres/day

according to some surveys, would still not cover the requirements of these dairy plants as they would be operating at only 19.13% of their capacity even with this quantity of milk.

Consequently, large-scale units with the necessary means are obliged to use imported products to ensure the operation of their plants at full capacity.

Milk and milk product prices are generally not controlled and are determined mainly by the forces of supply and demand. They sometimes fluctuate considerably in the course of the same year.

Finally, the processing margin of each dairy processing unit is between 7 and 12% although current regulations allow a margin of 25%. The dairies continuously seek to expand their market to the largest possible number of urban dwellers. However, the current purchasing power of urban consumers does not always allow these units to increase their margins substantially. As a result, they are obliged to conform to prevailing market trends, which are determined by the limited demand.

Even if the milk collection, in spite of a constant increase, cannot yet meet the requirements of processing plants, it nevertheless shows signs of improving. The number of producers supplying milk to the ROMANOR dairies rose from 624 in 1986 to 1632 in 1990.

The price of fresh milk also increased from 170 MGF/litre in 1986 to between 350 and 400 MGF in 1990.

Unfortunately, dairy plants are too large in relation to current production collection capabilities. However, this should not constitute a major constraint if raw materials can be imported.

However, the low purchasing power of potential consumers restrict the local market for dairy products and some milk is being exported to neighbouring Indian Ocean islands. The market for dairy products is currently unprotected in these islands, but efforts to develop dairying in these areas will eventually leave little room for imports. Consequently, dairy processing units in Madagascar should make efforts to develop the local market.

Discussion

The author clarified the objectives of the study, indicating that these were to increase production based on food self-sufficiency targets and to improve smallholder farm incomes in Madagascar. Asked to comment on price variation by market outlets and modes of sale, Ranaivoson noted that producer prices varied and were higher near the capital city and lower in the countryside. Direct sales to consumers are quite common

since they usually do not involve any processing or investment costs and hence give the highest income to producers. The disparity in demand for dairy products between geographical zones cited in the paper was attributed to ethnic differences in the rural areas. Concerning the inverse relationship between dairy consumption and household size, Ranaivoson indicated that this was probably due to the lower levels of disposable income available to larger households. It was recommended that the analysis be carried out in more detail, distinguishing between the marketing activities of different categories of producers (i.e. large vs small) and intermediaries (i.e. milk collectors vs retailers).

Survey planning, non-sampling errors and the dairy marketing researcher

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Abstract

In the belief that successful surveys are the product of detailed planning and seemingly inordinate attention to minimising non-sampling errors, this paper attempts to give dairy marketing researchers insights into improved planning techniques that will help them avoid non-sampling errors. The paper first discusses the need to approach the survey planning process in an "iterative" manner in which all stages of the survey are considered with respect to their contribution to the whole. The advantages of iterative planning over linear or chronological planning are discussed and the stages of iterative survey planning are presented. The potential impact of non-sampling errors on the selection of an optimal survey methodology, the design of questionnaires and the interview process are detailed in the latter portion of the paper.

Introduction

A tale of two researchers

Friday's seemingly endless meeting of the National Research Board closes with agreement on a clear statement of research priorities. Early Monday morning, the Director of Livestock Services and the Manager of the Livestock Marketing Board, their research priorities clarified by the Board's policy statement, draft research plans for their respective departments. Unbeknownst to each other, they each assign a researcher to look into the high-priority area of dairy marketing costs. By mid-day, the dairy specialists in each department, Sehou Ceesay and Alieu Bah, have received their research assignments.

Sehou Ceesay begins with all the zeal of a newly minted MSc graduate. He knows exactly what to do: survey and document milk marketing costs. No need to put anything on paper when his mental image is so clear. "Let's get on it! No time to waste!", Ceesay exclaims. Already he envisions producing the definitive dairy marketing study. Posterity will simply refer to "The Ceesay Report."

After some unforeseen problems in finding fuel for the Land Rover and people to serve as enumerators, Sehou sets off to interview with questionnaire in hand. He is sure he needs a census of all the dairy marketers ("After all, there aren't all that many."). He knows the questionnaire is a little long but… ("As long as the enumerators are in the field…"). Later, as the data are being collected, he sees problems arising. Nevertheless, he forges ahead in confidence: what few problems there are with data collection, he thinks, will be washed out when the figures are entered into the computer. And so Sehou marches onward.

Meanwhile, Alieu Bah, a wizened researcher with several years and many surveys to his credit, approaches the research proposal differently than Sehou Ceesay. With a sense of purpose and self-control, Alieu concentrates on what he thinks is needed for the final report. He judges the worth of every step in the survey by how it will contribute to the final report. While Sehou drafted long questionnaires and then charged to the field, Alieu simultaneously drafts questionnaires, designs field procedures, sketches output tables, and confers with experts on data processing procedures. He knows that all parts of the survey must congeal into a coherent whole, each part in its proper place and serving its purpose.

Two alternatives for survey planning

The stories of Ceesay and Bah present a stylised description of two commonly observed data-collection approaches. These "worst" and "best" case scenarios are referred to here as "linear" and "iterative" approaches, and are shown schematically in Figure 1.

The survey process is divided into four stages—preliminary, design, data collection and analysis and reporting. The preliminary stage includes the activities that surround the initial decision to conduct a survey. Design, the most important stage, includes all the planning and design activities that must be completed before starting the survey. The data-collection stage, as the name implies, involves those activities relating to the actual collection of survey data, supervision and quality control. Finally, the analysis and reporting stage includes editing, computer processing, analysing data and publishing the results.

A researcher following the linear survey approach, from the preliminary stage to the final report, seldom acknowledges the interconnectedness of the different survey stages. As suggested by Figure 1, in the linear approach each step of the survey is confronted and tackled chronologically, irrespective of the next step.

Figure 1. *Two alternative approaches to survey planning.*

Crises are resolved as they are met. Little regard is given to a problem's importance to other areas of the survey. "We will cross that bridge when we come to it" is the standard response to anyone raising questions about future contingencies. Not surprisingly, the value of the final report diminishes as unforeseen problems necessitate changes and inevitable compromises. Obstacles and errors accumulate at each survey stage and end up contributing to a much depreciated final product.

The depreciation of the final result is not a problem in the iterative survey approach since its goal orientation and constant interaction between and within stages keeps the researcher on track. In the iterative approach, each step of the data-collection process is informed and guided by other steps and, ultimately, by the intended final output of the research. Hence, the researcher solves his current problem (e.g. questionnaire design) and related problems (sample size, data processing etc) in the context of their contribution to the desired final result. In fact, the work of each stage is judged by its contribution to the expected output, the operative principle being: **if it does not contribute to the final output, do not do it**!

The remainder of this paper consists of two major sections. The first concentrates on planning methodology. The concept of iterative planning is explained and each stage of the iterative survey approach is set out in detail. In the context of the presentation, important linkages between the survey design stages are discussed. In the second section, more specific comments are made on how to minimise non-sampling errors.

In this paper, the term "survey" is used in the broad sense of an organised data-collection process, be it a rapid reconnaissance, a national census or a highly technical probability sample design. While not all the activities discussed in this paper will be appropriate for every type of survey, we believe they are relevant for proper planning and minimising non-sampling errors. Appendix A lists the components common to many survey techniques.

The iterative survey approach

As the name implies, the iterative process emphasises the need for an awareness of the linkages between the four survey stages. Ultimately, each stage is united into a cohesive whole and driven by clearly elucidated hypotheses and a vision of what the final result will be. In this section we will discuss the four stages of the survey process and point out key linkages between them.

