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THE CASE OF BEEF IN NIGERIA

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

JOHNSON UDO OBOT

Norman, Oklahoma

1977

MOVEMENT AND THE REMOVAL OF NUTRITIONAL DEFICIENCIES:

THE CASE OF BEEF IN NIGERIA

APPROVED BY

DISSERTATION COMMITTEE

MOVEMENT AND THE REMOVAL OF NUTRITIONAL DEFICIENCIES:

THE CASE OF BEEF IN NIGERIA

BY: JOHNSON UDO OBOT

MAJOR PROFESSOR: GARY L. THOMPSON, Ph.D.

The purpose of this study was to evaluate the problem of food deficit and its consequential protein malnutrition in less-developed countries. Protein-caloric malnutrition in children causes marasmas and kwashiorkor. The malnourished children have stunted growth, protruding belly, pale color of the skin, abnormal reddening of the hair, swollen legs and feet, and accumulation of excessive fluid depending upon the severity of the deficiency. The high mortality rates in the one to four year-age old group suggest that protein malnutrition affects about fifty percent of the children. In adults it causes lethargy and poor motivation and can trigger off psychiatric illnesses.

Inadequate protein intake in these countries does not mean that protein foods are not produced in them. The problem is that their production is restricted because of adverse climatic conditions, poor technology and insect infestation. Solution lies in shipping high protein foodstuffs from production region to deficit areas. This requires capital, entrepreneurs, and experts for research, planning and development. The less-developed countries lack all these.

In order to analyze carefully the protein syndrome, Nigeria, was chosen as a particular example for investigation. In Nigeria the prevalence of Glossina, vectors of trypanosomiases, precludes successful animal husbandry in the southern provinces. It is only through costly and controlled schemes that animal husbandry can be practiced. The trypanosome-resistant dwarf Muturu and Ndama varieties raised in the south provide little meat and milk.

Supply of beef in the south must come from the northern Sahel zone that is tsetse free. Inefficient physical distribution management has made it impossible to transport and distribute beef cattle in the south. Consumers in this area prefer fresh beef to either refrigerated or canned meat. Live cattle must be shipped from north to south. The journey takes five weeks by foot, four days by truck and three days by train. The long journey coupled with poor feeding makes the cattle susceptible to diseases, such as, trypanosomiases.

The results are shrinkages, weight and death losses; and the meat that is obtained is masculature.

Increased protein intake in southern Nigeria can be encouraged if transportation and physical distribution managements are planned and developed in the country. Initially, the government should subsidize and supervise transportation of cattle from the north and distribution in the south. Later on the government should hand over the enterprise it started to the private sector so that profit motives may lead to efficient development and expansion. Overstocking of livestock by the Fulani should be discouraged by taxing hoarded herds. Food science education should be encouraged in all public places. Refrigerated meat should be included in all school and restaurant menu.

ACKNOWLEDGEMENTS

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MOVEMENT AND THE REMOVAL OF NUTRITIONAL DEFICIENCIES:

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CHAPTER I

INTRODUCTION

Movement and Food Deficits

Since the end of the Second World War the problem of

food deficit and consequent malnutrition in the less-developed

countries has commanded the attention of many social and nutri-

tional scientists. Their focus, however, has largely been on

increased production through mechanization, hybridization, irri-

gation, fertilization and other scientific means without consid-

eration of the movement and distribution of the already known

and available food products from areas of production surplus to

deficit areas. In 1946, the Food and Agricultural Organization

(F.A.O.) in its Preparatory Commission Report on World Food Pro-

posals stated that:

> . . . if nutritional standards are to be raised in
> accordance with the Copenhagen objectives, the deve-
> lopment and modernization of agriculture in the mal-
> nourished countries is essential. We recommend to
> such countries the early formulation of development
> programs, the establishment of any needed administrative
> machinery, and the seeking out of advantageous con-
> tacts in other countries. We recommend to the Food
> and Agricultural Organization of the United Nations
> the initiation of certain agricultural surveys, of
> clearinghouse activities for international inter-
> change of personnel, scientific material and infor-

1

mation, and of work on extension programs (advisory
services), and a rural welfare (F.A.O., 1947, p. v).

One author, recognizing the crisis proportions reached
by protein malnutrition in these countries, calls for increased
food supplies and emphasizes that: "All means for increasing
protein supply require better application of existing technologies
or development of new ones" (Altschul, 1974, p. 23).

Effects of Food Deficit

Protein deprivation concomitant with food deficit results
in lowered energy output, fatigue and inability to perform hard
work. The afflicted individual is apathetic, depressed, and
lethargic.

Food deficit and its consequential protein-caloric mal-
nutrition in children causes marasmas, a disease caused by cal-
oric deficiency, or lack of food; and kwashiorkor, a disease
that is caused by lack of protein in meals (Dema, 1965, p. 18).
The visible signs of protein deficiency are stunted growth, pro-
truding belly, pale color of the skin (the skin may begin to
flake and eventually open sores may develop), abnormal reddering
of the hair (the hair becomes pale and may fall out), swollen
legs and feet, and, or accumulation of excessive fluid depending
upon the severity of the deficiency (Brock and Autret, 1952, p.
15). The extremely high morbidity and mortality rates in the one
to four year-age group in the less-developed countries suggest
that moderate protein malnutrition affects, at least, fifty per
cent of these children (President's Science Advisory Committee,

1967, p. 17). In studies conducted in South Africa and Chile

it was found out that children who were severely deficient in

protein displayed significantly smaller head sizes and that

there was a significant correlation between cranial size and

(IQ) intelligent quotient (Read, 1969, pp. 12-14; Monckberg,

1973, p. 114).

The relationship of food deficit and its inevitable mal-

nutrition to physical growth and development is illustrated in

Figure 1. The growth of boys in five Far Eastern countries

(Bangladesh, Burma, Malaysia, Thailand, and Vietnam) is compared

with the growth of the lowest quartile of boys in Iowa as a re-

ference growth standard. At the age of five, it can be seen

that the heights and weights of the Far Eastern boys are below

those of the Iowa boys of the same age. Deficiency in food which

brings with it protein deprivation (though there may be other

causes) is the main reason for the difference.

Oomen (Rajalakshmi, 1973, p. 20) has added a new dimen-

sion to the problem of protein malnutrition. He reported the pre-

sence of nitrogenfixing bacteria in human intestine under con-

ditions of marginal protein supplies and their disappearance

with adequate protein intake.