The preliminary stage

We think that the preliminary stage begins when the need for a particular piece of information is first articulated; that is, when individuals begin to recognise a

need for data and start discussing ways to meet this need. The recognition of a need for data can come from almost any direction—top policy-makers, administrators, programme planners or even dairy-marketing economists.

At this point, some basic questions must be answered:

- What are the hypotheses to be tested?

- Can the hypotheses and study objectives be clearly stated?

- Can the concepts be operationalised?

- Are the data *really* needed?

- Are acceptable data available from secondary sources?

- What level of accuracy is necessary?

- If a survey is necessary, will it be highly technical or relatively simple?

If deliberations on these questions indicate a clear need for a survey, additional issues should be raised and resolved during these preliminary discussions (a complete list is found in Appendix A: Survey planning guide). Note, however, that it is premature to make decisions on sample design and sample size at this time. These issues are best addressed after the need for a survey is more firmly established.

Two items to be considered immediately are funding and management personnel. While it is not possible to determine the cost of the survey at this time, it is important to consider potential funding sources and to communicate to these sources the need for support. It is also important to designate a survey manager or researcher who will have overall responsibility for planning and conducting the survey. Depending on the anticipated size of the survey, there may be a need for an administrator who is responsible for all administrative details of the survey and a design statistician, responsible for all technical details of the survey. For a small study, the duties of these three individuals may become the responsibility of one researcher, which in no way lessens their importance.

Once survey leadership is established, preliminary tasks can be assigned, hypotheses can be discussed and an outline or skeleton of the final report, with dummy tables, should be drafted. A timetable can be developed specifying when the main tasks of conducting the survey are to be completed. While all of these plans are tentative for the moment, the researcher should have a firm idea of the survey schedule and content to assure the feasibility of completing the entire project on time.

In all this, the researcher and those requesting the data must work together to develop a logical survey operations procedure that will produce data satisfying the requirements of the data user. Once the scope of the survey is determined,

the survey proposal can be prepared for the decision-makers who will finally determine whether the survey is to be conducted.

We recognise that all this preliminary planning might seem unnecessary when the need for a survey is already determined, as when one's boss simply demands a survey be carried out. In those cases, the researcher must quickly go through these preliminary steps and establish a statement of objectives with a clear vision of the desired survey outputs before continuing. Without agreement on the goals and scope of the study, the researcher is open to innumerable requests from people who think of additional questions to add to the survey. The wise researcher can often limit extraneous requests that will detract from the survey's goals by establishing specific objectives at the outset.

We believe that the most concrete method for establishing survey objectives is to prepare an outline of the final report and to draft dummy tables for the data to be collected during the survey. This process will not only give the researcher and the policy-makers a common ground on which to agree, it will force the researcher to think in some detail about the content and scope of the survey. This preliminary thinking is crucial to all later stages of the survey process. It will eliminate unnecessary questions from questionnaires, help determine the proper survey methodology and suggest the size of field staff necessary to complete the effort.

Drafting the skeleton report and dummy tables

Producing dummy tables and a skeleton report serves many purposes, including a more precise definition of hypotheses and a means of guiding the development of the survey instrument. The dummy tables should represent a serious effort but should not be sacrosanct. Later, during the design stage, the tables will serve as the guide for plans but should be altered freely if new information becomes available or additional data needs are discovered. At the earliest stages of the survey, the tables can be distributed to people involved for comments on: 1) their relevance to the problem; 2) their feasibility for data processing; 3) their contribution to questionnaire length and content; and 4) the accuracy of the expected results.

Too often researchers avoid this process by rationalising that the expected output is so obvious there is no need to put it on paper. But the process of drafting dummy tables is not as difficult as it might seem. A simple two dimensional table with a few footnotes can quickly identify specific questions that should be included in the survey. Table 1 presents an example of how one might draft dummy tables.

In this example, the researcher's basic hypotheses concern the differences between two divisions of the country and the implication this has for livestock and dairy marketing. The Western Division includes the nation's capital city and

Table 1. *Example of a dummy table.*

Table XX. *Cattle: Inventory and sales, by Division, The Gambia, 1991.*

	Item	The Gambia	Western	Lower River	North Bank	Mac-Carthy Island	Upper River
						Division	
(a)	Rural households[1]	45,490	10,859	4559	9832	11,796	8444
	Cattle inventory:						
	Households reporting cattle						
(b)	Number	15,000[2]	x,xxx	x,xxx	x,xxx	x,xxx	x,xxx
(c)	%	33%	10%?	xx%	xx%	xx%	75%?
(d)	Number of cattle	300,000[2]	xx,xxx	xx,xxx	xx,xxx	xx,xxx	xx,xxx
(e)	Average per household[3]	20	10?	xx	xx	xx	40?
	Sales:						
(f)	Average per household[3] (head)	xx	x	x	x	x	xx
(g)	Average price per head[4]	9000	6000?	x,xxx	x,xxx	x,xxx	11,000?

1. Population census 1983 (Any major shifts in population since 1983?).

2. Livestock Marketing Board Annual Report 1989.

3. Average for households reporting cattle.

4. Dalasi (farm-gate or price at weekly market?).

is the major population centre. Most of the cattle are found at the other end of the country in the Upper River Division—the home of the Fulani cattle herders. By using a survey, the researcher hopes to determine more accurately the number of households with cattle in the two divisions and details on dairy marketing.

Secondary data are found for rows (a), (b) and (d). The researcher notes that the census data are out of date, but the Livestock Marketing Board has a good reputation for reliability. He thinks rows (c) and (e) are crucial to answering his hypothesis about the number of cattle-raising households and average herd size. He expects the majority of households in Upper River Division to own cattle and the average number of head per household to be at least four times that of the Western Division where few farmers own cattle. Since he has no specific information or hypotheses about the remaining divisions, he leaves these cells blank. Similarly, for rows (f) and (g) he may have only hypotheses for the Western and Upper River Divisions.

The dummy table now gives an overview of what is known and what additional data are needed. The researcher can easily modify the table as more information is uncovered. As he reviews the table, the researcher will be forced to consider whether a nation-wide survey is required or whether it is only necessary to conduct localised enquiries. He will also use this table to spawn additional tables that organise data needs for dairy cattle, milk sales and other items of interest.

The skeletal report is outlined, based on the literature review and the researcher's own observations. The outline should state the specific hypotheses as they will be analysed from the survey. The researcher should recognise that time spent on this initial stage of the survey will avoid mistakes and save countless hours during the latter stages.

With hypotheses clearly articulated in the skeleton report and dummy tables, the researcher can now move on to the remaining three survey stages. A successful survey design will depend on a coherent linking of these stages with the plans laid during the preliminary stage.

Design stage

With the preliminaries completed, the researcher enters the crucial design stage. It is during this stage that all requirements and contingencies must be recognised and discussed. By following the iterative process, the researcher will complete the design stage with the full awareness of how his decisions will affect the final output. Responsibilities in the design stage can be divided into administrative and technical (primarily statistical). We distinguish between the two to emphasise the importance of these rather discrete inputs. At the same time, the need to coordinate these inputs is essential to any successful survey effort.

Administrative responsibilities encompass all the logistical details of the survey. These details can be grouped into the following general categories:

- Financial

- Legal

- Transport

- Personnel

- Training facilities and equipment

- Field equipment and supplies

- Summary facilities and

- Publication facilities and supplies.

It is essential that each of these needs is addressed during the design stage and that suitable solutions are found before continuing the survey programme. The solutions to these problems must be considered in coordination with the statistical aspects of the survey.

Technical responsibilities encompass all the statistical aspects of the survey:

- Sample frame
- Sample design
- Sample selection
- Summary procedures
- Output-table specifications
- Estimators
- Methods of measurement
- Questionnaire design
- Pretesting
- Edit specifications and
- Enumerators' instruction manual.

Again, decisions regarding these details are meaningless if they are not based on the final report or are not coordinated with the administrative needs of the survey. Figure 2 illustrates the interrelatedness of the major components of the design stage.

Sample design

With his data needs firmly in mind, and a basic knowledge of the target population, the researcher must choose the appropriate survey methodology. There is a wide range of possible choices— from a single case study to a highly sophisticated probability sample design. An important factor in the choice will be the level of accuracy that the final summaries must have to answer the hypotheses. Anticipated costs must be considered as a possible constraint to the survey. If the survey choice is to be efficient and cost-effective, the researcher must again fit this decision into the context of the entire survey.

Questionnaire design

Questionnaire design determines how and what measurements are to be taken. Deciding on a questionnaire format includes resolving such issues the order,

Figure 2. *Some related issues in survey design.*

style and wording of questions. Questionnaire development must be closely linked with the conception of field procedures, and especially the level of talent of prospective enumerators. Ideally, the questionnaires should facilitate the use of computers.

Field procedures

Throughout the design stage, one must remain keenly aware of field procedures and logistical needs. The sample design will greatly determine the nature of field procedures. Some of the important issues to be kept in mind about field procedures are:

- Will enumerators have to make repeated visits to the respondents? If so, will they have transport?

- How will the researcher communicate with the enumerators?

- What will be the costs, in both cash and time, of training enumerators to the required level?

- Will all the necessary equipment be available (e.g. scales, measuring tapes etc)?

Hiring field staff

Choosing the appropriate field staff is highly dependent on the nature of the survey. In general, field staff (enumerators and supervisors) should be as close as possible to the respondents in economic and social status. The effect on non-sampling error of an aloof enumerator arriving on a farm in shiny black shoes and a trim, neatly cut pair of trousers is incalculable but significant.

Control of enumerators is important. Try not to hire enumerators you cannot fire or replace. If possible, train more than are required, then test and select the best. Build rapport, emphasise the need for high-quality data and let the enumerators know that their work will be closely monitored. Spot-check questionnaires and require re-enumeration or even replacement of the enumerator if necessary. Knowledge of local languages is a must! Use female enumerators to interview female respondents. Nurture enumerators who show an interest and aptitude for high-quality work. Replace or reassign those who do not.

Training field staff

The training programme is fundamental to achieving the goal of collecting high-quality data. It is simply not possible to expect good survey results if the enumerators are not knowledgeable about the purpose of the survey, well-trained in the basic techniques of data collection and intimately acquainted with the

survey questionnaire. No shortcuts should be taken in this most important activity. With questionnaires fully developed and printed before training, enumerators should be thoroughly trained in the meaning of each section and question.

An enumerators' manual should be given to each enumerator during training. The manual will serve as a constant reference to the enumerator as the survey progresses, forestalling the common enumerator's complaint, "But that is not what you said during training." Mock interviews between enumerators are an excellent means of examining the enumerators' understanding of subtle points. Actual field demonstrations and interviews should be a part of the training exercise. Each enumerator should be able to demonstrate his proficiency with the questionnaire before he/she is certified for field work.

Researchers should view the training component as an integral part of the iterative planning process. During the training programme, issues will arise that may cause a re-evaluation of the research hypotheses, with direct impact on the dummy tables and skeleton report.

The training exercise is the last chance the researcher will have to refine the survey before it goes to the field. Once data collection begins, changes to the questionnaire or survey methods will be extremely difficult. Mid-survey adjustments are often misunderstood by enumerators and result in additional unanticipated errors.

Data processing and analysis

With the wide availability of microcomputers, we assume that any relatively large survey effort will be computerised. Under the heading of data processing we include not only the actual keying in of questionnaire data but also the design of data-entry procedures, the generation of summary statistics and the maintenance of all data once they have been taken from the questionnaire.

The researcher must have an understanding of data-processing procedures. Using a well-designed questionnaire, survey data can be captured in computer-ready form. With the assistance of the dummy tables and skeletal report, the survey designer should be able to visualise how the data from each question contributes to the final report. If the questionnaire is to be completed at several different levels, e.g. individual, household and village, the researcher should understand how all three levels can be linked during data processing.

The data processing and analysis component may have dramatic implications for the cost of the survey, especially if computers, printers and software have to be bought. No complex survey questionnaires or complex reports should be envisioned unless skilled data processors are available to oversee the work. Here

again, the constraints of one component, in this case data processing and analysis, directly influence other components of the survey.

Publicity

Finally, it is very important to publicise the survey. Throughout the preliminary and design stages, informal publicity has taken place. Administrators and researchers have sought support for the survey since its inception. But now it is essential to let the public know that a survey is forthcoming and enlist public support.

Any advance publicity that explains the purpose of the survey helps eliminate some of the questions that the people may have when an enumerator begins canvassing their locality. The form of the publicity will depend on the size of the survey and the facilities available. Radio announcements are often effective, as are meetings with village leaders and potential respondents.

At this point, let us pause to consider the impact of survey planning on the quality of data that are collected. Statisticians usually talk about data quality in terms of "sampling error". The quality of data is also influenced by all the other details considered during the design stage. These other errors are not caused by the sample so they are called "non-sampling errors". They are not as easy to measure as sampling errors, but they often contribute much more to inaccuracies in the data. Hence, it is important to consider the elimination of non-sampling errors as the major way to improve the quality of the data at each step in the survey process. As mentioned above, good training for enumerators is essential in minimising non-sampling errors. Time spent in questionnaire design and pretesting questions will help eliminate errors caused by misinterpretations or misunderstandings.

As long as the administrative details are attended to they do not jeopardise data quality, but if some details are forgotten they can greatly affect the enumerators' performance in the field. Only when the chances for non-sampling errors have been minimised by thorough planning are we ready to begin collecting data.

Data collection stage

With the design stage completed, the researcher begins collecting data. In this section, the researcher will gain insights on how data collection, supervision and quality control can follow easily from the decisions made during the design stage and can thus lead directly and efficiently toward the final output.

Although questionnaires are administered by enumerators, it is important for the researcher to know what is happening in the field. If the survey is large, there should be a staff of trained supervisors and inspectors available to answer enumerators' questions and to verify that proper data-collection techniques are

followed. A quality-check survey for a subsample of the sample units should be conducted by supervisors to give an indication of what biases may be present in the data.

Survey workers should be well aware of what is written in the enumerators' manual and what **should be** done in the field, but the researcher can only discover what is **actually** taking place by being there. We recommend that the researcher travel to the survey site frequently and personally enumerate some sample units to learn more about the quality of the data.

In smaller surveys, it is often possible for the researcher to form a mobile survey team that moves as a unit from one survey site to the next. By travelling with the team, the researcher will be intimately aware of the problems that arise and quite able to make adjustments that are in concert with all other stages of the survey process.

While emphasising data quality, the administrative aspects cannot be overlooked. The researcher must see that the data collection is carried out as efficiently as possible, with a minimum of time spent waiting for support. Oversights, such as the lack of vehicles and delays in receiving pay checks and per diem, all have serious negative effects on enumerators' field performance.

Preliminary data entry and editing

Data processing should begin while the survey is still underway. The researcher should use the results of the pretest and training interviews to test the plans for data entry and computer processing. This way, insights from the data-processing staff are returned to the field staff. This will give an opportunity to correct questionnaire problems before they become too grave.

Summarisation

The summary process should be thoroughly tested at this early stage, and should include computation of basic indicators by subregion or village. This gives the researcher an early indication of whether the data being collected will satisfy the cells in his dummy tables.