HEIGHTS AND WEIGHTS OF BOYS IN SOME FAR EAST COUNTRIES COMPARED WITH REFERENCE GROWTH STANDARDS

WEIGHT

POUNDS

45
40
35
30
25
20
15
10
5

HEIGHT

INCHES

45

40

35

30

25

20

● — ● Malaysia
------ Burma
•••••• Thailand
—○— Bangladesh
— — Vietnam
———— Reference
Growth Standard

0 1 2 3 4 5 6

AGE (years)

Figure 1
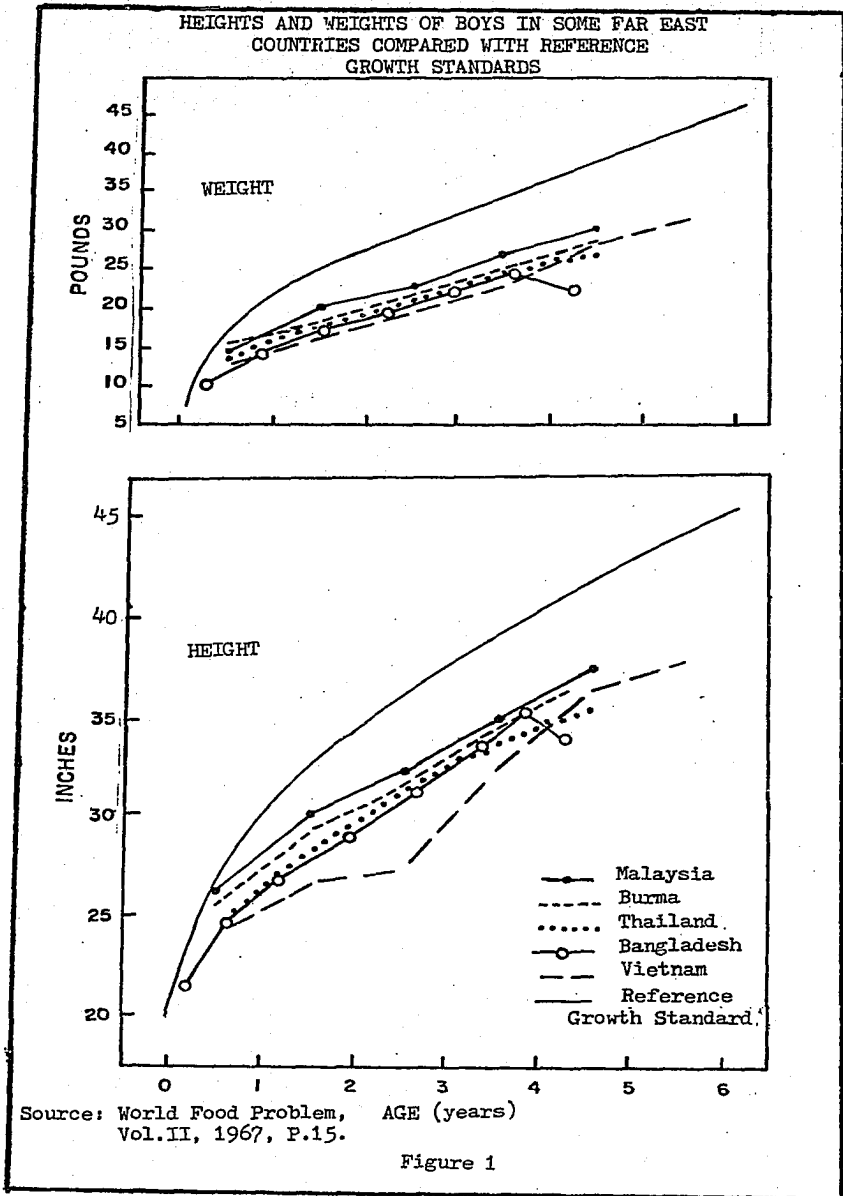
Suggested Action

While the situation is very precarious in many less-developed countries, Paarlberg finds a combination of factors which can be overcome with help from the advanced countries. He says that from the next decade or so the probability is good that total (world) food production will keep a half step ahead of population growth, but that there will be times and places of critical shortage (Paarlberg, 1974, p. 1). The United Nations World Food Conference in trying to find a solution to the food deficit problem in the less-developed countries concluded that:

> It [the World Food Conference] should combine a sense of immediate urgency with a long-run optimism that the developing countries, with assistance from developed countries, can achieve the necessary increases in food output while meeting more adequately the goals of rural development and social justice (United Nations, 1974, p. 5).

In India the common diets provide only eight to ten per cent of the required daily protein intake (Rajalakshmi, 1973, p. 20). A study at Maku (Southern Nigeria) showed that the people had a protein deficiency of about 12g/head/day (Dema, 1965, p. 87). In the Philippines the animal protein intake is approximately thirty per cent of the required minimum amount (Woolley, Jr., et al., 1972, p. 67).

Secretary General of the United Nations, U. Thant, in his 1971 annual address viewed the protein malnutrition problem as one of the great tragedies that besets less-developed countries. He suggested that:

> In the world today, there is a considerable body of

scientific knowledge, as well as the necessary tech-
nology, that could be used to reduce the severity of
protein malnutrition which affects hundred of millions
of people, particularly children. The principal need
now is to find means of accelerating the way whereby
scientific knowledge and technology is put to work for
this purpose. . . . Certainly much remains to be done
to close the gaps in scientific knowledge and in deve-
loping and adapting the necessary technology in various
aspects of protein problem. The scientific and tech-
nological obstacles and the work that must be pursued
cannot be underestimated (United Nations, 1971, p. IV).

Other experts think that the solution to the protein

malnutrition problem lies in the development of better cereal

varieties, increased use of fertilizers and related improvements

in agricultural practices (Milner, 1969, p. 97). These projects

need a long time for research and development. In the less-deve-

loped countries there is little capital for investment in research,

development, and advertisement; and the experts versed in such

research and development are difficult to find in the countries

that need them most.

Today, a more promising approach to the problem of pro-

tein malnutrition in the less-developed countries may lie in the

more efficient movement of existing perishable food commodities

from producing regions to deficit areas. The movement of food-

stuffs in the less-developed countries has unacceptable time-lags,

depending upon the type of transport mode used. These time-lags, es-

pecially when perishable food supplies are concerned, inhibit the es-

tablishment of efficient production-consumption systems in the third

world states. Unless entire systems are designed to transport and

distribute food supplies rapidly regional, specialization cannot occur

and surplus food areas are inhibited from further growth.

There has been a notable lack of research in the development of modern distribution systems in the less-developed countries. Movement is obviously fundamental to the removal of food deficits in many such countries. Food deficit represents a spatial imbalance in the afflicted economies. This spatial imbalance is empirically well illustrated by the statement that:

> The African situation is a dramatic illustration of wide variation among subregions and nations. The Savannah regions of West Africa have protein consumption levels of close to 70 grams per person per day. In comparison, in the Southeast Zone of West Africa, the protein intake approximates 43 grams, a level just slightly higher than the levels in the Congo and the Dominican Republic, the two countries included in the F.A.O. Indicative World Plan for Agricultural Development (IWP) study with the lowest per capital protein consumption (Schertz, 1971, p. 6).

Movement is the only means of correcting this kind of spatial imbalance. With increased accessibility offered by efficient transportation systems, movement can be speeded up and large areas of their perishable products can be tapped. The perishable product, in turn, can be marketed over great distances.

Without improved transportation, areas of high population are limited to the goods they can produce, and unproductive areas are left with a deficiency in their needs. Most areas in the less-developed countries suffer from food deficiency problem and its accompanying protein malnutrition because of poor and underdeveloped means of transportation. In order to supply food deficit areas in the less-developed countries with the deficient foodstuffs the development of an overall distribution system for the transportation of the needed foods from the production regions,

and the distribution of the products to the vulnerable groups
should be given priority over other development projects.

There are many examples in the less-developed countries
where lack of efficient transportation-distribution system has
frustrated well-intentioned efforts to supply the people with
badly needed foodstuffs. In many parts of the less-developed
countries intensification of agricultural production has often
been thwarted by poor quality and high cost of rural mobility.
The situation has been summarily stated that:

> In Thailand, partially used jungle land was trans-
> formed into highly productive, prosperous farms a-
> long the hundred-mile course of the Friendship High-
> way. Travel time was reduced from eleven hours on
> the road to three on the new. . . . In Bolivia, the
> highway from Cochabamba to Santa Cruz reduced travel
> time in the rainy season from several weeks to fifteen
> hours and provided a link between the country's food
> supplies and its consumers. Until then the price of
> Bolivian rice was 50 percent higher than imported rice
> simply because the cost of domestic transport was
> high. . . . In Costa Rica, before the Inter-American
> Highway was constructed, driving beef from grazing
> lands to San Jose customarily resulted in a 40 percent
> loss of weight, and imports were necessary to satisfy
> domestic market demand for beef. With an all-weather
> highway, it became possible to deliver cattle by truck-
> trailer units overnight and Costa Rica has become self-
> sufficient in meat (President's Science Advisory Com-
> mittee, 1967, p. 573).

In Nigeria the demands for general traffic in the early 1950's
have resulted in a backlog of peanut (groundnut) tonnage each
year and a quota system restricting the tonnage of peanut in
transit from the Niger Republic. The difficulty was due to in-
ability of the transportation system to move the goods (IBRD.,
1955, p. 467; Niven, 1971, p. 60).

The Problem of Food Deficits and

Distribution in Nigeria

In the opinion of many development economists and planners, the most pressing economic problems in the less-developed countries concern initiating and sustaining economic development and growth. A distinction should be made between economic development and economic growth. Kindleberger (1965, p. 3) states that:

Implicit in general usage, and explicit in what follows, economic growth means more output, and economic development implies both more output and changes in the technical and institutional arrange-ments by which it is produced.

Development is, therefore, a term that is more appli-cable to sustained increases in productivity in a lesser-developed country. For this to occur improve-ments in the basic social, economic, and physical infrastructures are required. Growth is a term more applicable to sustained increases in produc-tivity in an economy that is already advanced and has well established infrastructures (Dilisio, 1975, p. 21).

The goals of initiating economic development and sus-taining increases in productivity lie at the center of govern-mental policies in most of the less-developed countries. Con-cerns with the efficient allocation of resources and the equit-able distribution of social and economic resources are often secondary. The sense of urgency in development arises in part from the fact that economic development is gauged by the level of per capita income; and because:

The leaders of underdeveloped countries are being constantly tempted, by their own desires for pres-tige, by the pressures of local special interests and of special interests in aid-giving countries to give a high priority to projects which have a high

prestige value but a low real economic yield (Reid, 1965, p. 26).

This same view is expressed by another author, Alpert thusly:

> The drive [for economic development] was motivated,
> first of all, by the desire to break free from trad-
> itional subsistence way of life that suddenly become
> intolerable. But apart from this longing for the good
> things of life, which only the populations of the
> industrialized countries could afford to enjoy, a
> powerful incentive in the drive for development was
> the desire to achieve equality of status with the
> rich and powerful nations of the industrialized world.
> This desire was especially deeply felt by the youth,
> the most dynamic element of the nations awakening
> from their protracted lethargy (Alpert, 1963, p. 4).

To Goulet one of the general goals of development in the less-

developed countries is self-esteem. This conviction is echoed

in the statement that:

> Just as nineteenth-century Japan embarked on the
> path of industrialization to avoid humiliation by
> technologically and militarily superior "barbarian"
> powers, so nowadays the Third World seeks develop-
> ment in order to gain the esteem which is denied
> to societies living in a state of disgraceful
> "underdevelopment." Therefore, the conviction is
> gaining strength throughout the world that mass
> proverty cuts societies off from due recognition
> or esteem. Once deprivation reaches an intolerable
> point, people are quite ready to begin desiring
> material "development" (Goulet, 1971, p. 90).

These views are not held by all Western social scientists.

Kindleberger himself (1965, p. 3) points this out when he says:

"By analogy with human being, to stress growth involves focussing

on height or weight, while to emphasize development draws atten-

tion to the change in functional capacity – in physical coordina-

tion, for example, or learning capacity." Souza and Porter hold

a related view of development. They argue persuasively that:

> . . . genuine development will come through animal hus-
> bandry, hand plows, and donkey carts, not by tangible
> monumets to progress such as huge hydro-electric pro-
> jects, glittering airports, impressive buildings of
> state, and air-conditioned offices. . . . indigenous
> agricultural systems can contribute to relief of pov-
> erty and provide the basis for authentic development
> in the underdeveloped world, but only if governments
> are prepared never to turn their backs on the interest
> of small farmers (Souza and Porter, 1974, p. 6).

A sense of urgency should properly arise from a concern directed towards raising the living standards of the people. Higgins calls this "the human ascent." He urges that:

> Deficiencies in standards of food, clothing, and
> shelther must be eliminated: for this, both agri-
> cultural improvement and industrialization are
> necessary, as well as general education, better
> technical training, increase savings and invest-
> ment. And all this will require planning (Higgins,
> 1968, p. 369).

Any attempt to raise the living standards of the people in the less-developed countries should have the social and economic well-being of the people as a priority all over other objectives. This will then result in increased productive capacity of the people and the national economy. In stressing the need for nutrition and health in less-developed countries, Alan Berg (1973, p. 17) says that investment in human capital is probably the major explanation for increases in the national output of the Western countries.