Unfortunately, too many researchers wait until all the questionnaires have arrived before they begin data processing. This linear approach ignores the important feedback between the data-processing exercise and the field procedures. A quick summary of the basic indicators from one small region may reveal a fundamental flaw in the design of the questionnaires or the enumerators' interviewing procedures.

If one waits until data collection is completed the cost of resolving a flaw rises dramatically. Early calculation of summary statistics is especially helpful in

multiple-round surveys, when corrections from early stages can be used to improve later rounds.

Mid-survey adaptations

Even with a conscientious adherence to the iterative philosophy, the researcher will have to make adaptations midway through the survey. This is to be expected and should be seen as a means of keeping the survey directed towards its initial goal: addressing the hypotheses embodied in the dummy tables and skeleton report. The means of communication becomes the most important element in enabling these mid-survey adaptations to take place. Phone or radio links are very helpful since they provide for immediate two-way communication. However, the availability of these facilities in much of rural Africa is limited. The researcher should plan regular meetings between himself and the field staff. Personal communication is much preferred to written messages.

Debriefing and retention of field staff

As the data collection of the survey is completed, it is often helpful if some of the field staff can be retained during the editing and summary process for clarification of work done during the survey. They may also be needed to return to the field to check certain questions or even to re-enumerate a portion of the survey.

Data analysis and reporting stage

In the iterative survey process, the analysis and reporting stage is far easier than in the linear approach. In principle, with the output tables completed at the beginning of the survey and a questionnaire designed solely to derive the necessary data, the researcher need only fill in the cells. His conclusions can be derived with close correlation to the hypotheses established at the beginning of the survey. In the sections below we make a few quick observations on this fourth and final stage of the iterative survey process.

We include questionnaire receipt, data entry and verification, editing, summary, data analysis and data evaluation and reporting as components of the final stage of the survey process (Appendix A). Two items that deserve special mention in the iterative planning process are the calculation of summary statistics and formal statistical estimates.

The calculation of summary statistics and estimates are directly driven by the existence of dummy output tables. In theory, one need only fill in the blanks in these tables. In fact, however, the format of the tables will continue to evolve as one begins calculating these statistics. The researcher may find that a table does not make sense, or that new columns need to be added. As with all other components of the iterative survey process, the calculation of summary statistics

and estimates must be guided by the hypotheses formed at the beginning of the survey.

One should always begin by summarising the basic data describing the sample before moving on to calculating more complicated summary statistics and estimates. Research reports do well to include a table entitled something like "Summary statistics from the sample data." Not only does such a table give the reader an understanding of the sample construction, but it also gives the researcher a better understanding of his own data-set before embarking on the more complicated task of deriving more complicated summary statistics and estimates. Few researchers can resist the impulse to charge ahead, calculating regressions and the like before a thorough review of the basic sample data has been completed.

The summary formats and procedures laid out during the design stage are now implemented as planned. Now is not the time to decide that additional information can be extrapolated from the data. In fact, last-minute tabulations are usually statistically invalid and should be strictly avoided. The survey was designed to answer specific data needs; it will if properly summarised.

After the initial summarisation, a thorough analysis of the survey data is the next step in the survey process. The summaries must be closely reviewed for errors and inconsistencies. Often, previous surveys and other data sources can be used to confirm the plausibility of the survey results. At this time, researcher awareness of the many possible biases and how they may have affected the results is crucial.

The publication of the survey results should be as descriptive as possible. Charts, graphs, tables and narrative should all be used in a combination that best presents the data. If the summary stage is particularly lengthy, consider the possibility of releasing preliminary results. We also encourage the inclusion of a section containing a description of the survey methodology, sampling errors for major survey items and a discussion of any factors that may have affected the quality of the data.

The researcher should expect, accept and answer all criticisms of the survey and its results. It is important to collect critiques from everyone who had an input into the survey and from the data users. Analysing the comments and responding to them can become a very positive step towards a better understanding of the current survey and improving the next.

If detailed cost records have been maintained, they will be invaluable in the design of future surveys. The survey principals should combine their notes regarding the survey even if there is no follow-up survey. It will be instructive for others who may follow to have a description of the survey methods, the costs and any candid comments concerning the strengths and weaknesses of the survey. It is regrettable that so many researchers neglect or are too embarrassed

to write meaningful analyses of their surveys. A more open sharing of survey problems and the attempts made to overcome these problems would help all data collectors do a better job in the future.

Minimising non-sampling errors

The two researchers revisited

Six months and many grey hairs later, with his boss riding him to complete the final report, Sehou knows he is in a fix. His vision of an erudite, timeless Ceesay Report has evaporated. As he drafts the report he sadly realises that the many problems he encountered during the survey have reduced the usefulness of his output drastically.

But the regret and remorse is quickly overcome by the resiliency of youth. Two months earlier, Sehou met Alieu Bah when he presented his preliminary survey results. Sehou, who knows a good thing when he sees it, vows to seek Alieu's advice in the future.

Below are some specific problem areas the two researchers encountered as they completed their surveys. As Sehou says, "If I had only known…"

Introduction to non-sampling error

In the previous section, we discussed the iterative approach to the four stages of surveying as the way to conduct efficient and cost-effective surveys. Now we turn our attention to non-sampling errors and offer some ways in which the researcher can try to minimise them. We will specifically view non-sampling errors in the important areas of selecting a survey method, questionnaire design and the interview process, with the discussion centred around dairy marketing research.

Statisticians speak of "errors" as the difference between the "estimated" value and the "true" value. That is, every population has true values that, if known, would perfectly describe the population. But in most cases, this perfect knowledge is not available. When the estimates of population values come from scientifically designed samples, statistical statements can be made about the accuracy of the value. The statements are usually expressed as the true value falling within a range either side of the estimated value. Unfortunately, these statements only include sampling error—that portion of the error attributable to the fact that only a sample of the entire population was observed. The non-measurable portion is called non-sampling error.

In contrast to the great amount of work conducted by statisticians in the pursuit of more sophisticated survey designs and more precise measurement of

sampling errors, non-sampling errors are little understood, difficult to control and almost impossible to measure. By definition, non-sampling errors are made up of all the mistakes made during a survey. Once the researcher begins to recognise the existence and common causes of non-sampling errors, he can begin to control them by paying close attention to every detail of the survey process. All areas of surveys are vulnerable to non-sampling errors.

Choosing the optimal survey method

With the wide choice of survey techniques available, the researcher must spend time in the early stages of the survey, deciding on the best survey method. Major factors to consider are:

Objectives of the survey: What are the hypotheses being tested? What information must the researcher have to make a statement about the hypotheses? What kind of statement is to be made about the population? Is a general description of the situation sufficient? Or, is a detailed measurement of rather precise variables required? Are acceptable secondary data available?

General characteristics of the population: Is the population homogeneous or heterogeneous? Are there many or few sampling units? Is the population geographically dispersed or concentrated?

Resources and time available for the survey: What amount of money is budgeted? How soon are the data needed for decision-making? How many people will be involved? Is this to be a single-person effort? Or, are the resources of a large data-collection organisation available? Are computers and data-processing staff available?

In Table 2, four general categories of survey methodologies are listed together with their strengths and weaknesses. All of the categories are legitimate methods of collecting data. How does one chose the most appropriate one? The wide range in choices is often daunting to the researcher. In choosing a survey methodology, the researcher must decide on the level of precision necessary to qualify his analysis. The key to the decision is then in choosing the method that will provide data of sufficient quality without wasting resources. These factors make the selection of a survey methodology primarily one of efficiency and cost-effectiveness. To be efficient, the researcher must collect data of sufficient quality at the least expense. Cost-effectiveness is achieved if the researcher uses the best procedures and collects only the necessary information for a topic that has been judged worthwhile when compared to alternative uses of resources.