The problem of food deficit in the less-developed countries has existed for a long period of time. But in recent years it has been noted that the population of the less-developed countries has been subject to overall food shortages and, or to

specific nutritional deficiencies (especially proteins). This
is due to the population increases which accelerated in the 1960's.
Commenting on this one geographer says:

> On the basis of the 1960 growth rate, the earth's pop-
> ulation will reach 135.8 billion by the year 2220, or
> about one person per square meter of land surface –
> certainly a catastrophic situation for humanity. The
> present growth rate of about 20 per 1000, an all-time
> high, portends a doubling of the earth's population
> within about 35 years, or an eightful increase in a
> century (Trewartha, 1969, p. 31).

Most of the recent increases in population take place
in the less-developed countries, where incomes are lowest and
malnutrition very frequent. In the industrialized western nations
population grows at an annual rate of 1.0 per cent, while growth
in the less-developed countries is about 3.0 per cent, and by
about the year 2,000 the less-developed countries will be gaining
population at the rate of 98 million in a year, seven eights of
the projected annual increase in the world as a whole (U.N., 1975a,
p. 3). Unfortunately, food production is not keeping pace with
the rising population.

During the last decade, there has been increasing aware-
ness of the extent and implications of the protein-caloric depri-
vation among the vulnerable groups. The Food and Agricultural
Organization of the United Nations estimates that 20 percent of
the population in the less-developed countries are undernourished
(have too little to eat) and 60 percent are malnourished (eat
the wrong types of food) (U.N., 1975a, p. 56). The United Nations
Committee on the Application of Science and Technology to Deve-

lopment summarily stated that:

> While the quantity of food (calories) is already
> causing considerable concern in many areas through-
> out the developing world, the quality (notably pro-
> tein) of the food consumption pattern is even more
> critical. For over one third of the present popu-
> lation in the developing countries the protein-cal-
> orie balance of the diet is inadequate (United
> Nations, 1968, p. 4).

The increase of protein (perishable) food intake in

the less-developed countries can be viewed as an explicit ex-

pression of the case of transportation development. A study by

the Food and Agricultural Organization of the United Nations

(F.A.)., 1966, p. 215) emphasized this when it said: "The low

average intakes are more probably the consequences of the lack

of availability or because the animal-protein foods are too high-

ly priced for certain groups." The present method of transport-

ing perishable protein foods in the less-developed countries is

very inefficient and inadequate.

Transportation in Developing Economies

There is, however, no consensus on the role of trans-

portation investment in developing economies. In any case, trans-

portation should not be conceptualized as an end in itself; rather

it should be a means to facilitate achieving other objectives.

In pursuance of this point three possible causal relationships

have been noted:

    (1) a positive effect on development process –
         the expansion in directly productive activities
         being a direct result of providing improved
         transportation facilities;

 (2) a permissive effect on development process,
   because transportation does not independently
   produce directly productive activities or sub-
   sequent increases in the level of economic growth;

 (3) a negative effect occurring when an overinvest-
   ment in transportation reduces potential growth
   in directly productive activity and, consequently,
   leads to an absolute decline in the level of in-
   come per capita (Gauthier, 1970, p. 613).

The state and national governments in the less-developed countries

must carefully consider the design and development of total dis-

tribution systems. A high level of productivity in a modern economy

cannot be achieved without heavy investment in such physical dis-

tribution systems, which may be composed of any feasible combina-

tion of transportation methods that provides an adequate and con-

tinuous flow of goods between producers and consumers (President's

Science Advisory Committee, 1967, pp. 573-574). Physical distri-

bution systems have been defined as:

> . . . the operation which creates time, place, and
> form utility through the movement of goods and persons
> from one location to another. The system encompasses
> all movement from the shipment of raw material to the
> final resting point of the finished product. Thus
> defined, it includes the physical facilities for in-
> tercity movement, physical arrangements for storage,
> and the terminal properties necessary to equalize
> demand and supply with respect to the size of the
> shipment (Mossman and Morton, 1965, p. 3).

  Some people feel that transportation network planning

must precede economic development - some say it follows, and

some say that it is concomitant. Hunter (1965, pp. 71-73) says

that transportation development was a precursor to the indus-

trial revolution (especially in the early stages) in Western

Europe. Hurst (1974, pp. 382-383) observes that conventional

Western attitude tends to view ample transport capacity as play-

ing the role of a prerequisite for economic development. Owen

(1964, p. 1) believes that it plays a key role in marketing of

agricultural commodities. Lloyd and Dicken (1972, pp. 89-90)

observe that transportation development increases areal special-

ization and emphasize that:

> Decline in the relative importance of transportation
> costs implies that other factors increase in signi-
> ficance. In particular, specialization of production
> on the basis of comparative advantage rather than mar-
> ket accessibility emerges, with a concomitant increase
> in areal specialization. In agriculture, for example,
> particularly favorable physical conditions can be ex-
> ploited, whereas their location relative to the market
> precluded their optimum use under less favorable trans-
> port conditions.

To some extent there can be reliance on the market mech-

anism for transportation development; but, since the organiza-

tion of transportation is a decision that rests on investment,

it must involve public policy. The difficulty envisaged in such

a reliance has been succinctly stated:

> Since private initative in this field is sure to
> prove woefully inadequate, government must bear the
> prime educational responsibility. It must also carry
> the burden of the new infrastructure investment
> (especially basic transport facilities), since the
> private sector is generally incapable of doing so
> except under politically untenable or economically
> undesirable conditions (Fromm, 1965, p. 3).

In the less-developed countries, the immediate task is to iden-

tify all of the urgent needs and then establish the order of prior-

ities in which the improvements should be undertaken to achieve

the much needed results. The development of efficient trans-

portation-distribution systems is one aspect of the infrastruc-

ture in urgent need of attention.

Since the decisions to invest in transportation are not easily reversed nor as readily corrected as in those sectors with facilities that wear out easily, or can be built in small increments, care should be taken before any investment is undertaken (Gauthier, 1970, p. 614). The decision to invest in a transportation enterprise involves a great deal of risk-taking so that the investor must exercise a great deal of study and care before plunging into this type of business. Too much investment in transportation may lead to a frittering away of resources that can be used elsewhere, and too little investment in transportation may hinder the rest of the economy.

During the past three decades physical distribution management has emerged in the Western countries as a major concern of business operations for the delivery of goods, in correct quantities, to consumers at different places, and in good condition at the lowest possible total cost. Perishable protein foods cannot be delivered to vulnerable consumers in less-developed countries unless physical distribution management is well planned and developed. The importance of this has been briefly stated:

> Production can build a high-quality product at the
> lowest possible unit cost. It remains for physical
> distribution to ensure that the right product is
> at the right place at the right time (Bowersox, 1974,
> p. 35).

The importance of physical distribution systems in developing economies is vividly described at the last section of this chapter.

Bases of the Problem

Millions of people in the less-developed countries never get enough to eat, and much larger number, although not actually hungry, do not get the right kind of diet necessary for good health (F.A.O., 1947, 1968; U.N. World Food Conference, 1974; U. S. Dept. of Agriculture, 1974). The situation has been illustratively stated:

> Tied in with the shortage of food for these people
> and others like them is the shortage of the right
> type of food, the kind that provides the proper
> amount of nutrition so necessary to a person's diet.
> For just as the lack of food can weaken, maim and
> destroy, so too, can a shortage of protein, vitamins
> and other nutrients (Givaudan Flavorist, 1973, p. 1).

The technological revolution, which has brought about rapid and self-generating economic growth and development in the advanced countries, has had one critically important effect in the less-developed countries--the reduction in the death rates in the population. Soon after the Second World War, the introduction of Western medicine for the prevention and cure of malaria and the use of vaccines to eradicate epidemic diseases, such as, smallpox and measles, led to increases in the longevity and life expectancy of the people in the less-developed countries. To illustrate this, one author stresses that:

> This startling phenomenon, "the population explosion,"
> as it is called, arises primarily from medicines'
> advanced techniques of "death control." Medical
> discoveries of the past decades have made possible
> sensational reduction in the death rate. The sys-
> tematic, large-scale use of antibiotics, sulfa drugs,
> DDT, and other insecticides has led to control of
> infectious diseases to an extent and with a speed
> previously impossible. In some less developed

countries death rates have fallen at a tremendous
rate – three to five times as fast as they did in
19th Century Europe (Wilcox, 1960, p. 860).

In most of the less-developed countries, the decrease
in the mortality rates has not been accompanied by a decline in
the birth rates. Consequently, it has created an unprecedented
occurrences of high rates of population growth. The less-deve-
loped countries of the world now contain about two-thirds of the
world's population (President's Science Advisory Committee, 1967,
p. 5). Food production in these countries seems to be barely
keeping pace or falling behind these burgeoning populations.
Though they may plant more acres or grow more food, there are
more and more people to feed. Rural populations are extremely
vulnerable due to a complex of factors including low incomes
and formidable transportation-distribution problems.

The increasing food deficit problem in the less-developed
countries arises from the uneven distribution of food supply
among countries, within countries, and among families with dif-
ferent levels of income. The spatial variations in protein in-
take are inevitably reflected in variations in personal incomes
received by the population. Birch (1968, p. 594) in a provoca-
tive paper questions why malnutrition is a curse for certain
groups in societies with an abundant and often enriched food
supplies. Lack of money and education (information) are his
only answers. The position that poverty, low education, and
culture are associated with protein malnutrition and its con-
sequent deterioration of physical and social conditions have

been substantiated by Delgado, et al. (1961), Jeans, et al.

(1952), and Mayer (1965). Here, this author adds that ineffic-

ient transportation-distribution system causes the greatest dif-

ficulties in the delivery of quality perishable foods to both

the urban and rural areas in the less-developed countries.

Of the low per capita incomes in less-developed countries,

half or more may be spent for food. Income-food expenditure re-

lationships reflect a hierarchy of cultural preferences ranging

from the most highly desired foods to the least popular. Income-

food expenditure relationships are often measured by income elas-

ticities which express the ratio of the percentage increases in

consumption of a given food to a percentage change in income.

In the third world, income elasticities are lowest for roots and

tubers. They are a little higher for coarse grains and progress-

ively higher for other cereals, pulses, fruits, vegetables, and

animal products. The diets of many people in Southern Nigeria

are biased towards starchy foods with little or no intake of

animal proteins.

Basing judgment on the work of Mottram and Graham (1941,

p. 76), who have concluded that no food should be counted as a

protein food unless it contains at least ten per cent protein,

the protein deficiency in the less-developed countries is not

only acute but chronic. Their criterion excludes all of the

leaf, root, seed vegetables, and fruits that make up the bulk

of the daily diets of the people in these countries. Support

for the above statements can be assessed through a nutritional

value analysis of the different sources of protein:

> The life-sustaining characteristics of the various
> sources of protein may provide a partial explanation.
> Animal proteins have a high biological value in the
> sense that by themselves they can sustain life and
> promote normal growth in the human being. Proteins
> from other sources have a low biological value; by
> themselves they cannot sustain life, let alone pro-
> mote growth (Belli, 1971, p. 19).

Assumptions of the Study

In order to supply the food deficit areas in the less-
developed countries with the badly needed protein-rich foods,
an interregional trade in perishable food supplies has developed
between the production regions and the deficit areas. The re-
liance on this trade to supply the protein-rich perishable food-
stuffs depends on how fast the perishable products can be shipped
fresh to the deficit areas. The development of this trade is
well illustrated by the Heckscher-Ohlin Theorem. The Swedish
economist, Elis Heckscher, and his student Bertil Ohlin, hypo-
thesized the factor endowment proportion and trade predominance,
which was developed as an alternative to the then prevailing
classical comparative-cost theory. The theorem quoted succinctly
reads:

> International (in this case interregional) trade
> results from (a) different production factor endow-
> ments from north to south, and (b) the different
> factor intensities of production processes for ·
> different goods. Exports from any one particular
> region comprise those goods in whose production a
> predominant quantity of relatively abundant factor
> is employed, and its imports include such commod-
> ities that predominant amounts of factors scarce
> in that area are used (Ohlin, 1933, p. 29).

In Nigeria there is regional specialization in both ex-
port and domestic agricultural production due to natural factor
endowments, and cultural differences. For example, in the West
the Yorubas raise cocoa, the Edos in the Midwest produce rubber,
and the Annangs in the Southeast concentrate on palm oil produc-
tion. In the Northern Region the Hausas, the Kanuris, and the
Nupe cultivate cotton and peanuts (groundnuts), while the Tiv
of Middlebelt produce sesame. The Cow Fulanis, who occupy the
Sahel region, produce the only source of beef in the country.
Most regions, because of either poor soil, harsh climate, or
disease infestation, cannot produce badly needed protein food-
stuffs. This is typified in the case of beef cattle that hardly
survive in the Southern Provinces because of the prevalence of
tsetse fly that causes trypanosomiasis in the animals. A new
dimension was added with the discovery of endemic infection of
the southern soil with claustridia group of anaerobic organisms
that infest and kill livestock at Obudu Ranch.[1]

Needleman has written of the inability of a region in a
nation to supply most of its own needs. He postulated that
trade between regions is due to insufficiency of certain commod-
ities:

> Regions are less self-sufficient than nations, so
> that trade is even more important for regions than

---

[1]The information here was obtained by letter communicated
dated 3rd March, 1975 from the Assistant Manager of Obudu Cattle
Ranch, Obudu, Ogoja, Nigeria.

nations. But though the importance of interregional
trade was recognized early and indeed was emphasized
in the title of a seminal work on trade theory,
Bertile Ohlin's Interregional and International trade,
1933, most of the theoretical work and almost all of
the empirical studies on trade have explicitly con-
centrated on trade between nations rather than between
regions. Part of the explanation is that the policy
problems associated with interregional trade were much
less obvious and apparently less urgent than those
arising from international trade (Needleman, 1968, p.
235).