The tendency of researchers to collect data "just in case" not only detracts from efficiency and cost-effectiveness but also increases the potential for erroneous results. For example, if a researcher loads a questionnaire with too much detail, both the enumerator and respondent will tire and will be less interested in

Table 2. *Four broad categories of survey methods.*

Method	Survey goal	Strengths and weaknesses
Probability surveys		
Census	Direct statement about the population	- Complete coverage of the population
		- Useful for "structural statistics"
		- Cost depends on population size and desired accuracy
		- Cumbersome and difficult to maintain accuracy for very large populations
Sample survey	Inferential statement about the population	- Need a sampling frame
		- Many sample designs are available
		- Possible to make probabilistic statements with known levels of confidence
Non-probability surveys		
Purposive survey	Information from knowledgeable sources	- Directed inquiry of expert sources
		- Quick access to information
		- Possibility of bias in selection of informant as well as information received
		- Length of interview can vary from "rapid appraisal" to "case study"
Tarmac survey	Observation only	- Quick
		- Little feedback on observations
		- Many possible biases due to inaccurate conclusions from superficial observations

accurate answers. When too many respondents are included, resources may be so stretched that only marginal logistics support and supervision are possible. This creates a prime opportunity for increased non-sampling errors. Errors are avoided by having a clear vision of goals. Such clarity comes only from concentrating on specific needs and eliminating all superfluous material.

A general understanding of the distinction between probability and non-probability surveys is essential to choosing a survey design.

Probability surveys

If the researcher has followed all the rules of using a sampling frame and selecting a scientific sample, the term "probability survey" is used. This allows the

researcher to make inferential statements about the population with a known level of confidence. When deciding to use a probability-type survey, some of the important considerations are sample frame, sample design and sampling rates.

The quality of a probability survey is highly dependent on the sampling frame, which should be a complete, up-to-date list of all units in the population from which a sample can be drawn. The researcher should understand the strengths and weakness of the sampling frame. The frame may be out of date, incomplete or contain duplication. If a reliable frame is not available, frame building can be both time consuming and expensive. If a frame seems suitable, it should be scrutinised thoroughly before the actual sample is selected. It will be important to determine if the "sampling units" on the frame are identifiable as "reporting units" once the enumerators search for them in the field.

The researcher should determine what units were used to construct the frame. These units are called sampling units and may be individuals, households, compounds or some other unit that was originally used to construct the frame. Surveys run most smoothly when the questionnaire and survey are so designed that the reporting unit is the same as the sampling unit. If the reporting unit is not obvious, it should be determined via a pilot survey or through a thorough pretesting of the questionnaire. If there are differences between the sampling unit and the reporting unit, the questionnaire and sampling procedures should be adjusted accordingly.

The next step is to decide on the specific sample design and determine the sample size. These decisions are best made with the assistance of a professional statistician. Some researchers seem to have a pet design which they try to adapt to all possible situations. However, this is seldom practical or efficient. The researcher should review sampling procedures, summarisation and variance calculations with someone who does this kind of work often. Errors in design and in selecting a sample can totally negate the researcher's ability to make statements from his data.

While a statistician can estimate the appropriate sample size based on the variance within the population, cost also heavily influences sample size. One choice is between a complete census (100% sampling) and a sample survey. Complete coverage is often the researcher's dream but seldom a good or even desirable goal. Only if the population is quite small should the researcher attempt complete coverage. Beyond that, the advantages of sampling, and the problems with complete enumeration, suggest sampling as being preferable.

Non-probability surveys

Non-probability surveys are composed of samples selected in such a way that the probability of a particular sample unit's inclusion in the survey is unknown. This means any inference from them is statistically suspect—not necessarily

invalid, but in need of careful review. The data from non-probability surveys can be valuable, although at times difficult to justify to a professional audience.

Some researchers shy away from non-probability samples because of their limitations. Other researchers use them almost exclusively without a full understanding of the potential for bias. While non-probability surveys can be extremely useful, the researcher should pay careful attention to the selection of the sample units and be keenly aware of biases that may enter. The researcher should know why the respondent was selected.

Case studies are a special type of purposive sample. Researchers often prefer this technique because it gives them a chance to control the selection and then to probe for in-depth information. While these are valid reasons to choose the case-study approach, it is important for the researcher to continually think about the degree to which the case study is representative of a larger group. If the unit is unique, the information will pertain only to this single unit and the study becomes esoteric and of limited use. However, if little is known about the population of interest, a case study can often be used to great advantage as the first stage of a research project, providing a rich source of hypotheses to guide the research.

Rapid assessment or rapid appraisal are terms applied to a wide variety of informal data-collection techniques. In a sense, these are more methods of observation than survey techniques. As the name suggests, rapid assessments are meant to be quick not only in the observational phase but also in getting the survey results to decision-makers. Typically the observation is conducted by an experienced professional or a multidisciplinary team that has a "good feel" for the general situation. Often the survey involves little more than travelling through a region, observing activities and conducting informal interviews with local people to gain more specific information. Rapid assessments are often criticised as unscientific, although if they are used correctly and their limitations are recognised, they can provide meaningful information in a short time with minimal cost.

Questionnaire design

The questionnaire is the key to any survey. It is the link between the researcher and the respondent. It is where concepts are operationalised into observable, measurable data. The ideal questionnaire will make it possible for each reporting unit's data to be entered and tabulated in a way that is identical to all other reporting units. However, the "survey instrument", as it is often called, could just as well be called the "culprit" in many surveys when the source of non-sampling errors is examined. This is the challenge to the questionnaire designer.

To minimise non-sampling error, the researcher must design the questionnaire with special attention to: (1) the education and number of respondents; (2) the

education and number of enumerators; (3) the data desired; (4) the flow and format of the questions; and (5) the summary techniques to be employed.

Respondent

The researcher should have a good understanding of the respondent's attitudes and activities before a meaningful questionnaire can be designed. Some appropriate questions are: Does the respondent have the information the researcher is looking for? Will he share it? What will be the respondent's sensitivity toward the survey topic or specific questions? What is his likely educational level? Is the respondent one of many? Or one of few? Is he a sophisticated businessman or a subsistence herder? Will language be a problem? What is the respondent's understanding of and relationship to the survey organisation and the central or provincial government? The researcher should remember that no matter how much he/she desires a piece of information, if he/she is asking for something the respondent refuses to divulge, inclusion of the question in the survey may be counter-productive.

Enumerators

Sometimes researchers can choose the enumeration staff, and other times not. To minimise non-sampling errors, the survey questions should be well matched to the abilities of the enumerators. Three levels of enumerators are:

Professional interviewers: Well-trained, experienced, highly literate, with a good understanding of survey objectives.

Experienced enumerators: Well-trained in the use of questionnaires, fully aware of the population, with no language or cultural barriers.

Inexperienced enumerators: New to data collection, trained only for this survey, may be well versed in local conditions, but relatively unaware of the objectives of the survey and the importance of minimising errors.

To assure accuracy, the enumerator must spend the time necessary to build up a level of trust between himself/herself and the respondent. In this situation, enumerators may have to reside in the village or region of the respondents, and hence may not be able to cover large and diverse regions. In multiple-visit surveys, it is often wise to discount the first survey round as a "getting acquainted" session between enumerator and respondent. Village meetings to explain the purpose and importance of the survey are often helpful in minimising fear and distrust. An endorsement from the village chief or elders can be invaluable.

Questionnaires must be able to elicit identical data no matter who uses them. Terms, definitions, concepts and formats must all be understood and applied uniformly by all enumerators, supervisors and researchers. If highly specific information is needed (e.g. dairy marketing costs), the questions must provide a logical flow that leads the respondent to reveal information that he/she might not normally discuss with strangers.

In Africa, the large number of languages can cause confusion during data collection. If interviews are conducted in a local dialect, great care must be taken to make sure terms are translated correctly and that enumerators are fluent in the language of the respondent.

Sometimes, despite his/her efforts to obtain data, the enumerator will be unsuccessful. An example is when a respondent is honestly unable to reveal information, such as in the area of in-kind transfers between family members. In many African households, these transfers account in large part for the family's economic stability. To dismiss these as meaningless is to lose the chance to get the real picture. However, capturing these data is difficult and fraught with possibilities for being misled.

Questionnaire design and format

If the questionnaire is well designed and flows smoothly, the interview will be completed with both speed and accuracy. Conversely, if the enumerator must stumble from section to section without adequate instructions or a logical flow, time will be wasted and errors will result. The questionnaire format should be easy to follow. Enumerator instructions and guidelines should be clearly noted. Use highlighting or italics for special enumerator instructions. Enumerators should find it easy to write responses directly on the questionnaire. Spaces for answers should be large and obvious. Leave plenty of room for notes on the questionnaire. Transcribing from a notebook or diary should not be allowed.

In formatting questions, perhaps the most common pitfall for researchers is the use of matrices or tables. These formats are dangerous because they offer little guidance to the enumerator and leave too much latitude for adaptation. As seen in the example below, the matrix theoretically contains space for all the required household information on income and wages. In practice, the matrix method encounters a series of problems, many leading to mistakes and inaccurate results. Only the most experienced enumerators can be expected to complete a matrix correctly. Each cell represents a separate question. Unless the enumerator phrases the appropriate question for each cell, information is lost. Novice enumerators often assume that the respondent understands the completeness of the matrix and enter zero responses if the respondent does not volunteer data for a particular cell.

Sample matrix for household income contribution.

#	Name	Salary income	Wage income	Transfers	Sales earnings	Other
1						
2						
3						
4						
5						
6						
7						

Another common pitfall in questionnaire development is the use of the open-ended question. For example, the researcher may want to know how the respondent would use credit if it were made available. He might ask: "If credit were made available, how would you use it?" and the enumerator is given a half page in which to write the answer. If the researcher hypothesises, however, that credit would be used predominantly for either capital purchases or repayment of loans, then a more desirable format for the question is:

If credit were made available, what would you use it for?

1. repayment of loans

2. capital purchases

3. other _____

Formatting the question in this manner will greatly aid the capacity for drawing conclusions from the research. In part this is because of a direct link to the data-processing component. A question with three (or more) possible numerical answers could be summarised in a matter of seconds by the computer, even for a survey with a large sample. Summarising descriptive paragraphs for the same size of sample, however, could take weeks.

If several different questionnaires are being used in the same survey, the researcher should clearly identify each form. Enumerators and supervisors can waste a lot of time searching for the correct form if the differences are subtle. Using different coloured paper and double-sized printing at the top of each page is very effective.

The questionnaire's overall length and its impact on respondent fatigue is too often overlooked by researchers. Typically, one will draft a questionnaire that covers all the variables of interest only to find it takes several hours to complete.

It must be kept in mind that, beyond a certain point, lengthening a questionnaire may lead to a serious reduction in response quality. The fewer the questions and the shorter the interview, the more likely one is to receive quality information. The researcher must balance the added cost of multiple visits with the very real chance of increased non-sampling errors by burdening the respondent with a long, detailed questionnaire. A pretest of the questionnaires will quickly identify potential problems. If the questionnaire is long and involved, try to find alternatives, e.g. multiple visits.

Compatibility with summary techniques

The data processor in charge of summarising the survey should be a full partner in the design of the questionnaire. Although we seem to presume the use of microcomputers to summarise most surveys, other alternatives are available. Whatever the system, the summary will proceed faster and have fewer errors if the questionnaire is formatted so the data can be quickly transcribed.

The interview process

Probably the most vulnerable area for non-sampling errors is the interview because it is the area where the researcher has the least control. Even if the researcher himself is conducting the interview, the respondent is free to answer as he/she chooses, truthfully or not. This puts the burden on the researcher to do everything in his power to minimise non-sampling errors in the interview process. Items to be aware of are listed below. A detailed outline of the important steps to follow in completing an interview is given in Appendix B.

Getting started

Even though the enumerators have gone through a training programme, it is good practice to remind them of the purpose of the survey and to review with them the sampling scheme just before going to the field. Enumerators must understand their responsibilities and the location of their enumeration area. They must know how to locate and identify the sample units they are to enumerate.

The enumerators' manual should contain a check-list of all the material the enumerator needs: pencils, diaries, maps, listing sheets, questionnaires and the like. The enumerators must also understand clearly the procedures to follow in case they need additional supplies or run into a problem.

Local customs should be well understood and respected. In particular, enumerators must know and follow the correct protocol; this means talking to the right people in the correct sequence. In some situations this may mean interviewing a chief first, in others it may mean contacting the local agricultural agent before conducting interviews in the area. Whatever the specifics, it is

important that protocol is followed. Many surveys have failed because local customs were not respected.

If a survey will have considerable impact on a particular geographic area, the researcher must make sure the pre-survey publicity is thorough. How this is done depends, of course, on the size and location of the survey. A combination of television, radio and newspapers may be used in some cases, while only radio or word-of-mouth can be used in others. The language of the publicity must be the language of the respondents. It is important to incorporate into the publicity an endorsement of the survey by important local people, such as a chief, an agricultural officer, a religious leader or a political leader.

Logistical procedures must be finalised and understood by all members of the survey team. Considerations here are: transport, delivery of salary and per diem, where supervisors and enumerators will stay, how members of the survey team are to contact one another and how communications between the enumerators, supervisors and headquarters will be handled.

Each member of the team must understand the overall survey programme and the responsibilities of the other members. The sequence of the survey procedures must be understood and followed, timetables must be kept to or the survey may fail. Above all, survey management must avoid false starts; often a survey gets off to a poor start by failing to consider the many preliminaries suggested above. To start a survey and then stop it, perhaps because of inadequate transport, can result in a loss of confidence by the enumerators. If the survey loses momentum, the project may have to be postponed until organisation can be re-established.

The interview

If a survey is to provide consistently high-quality data, questionnaires must be administered in exactly the same way by all enumerators to all respondents. To even approach this high goal, it is essential that enumerators be well trained in good interview techniques. The enumerator should recognise that while the interview is a cordial exchange, much as a normal conversation, it should also be restricted to the purpose at hand, namely asking the questions on the questionnaire and recording the answers as given by the respondent.

Appendix B contains guidelines for conducting an interview. The outline should be helpful to the researcher in his/her own interviewing and in training enumerators. The interview process is divided into three parts: introduction, body and closing. Each part is essential to the successful completion of an interview. Asking a number of questions without an introduction would leave the respondent bewildered and probably unwilling to answer questions again. For this reason, it is strongly recommended that enumerators be trained to do a complete interview, including a good introduction and closing. It should also be

noted that the guide concentrates only on the interview processes between enumerator and respondent; all preliminary protocols of meeting district and village officials are presumed to have been completed successfully.

Summary

In this paper we have attempted to do two things. First, we described a planning process that will help the researcher face each step of the survey with the knowledge that all his/her decisions have a wider importance than just solving the immediate problem. By approaching survey planning in an "iterative" frame of mind, the researcher will find that he/she reaches the final stages of the survey with most of his/her original goals intact and a clear understanding of the data-set and the survey conclusions. Secondly, we emphasised the need for the researcher to minimise non-sampling errors by paying special attention to the areas of choosing a survey design, designing questionnaires, and encouraging high-quality interviews.