It is further hypothesized that the dualistic nature of

the economies of many less-developed countries is real, exist-

ing in the form of a subsistence-export economy. This dualism

also reveals a spatial aspect called "Regional Inequality" by

Myrdal (1957, pp. 23-28). The nature and degree of geographical-

economic dualism depends not only on the stage of the local econ-

omic development, but also upon the spatial processes of the dif-

fusion of important innovations, such as, Western education,

religion, technology, and communication-transport facilities.

In the less-developed countries cultural characteristics depend

on a variety of factors: (1) urban or rural setting; (2) the

impact of formal education; (3) social organization and religion;

(4) resource base and the stage of technological development;

and (5) remoteness and resistance to cultural change. Hence,

less-developed countries of the world are characterized by

varied cultural patterns; some regions have traditional ways of

life while others adapt more readily to new technologies and

new forms of social organization.

Objectives

The increase in the demand in Nigeria for high protein

foods due to increasing population, urbanization, rising incomes,

and heightened nutritional awareness caused by what Nurkse (1970,

pp. 63-67) calls "demonstration effect,"[2] has not stimulated in-

creases in the efficiency of transportation and distribution of

perishable protein foods from production to demand regions.[3]

Meat is therefore scarce and highly priced in such deficit areas

as southern Nigeria. The question of concern here is: How can

the inadequate supply of perishable (protein) foods, such as,

beef, be increased in southern Nigeria so that protein malnutri-

tion may be eliminated among the vulnerable consumers" Increased

protein food supply is only possible through increased efficiency

in transportation and physical distribution management. Efficient

transportation and physical distribution management will result

in increased capacity, and this will help to reduce costs of

supply. Lowering cost of supply will lead to increased consump-

tion of the badly needed protein foods.

---

[2]Demonstration effect here can be seen as the dependence of
every individual's consumption behavior on that of every other
individual. The situation is well illustrated when it is argued
that: In given circumstances, the individuals in question come
into contact with goods superior to the ones they use with a cer-
tain frequency. Each such contact is a demonstration of the
superiority of these goods and is a threat to the existence of
the current consumption pattern. It is a threat because it makes
active the latent preference for the goods (Duesenberry, 1949, p. 26).

[3]Railroad extension has been attempted in the country and
the use of trucks for hauling is on the increase but protein de-
ficiency still persists. The difficulty here is that of ineffi-
cient physical distribution management.

There is no evidence of a world-wide shortage of quality (protein) foods in Nigeria. There is a large production of livestock and livestock products, especially meat; and Nigeria can be self-sufficient in meat production (U.S. Dept. of Agriculture, 1972, p. 45). The problem of food deficit and its accompanying severe protein deprivation can be seen as an expression of lack of efficient transportation and physical distribution management in the country (Anthonio, 1966, p. 81).

In the past perishable (protein) foods were available during traditional festivities (Ferguson, 1967, p. 7; Ilori, 1972, p. 57). For example, in Benin, many cows were trekked into villages during the time of the ceremony marking the burial of a chief or a wealthy citizen (Ryder, 1969, pp. 313-314). Cows were also slaughtered during the celebration that accompanied the fattening of a girl for betrothal. This practice was very common among Ibibios in Southeastern Nigeria and until the late 1960's the people of Ika were still pratising virgin girl fattening ceremonies before marriage. Today, these traditional festivities are no longer held and local consumers with poor purchasing power have less perishable protein foods available to them. This situation will continue for long unless adequate physical distribution systems are planned and adopted. The delivery of perishable protein foods to southern Nigerian consumers (i.e., at least, or lesser cost solution) is very important and urgent.

It is, therefore, the purpose of this research to:

(1) evaluate the present cost characteristics of the different

modes of transporting and distributing perishable protein foods

from the production region to the deficit areas in Nigeria, (2)

develop a possible solution to provide a more economical means

of transporting perishable protein foods to the most vulnerable

consumers (i.e., allocate protein food shipments from origin

(in the north) to the deficit areas (in the south) so that trans-

portation costs and delivery times may be minimized."

Investment in alternate means of preservation, such as,

freezing, freeze-drying, smoking, and canning are ruled out when

Nurkse (1970, p. 7) stresses that: "The inducement to invest is

limited because of the size of the market." Freezing, freeze-

drying, smoking, and canning would produce new meat that would

require an additional educational process in order to orient the

consumers to the new foods. Moreover, there would be value added

to the processed products, and the added transportation costs

would further limit the ability of the low-income consumers to

buy the products. For the poor and least able to afford costly

protein-rich foods the best solution lies in the movement of the

already available beef cattle from northern to southern Nigeria.

For this to be successful well planned physical distribution

systems are added.

Modern Distribution Management

In recent years there has developed a considerable inter-

est in new business management techniques that address the hither-

to neglected area of physical distribution. In the past, when
other areas of business operations (production, purchasing, ware-
housing) have been subjected to the most careful scrutiny and
appraisal, physical distribution has been either neglected; view-
ed as a cost center, or an inevitable source of profit erosion
(Christopher, 1971, p. 1). Today, physical distribution systems
constitute a major functional factor in the economies of indus-
trialized nations.

Integrated physical distributions systems have allowed
the modernization of western economies as opposed to the tradi-
tional systems in less-developed countries. Physical distribu-
tion systems are largely the result of planning within the frame-
work of western corporate management systems. Central economic
planning requires similar systems planning to move goods from
surplus regions to points of consumption. In Third World "prob-
lems of physical distribution are often brushed aside as matters
of little importance" (Bowersox, 1974, p. 2). One major defic-
iency of traditional physical distribution has also been blamed
on its lack of integrated treatment (Bowersox, et al., 1968, p.
102). In Nigeria physical distribution systems are so fragmented
that both planning and development of the total system are pro-
hibited.

A properly designed physical distribution system can
help in the generation of sales by: (a) minimizing out-of-stock
occurrences, (b) reducing customer inventory requirements, (c)
solidifying supplier-customer relationships, (d) increasing de-

livery discount to customers, (e) enabling expanded market cover-

age, and (f) allowing greater concentration on demand creation

(Bowersox, et al., 1969, p. 62). In order that all these can be

fulfilled the logistical system should be designed to minimize

transportation cost in relation to the total system cost (Bowersox,

1974, p. 20). That physical distribution systems play a major

role in business management as well as contribute to a very high

level of consumption in the Western countries has been stated:

> In a practical sense, physical distribution is concerned
> with directing the desired assortment of products to the
> right place, in marketable conditions, in a manner timely
> to sales or processing requirements. Physical distribu-
> tion then engages the management of product flow. In the
> livestock and meat industry such physical distribution
> flow originates with the initial transport of livestock
> and ends when a particular cut or assortment of meat is
> sold for consumption (Bowersox, et al., 1969, p. 69).