The message is clear: Poor planning, lack of focus and poorly trained personnel lead to non-sampling errors, poor data quality and an unsatisfactory end product. Iterative planning, concentration on the final product and attention to detail leads to fewer non-sampling errors and a higher-quality result. And, of course, a generous serving of Good Luck always helps!

Acknowledgements

Useful references

Data collection

Casley D J and Lury D A. 1979. *Data collection in developing countries.* Oxford University Press, Oxford, UK. 244 pp.

Hunt K E. 1969. *Agricultural statistics for developing countries.* University of Oxford, Institute of Agrarian Affairs, Oxford, UK. 138 pp.

Johnson A C, Jr and Rowe J S. 1987. *Agricultural statistics for developing countries.* University of Wisconsin–Madison, Madison, Wisconsin, USA. 318 pp.

Zarkovich S S. 1966. *Quality of statistical data.* FAO (Food and Agriculture Organization of the United Nations), Rome, Italy. 395 pp.

Statistics and sampling

Hansen M H, Hurwitz W N and Madow W G. 1953. *Sample survey methods and theory: Volume I. Methods and applications.* John Wiley and Sons, New York, USA. 638 pp.

Kish L. 1965. *Survey sampling.* John Wiley and Sons, New York, USA. 643 pp.

Kish L. 1987. *Statistical design for research.* John Wiley and Sons, New York, USA. 267 pp.

Scheaffer R L, Mendenhall W and Ott L. 1986. *Elementary survey sampling.* Duxbury Press, Boston, USA. 324 pp.

Williams B. 1978. *A sampler on sampling.* John Wiley and Sons, New York, USA. 254 pp.

Yates F. 1981. *Sampling methods for censuses and surveys.* Fourth edition. Charles Griffin and Company Ltd, London, UK. 458 pp.

Discussion

The paper was appreciated as a valuable and exhaustive check-list for field surveyors and researchers. Some comments and questions were put that could help improve the wider appeal and use of the paper. It was felt that the title of the paper did not do justice to its content, which goes far beyond survey planning for dairy marketing research. For example, the title might better reflect the overall purpose of improving data quality and making inferences from such data which form the basis of the "iterative" approach. There is some need for caution in laying too much stress on the "iterative" approach, which involves looking forward and backward, anticipating information to be collected, table of contents etc, as "a way to conduct efficient, cost-effective surveys". New practitioners may require more clarification and guidance in the use of the "iterative" approach than is offered in the paper. Although the approach will help diminish the ratio of cost to quality and efficiency of the data and survey process, the opportunity cost of the time and effort it requires is likely to increase at a constant, probably also at an increasing, rate as time passes and deadlines close in. There is thus a need to weigh the risk involved in delaying a decision until better-quality data are obtained against the risk of taking decisions sooner on the basis of lesser-quality data. Another point raised was that the paper does not always nail down the "hows" at all crucial instances and stays at the "should be" level, thereby leaving a gap which can be filled by those with some experience but risks leaving behind those with little experience and training.

Some issues need further elaboration. For instance, is it possible or necessary to have clearly defined hypotheses to get survey information for decision-making purposes? If yes, has the need for considering tested hypotheses in relation to decision-making objectives been emphasised enough and is there no risk of transforming the original decision-making objective into one of testing hypotheses that are not well related to it? A lesser or more-qualified emphasis on hypothesis

formulation would perhaps make the method more user-friendly. Finally, the issues of when, how and with what care one should go into multiple interviews, deal with dynamic phenomena like cycle and seasonality of milk production and marketing, categorise answers to open-ended questions and administer questionnaires ought to have been treated in much more detail in the paper.

Appendix A: Survey planning guide

Preliminary stage

A. Recognise the need for information

B. Reach preliminary agreement on funding

C. Discuss who will be involved

    1. Identify a lead researcher

    2. Identify administrative staff

D. Reach general agreement on objectives, plan and timetable

E. Assign preliminary tasks. Who is responsible for:

    1. Hypotheses to be tested?

    2. Contents of final tables?

    3. Decision on data-collection techniques?

    4. Equipment procurement?

    5. Questionnaire content?

    6. Questionnaire format?

    7. Overseeing data collection?

    8. Clerical functions?

    9. Data editing?

    10. Data processing?

    11. Data analysis?

    12. Publication?

F. Management decisions

    1. Delineate lines of authority

    2. Designate a survey manager. The survey manager becomes the focal point of the survey with responsibility for adherence to the timetable.

    3. Who will have access to the data?

_____

NB. As chronological as this guide may appear, the user must digest the guide in its entirety and consider each stage and step as it relates to the other stages.

4. Will a preliminary report be published? Who will have access to the preliminary report?

G. Finalise statement of objectives, hypotheses and timetable

    1. A clear statement of research hypotheses and survey objectives will eliminate misunderstandings later

    2. Draft skeleton report and dummy tables

    3. Identify 'go/no-go' decision points

    4. Set training dates

    5. Set beginning and ending dates for data collection

    6. Set dates for clean and summarised data-sets

    7. Set date for final review of report

    8. Set dates of progress reviews

Design stage

A. Survey methodology and sample design

    1. Consider alternative methodologies. Choose the most cost-effective and efficient sample (e.g. probability, non-probability)

    2. Strongly consider a scientific sample design

    3. Agree on sampling units and reporting units

    4. Locate and update sampling frame, lists, maps and photos

    5. Consider the need for a pilot survey

    6. Determine sample size

    7. Select sample

B. Staffing

    1. Hire enumerators

    2. Assign tentative work-loads

    3. Notify staff of survey timetable

C. Questionnaire design

    1. Content—concepts must be operational

    2. Format—obvious flow, obvious answer spaces

3. Computer-compatible identification scheme

4. Draft questions and transition statements

5. Develop coding scheme for data processing

6. Pretest—control length of questionnaire

7. Revise

8. Final typing and printing

9. Pre-enter ID numbers, if possible

D. Enumerators' manual

   1. Contents:

      a. Purpose

      b. Survey design

      c. Terms and definitions

      d. Roles and duties of the staff

      e. Explanation of all parts of the questionnaire

      f. Detailed instructions of special procedures

      g. Administrative instructions

   2. Write, edit, review and rewrite

   3. Print

E. Training plans

   1. Establish training dates

   2. Establish objectives and agenda

   3. Contact trainers and guest speakers

   4. Locate and reserve site

   5. Develop and print training materials

   6. Give manuals and survey information to enumerators

   7. Walk through training school with trainers

F. Survey materials

   1. Questionnaires

   2. Paper, pencils and pens

     3. Maps and aerial photos

     4. Enumerator assignments

     5. Enumerator manuals

     6. Equipment

     7. Administrative forms

G. Summary system

     1. Output-table formats

     2. Required analyses

     3. Input format

     4. Edit specifications

     5. Summary software—revise if necessary

H. Logistical and fiscal planning

     1. Final funding in place for:

         a. Vehicles

         b. Gasoline

         c. Per diem

         d. Contingency account

     2. Reach an understanding with fiscal officers as to the availability of funds and procurement procedures

I. Final survey plans

     1. Necessary equipment in place

     2. Supervisory system and quality-control methods in place

     3. Enumerator assignments finalised

     4. Flow of completed questionnaires understood

     5. Office procedures established

     6. Edit/correction loop understood

     7. Data-entry procedures ready

     8. Timetable updated

J. Publicity

    1. Radio

    2. Television

    3. Mail

    4. Administrative (political?) channels

K. Training

    1. Overview of survey design and expectations

        a. Solicit individual participation

        b. Expect performance

        c. Participation $\rightarrow$ ownership $\rightarrow$ quality

        d. Recognise different experience levels

    2. Demonstrate techniques

        a. Interview techniques

        b. Handling non-respondents

        c. Use of equipment, specific measurements

    3. Role-play

    4. Informal testing

    5. Practice, practice, practice

    6. Check-list of enumerator duties

    7. Due dates understood

    8. Administrative instructions

    9. Quality-control system

    10. Evaluate training session

Data-collection stage

A. Data collection

    1. Protocol—introductions

    2. Verification of sampling unit

    3. Questionnaire completion

    4. Special measurements

    5. Quality checking

B. Supervision

    1. Non-response follow-up

    2. Assistance in improving data quality

    3. Identify enumerators for advancement, retraining or replacement

C. Smooth flow of completed work to central office

    1. Field edit

    2. Preliminary summarisation

D. Inspection and re-enumeration

Analysis and reporting stage

A. Receive questionnaires

    1. Check-in

    2. Pre-edit coding and checking

B. Data entry and verification

    1. Maintain detailed record of computer files

    2. Backup computer files frequently

C. Edit loop

    1. Error detection

    2. Error correction

    3. Update raw data file

D. Summary

    1. Expand data

    2. Compute sampling errors

    3. Generate tables and graphs

E. Data analyses (computer process)

    1. Detection of outliers **or** lack of variability

2. Appropriate statistical tests

F. Data evaluation (data review)

    1. Conventional wisdom—Do data make sense? Do parts fit?

      Are deviations explainable?

    2. Critical review of data-set

      a. Sampling errors

      b. Non-sampling errors from:

          (1) Sampling operations

          (2) Faulty operationalisation of concepts

          (3) Respondent

              (a) Lack of understanding

              (b) Wrong respondent

              (c) Concealment of truth

              (d) Sensitive or loaded questions

          (4) Enumerator

              (a) Non-interviews (refusal, inaccessible)

              (b) False interviews (enumerator fraud)

              (b) Not understanding the concepts

              (c) Errors in completing questionnaire

              (d) Recording errors

          (5) Processing errors

G. Report preparation

    1. Summary tables and graphs

    2. Narrative

H. Preliminary review and printing

I. Final review and clearance

J. Publication of survey results

    1. Consider audience—multiple reports?

    2. Include an honest evaluation of data-collection methods

3. Professional-looking document

K. Feedback to respondents

    1. Were the respondents promised anything?

    2. Are they owed anything?

L. Survey evaluation

    1. Cost analysis

    2. Solicit comments from associates and data users

    3. Record notes and lessons learned for next time

Appendix B: Interview guidelines

Introducing the survey and establishing rapport

A. Introduce the survey to the respondent and state your purpose

- Give your name and the name of your organisation

- Make the subject and purpose of the survey clear

- Stress confidentiality of answers

- If the respondent asks how he/she was selected, the enumerator should have a ready reply. This can be a little tricky; the enumerator must avoid intimidating the respondent with statistical jargon.

B. The interview should be open and non-threatening

- Enumerators should not appear to pass judgement on the household, farming practices and the like

- Some respondents will seek approval of what they are doing or shape their responses to what they think the enumerator wants to hear; the enumerator must be careful not to give hints of any desired responses.

C. The enumerator must make the respondent feel the survey is important

- Field experience suggests that rural people, especially farmers, are quite open in responding if they believe the data are important for agricultural development

- The question of whether to pay respondents should be considered. Opinion on this is divided; we do not encourage payment because of the future expectations it creates.

D. The enumerator must make the respondent feel his or her answers are important

- Often respondents are reluctant to answer as they feel insignificant—"I am just a small farmer" or "Our family is very poor." A response is needed from every sample unit. The enumerator must be able to explain why.

E. The enumerator must appear neutral, non-threatening

- Clothing should not be so different from the respondent's as to suggest a class difference

- Similarly, the language of the enumerator should not suggest a class difference

- If possible, the enumerator should be of the same sex as the respondent (i.e. female enumerators usually elicit higher-quality data from women respondents than do male enumerators)

- The enumerator should show no reaction, adverse or otherwise, to the respondent's answers.

F. The enumerator must be flexible

- The enumerator must be willing to do interviews whenever and wherever the respondent desires. An accommodating spirit demonstrates to the respondent that the interview is important and that the enumerator is willing to do whatever is necessary to complete the questionnaire

- It is usually most efficient if the enumerator completes the interview on the first visit. However, the enumerator should be patient and understanding. If the respondent prefers not to answer questions on this call, honour the respondent's wishes and make an appointment for a more convenient time

- In many locations an "appointment" lends importance to the occasion.

G. The interview should be in a quiet place

- It is often best to interview at the respondent's home or farm, as people usually feel less intimidated in their own environment

- The enumerator and the respondent should be alone. In most developing countries a private interview is not possible because of friends and neighbours. In these situations the enumerator should get the respondent's permission to proceed with the questions in the presence of visitors

- The enumerator should be sensitive to problems associated with collecting data while visitors or relatives are present. The enumerator should ask to come back another time if he/she sees that the presence of others is influencing the respondent's answers.

Completing the questionnaire

A. Questions should be asked as worded on the questionnaire

- This is necessary to ensure comparability of answers across all respondents

- If the respondent does not understand the question, the enumerator must try to rephrase the question without losing its original meaning. The possible explanations and interpretations of difficult questions should be

discussed in the enumerators' manual and during the training session so each enumerator is prepared to handle questions in the field

- Enumerators should understand the translation of survey terms in the local dialect.

B. Enumerators must follow carefully the instructions on the questionnaire

- Questions should be asked in the order listed on the questionnaire. However, enumerators must be prepared to record answers out of order. Often in responding to a question, the respondent may think of something to add to a previous answer

- Ask every question

- There can be no hope of consistency unless every enumerator follows all the instructions and asks every question.

C. Handle reluctant answers tactfully

- Respondents are often reluctant to answer specific questions because they do not understand the reason they are being asked. The enumerator should be ready to explain why data from sensitive questions are necessary.

D. Maintain rapport throughout the interview

- The enumerator must remain sensitive to the respondent's mood. If the respondent is becoming bored with the interview, the enumerator must be able to revive the situation.

E. Use the questionnaire informally, with ease

- The enumerator should create the impression that he/she is a professional who can use the survey questionnaire smoothly without being officious.

F. The enumerator should use probing questions when responses are irrelevant, unclear, incomplete, suspicious or obviously false

- The enumerator must continually assess the quality of the responses and be ready to probe for more accurate data

- Probes must not suggest responses. "Leading" questions are the bane of all surveys. Enumerators must be aware of the damage leading questions can cause and know how to avoid them

- Probes presume good rapport and require tact. The enumerator must be able to question the respondent's answers without making it sound like an interrogation.

Closing the interview

A. Thank the respondent

- The enumerator should leave the respondent with the feeling that the interview was a pleasant experience

- The respondent should be warned that the enumerator may return with more questions at a later date.

B. The enumerator should respond to any questions or concerns that the respondent raises during the interview

- The respondent's concerns must be taken seriously and help should be offered when possible

- The enumerator should record any specific questions that he/she was unable to answer during the interview so they can be addressed by his/her supervisor.

C. All answers and notes must be recorded on the questionnaire at time of interview

- Enumerators should not write on scratch paper or rely on making notes later

- All writing must be legible.

D. Account for all non-responses in detail

- It may be necessary to make estimates for missing data.

E. Significant events during interview should be recorded

- If noted, comments or circumstances of the interview may help the enumerator recall something later that will assist in clarifying questionable data.

F. Double check the questionnaire for completeness before the next interview

- Verify that the questionnaire is totally correct and complete

- Enumerators cannot expect to record notes at the end of the day. It is nearly impossible to remember all the situations and keep them straight once several interviews have been conducted in the same day.

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About the participants

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