Physical distribution is founded on the basically simple

discovery that the costs of storage and of movement are closely

interrelated; and that it is only by dealing with them together

as a single unified activity can the potential of each of them

contribute to the overall objectives of movement and distribution

(Wentworth, 1970, p. 35).

In the past, once a manufacturer sold a product to a

wholesaler, the wholesaler pushed the product forward to the

retailer, who in turn pushed the product to the market (ultimate

consumer). This "push" philosophy has changed to a marked de-

gree as a result of the various manufacturers being attuned to

customers needs and wants. In the Western countries, today,

major producers have adopted a "pull" philosophy, which primarily

involves manufacturers preselling the product to the ultimate
consumer who in turn searches retail outlets for the product
(Davis and Brown, 1974, p. 229). This is impossible in less-
developed countries because of poor communication media.

Moving and sorting goods on their way from production
points through various subassemblies and assemblies to their
ultimate consumers cost a lot of money. Presently, the cost of
moving and sorting goods is the third highest in all business
operations; it is surpassed only by costs of materials and labor.
The high cost has cut into profit margins, and a new attack is
launched on physical distribution for purposes of achieving some
savings.

Since physical distribution is fundamentally concerned
with the spatial aspects of business operations, it is under-
standable that the primary emphasis is placed upon geographical
arrangements of exchange facilitites (Bowersox, et al., 1968, p.
56). Figure 2 (Structure of distribution channels) shows the
channel structure of a typical distribution system. It can be
noted from the figure that raw materials from production loca-
tions 1-3 are transported to the processing or manufacturing
center. After processing the goods are shipped in bulk to stor-
age where they are stored or sorted before being shipped to the
warehouse. The warehouse operation is essentially a break-bulk
and, or regrouping procedure. Describing this operation it is
said:

    . . . individual carloads of separate commodities may

Strucuture of Distribution Channels
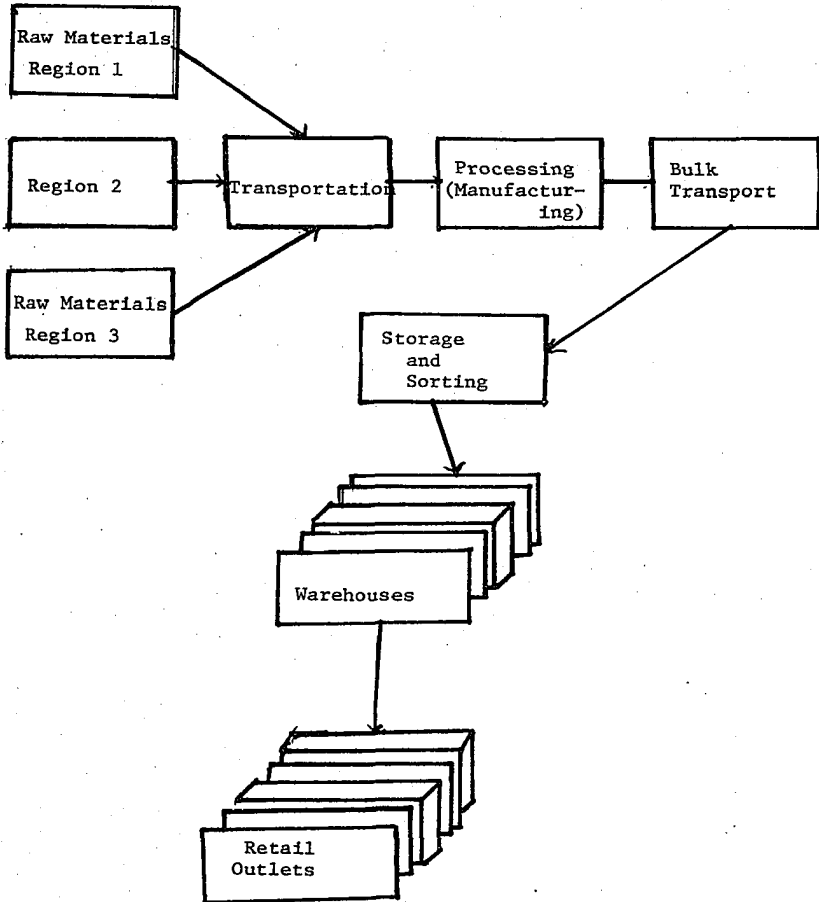
Figure 2

> come in from many separate origins and be placed in the
> terminal for temporary storage; they are then reassembled
> in smaller quantities, still as individual commodities,
> but each outbound shipment will constitute a volume move
> (Mossman and Morton, 1965, p 236).

The warehouse (break-bulk and reassambly terminal) is often loc-

ated near the market (center of demand-cost for a distribution

region) and away from processing points (Attwood, 1971, p. 27).

Goods shipped from the warehouse go to wholesale or retail agents

from whom customers buy their needs. This does not mean that the

answer to efficient physical distribution lies in the location

of more warehouses. Increasing the number of warehouses in a

system increases the operating costs (Attwood, 1971, p. 27). It

may, on the contrary, mean fewer warehouses. It can mean the

use of whole truckload instead of the more costly less-than-truck-

load (LTL) shipments. Or it may mean the use of truck, boxcar,

or van trailers as a rolling warehouse if the transportation com-

pany can be relied upon for dependable deliveries.

Importance of the Study

There are many interrelated determinants of human well-

being. Good nutrition is one of them, and can be a precondition

to the development of other factors of production. It can be a

propellant to higher economic achievement levels. Malnutrition

may be viewed as a consequence of less-development (Aylward and

Jul, 1975, p. 16). It is also a drag on the potentials from

which national development can be directed. A well-nourished

population is a significantly important factor in the economic

development of any nation.

In Nigeria problems of balanced diet exist. The danger
inherent in such a qualitative (or animal protein[4]) food defic-
iency has been succinctly put by a United Nations panel of ex-
perts. They say:

> Protein malnutrition is an important cause of infant
> and young children mortality, stunted physical growth,
> low work output, premature aging and reduced life span
> in the developing world. Recent research has also re-
> vealed a link between malnutrition in infancy and early
> childhood and impaired learning and behavior in later
> life. . . . The direct and indirect costs of malnutri-
> tion to the economy are often more than would be required
> for prevention (United Nations, 1971, p. 18).

In 1962 the F.A.O. Committee established the level of safe prac-
tical allowance of protein intake at between 0.66 and 0.84 g/kg/day
(grams per kilogram of body weight per day). It depends upon
the diet regime of the country whether or not the minimal re-
quirement of 0.33 g/kg/day can be met.

The F.A.O. study in many less-developed countries in 1965
proved that countries, such as, India has a daily protein intake
of 50 grams, Nigeria has 51 grams, and Surinam has 45 grams as
compared to 90 grams in Australia, 91 in the United States and 92
in Denmark. Protein malnutrition in Nigeria seems deceptively
straightforward and the temptation to simplify and overlook it

---

[4]Animal protein is high quality protein because it supplies
all the essential amino acids (leucine, isoleucine, valine, lysine,
histidine, tryptophan, methionine, threonine, and phenylalaning)
in near optimal proportions. The term 'high quality' is used here
because proteins from animal sources are usually complete, not be-
cause proteins with full complements of amino acids are exclusive-
ly derived from animal sources (See the World Food Problem, Vol. II,
p. 302).

is almost irresistable. The United Nations has summarized the

dangers involved because of the wide gap existing in protein

consumption in less-developed countries. It states that:

> The gap between nutritional requirements and the actual
> consumption of protein by greater part of the popula-
> tions of the developing countries is widening rapidly.
> Protein deficiency already has serious consequences for
> the health and working efficiency of the population of
> the developing countries. If the situation worsens,
> the physical, economic, social and political develop-
> ment of the populations involved may be completely
> arrested. Protein-calorie malnutrition not only in-
> creases susceptibility to acute and chronic infections,
> but also causes a compensatory reduction in the capacity
> for physical activity and promotes apathy. The direct
> effects on adult populations impede the economic pro-
> ductivity and development of countries which are des-
> perately in need of improving the status and potential
> of their people, quite apart from human suffering in-
> volved (United Nations, 1968, p. 4).

The average animal protein consumption in Nigeria shown

by the United Nations survey above is misleading because con-

sumption varies with real income or purchasing power, and the

seasonal fluctuation of perishable protein food supply in south-

ern Nigeria. It can now be asked: How can perishable protein

food items be moved from the production region in Northern

Nigeria for distribution in the deficit areas in the Southern

Provinces at a reasonable speed so that the cost is at a min-

imum and perishability eliminated? The adoption of efficient

transportation-distribution systems will not only improve in-

terregional trade on perishable food supplies in the Southern

Provinces, but will also reduce shrinkages (parasitic attacks,

weight and death losses). These measures will result in what

Janelle (1968, pp. 5-10) has called time-and-cost-space con-

vergence. The decline in the relative importance of transporta-
tion costs will lead to increases in the significance of other
factors of production. This is particularly due to areal special-
ization of production which is based on the principle of compar-
ative advantage (Lloyd and Dicken, 1972, p. 89). Eventually
this will bring about time- × -cost-and-space convergence, and
will result in increased animal protein intake in the Southern
Provinces of Nigeria.

With modernization, people in Nigeria abandoned the rela-
tive security of hunting and gathering foods from the forest and
relied on the uncertainty of the cultivated farms. This makes
the adequacy of food supplies an appropriate concern of the
Nigerian government, and any action taken by the national govern-
ment to assure regular flow of high protein foods from the nor-
thern production region to the deficit areas of the south at
reasonable prices should be accepted as proper.

Summary

In this chapter a survey of the problem of food deficit
and the consequent protein malnutrition in the less-developed
countries has been undertaken. It is now well known that pro-
tein malnutrition has reached crisis proportions in these coun-
tries and that the human sufferings from it needs immediate atten-
tion. The existence of protein malnutrition in the less-deve-
loped countries does not mean that protein foods are not produced
in most of these countries. The problem is that the production
of perishable foods in less-developed countries is restricted

to limited areas because of insect infestations (e.g. tsetse fly). The immediate solution to increasing perishable protein food supply in the deficit areas in the less-developed countries is the movement of these foodstuffs from the production region to the deficit areas.

In order to view carefully the position of protein deficiencies in the less-developed countries one country, Nigeria is chosen as a particular case for investigation. Nigeria provides an excellent laboratory for analyzing the present perishable protein food distribution system in the less-developed countries. In order to use Nigeria as a case study it is wise to look at the present pattern of perishable food production and consumption in the country. In Nigeria the prevalence of tsetse fly which causes trypanosomiasis in cattle precludes any good animal husbandry in southern Nigeria. Cattle raising is practiced in the northern Sahel Zone that is tsetse free. Supply of beef in the south must come from this area. Inefficient physical distribution management has made it difficult to transport and distribute beef cattle to consumers in the Southern Provinces. In the following chapter this problem is examined in depth.

CHAPTER II

PROTEIN PRODUCTION AND CONSUMPTION--

NIGERIA AS A CASE STUDY

Protein Malnutrition in Nigeria

The presence and persistence of serious malnutrition

in many parts of Nigeria have long been recognized (Dema, 1965,

p. 30; Nicol, 1959, p. 307). The prevalence of such chronic

malnutrition is caused by shortages of foodstuffs in many parts

of the country. In particular, there is marked deficiency of an-

imal protein in the Southern Provinces (Floyd, 1969, p. 239;

Oyenuga, 1967, p. 12). Two foreign experts who have investi-

gated the malnutrition problem in Nigeria emphasized that:

> The consensus of medical opinion, as well as such few
> records as were available [for] investigation into
> nutritional standards, suggest that the large majority
> of Nigerians suffer to a greater or lesser degree from
> undernutrition and ill-balanced diet. Although the
> nature of the dietary deficiencies varies greatly as
> between the Northern, Eastern and Western Territories,
> and almost from Province to Province and month by
> month within the Provinces according to the nature
> of the agriculture and the general income level,
> there is common to all a serious shortage of pro-
> tein (Shaw and Colvile, 1950, p. 69).

The dietary patterns vary considerably within and among

broad geographical areas. In his study of agriculture in

Nigeria Oyenuga (1967, p. 12) observed this spatial pattern when

he concluded that: "It is very well known that a serious short-

35

age of animal protein exists in Nigeria, and that the shortage

is more acute in the south than in the north." In a study of

the "Protein Requirements in Nigerian Peasants" in different

communities, the spatial patterns of protein deficiences were

noted. The observer stated that:

> The mean intake of men and women over 12 years of
> age in the grain-eating areas (Jarawaji, Tangaza,
> Bunga, Tunga Maidubu and Langai) was 85 g. protein
> which scored 77, whereas in yam-eating areas (Bero-
> Okuta and Mbanege) the respective figures were
> 51 g. and 50. The grain-eating groups consumed
> between 1 and 2½ times the safe practical allow-
> ance. The diets of the yam-eating communities
> provided a little more protein than the minimum
> requirement, but in no instance did they supply
> the safe practical allowance (Nicol, 1959, p. 311).

From Table 1 it can be seen that there is an absolute

shortage of animal protein in Southern Nigeria. At Bero-Okuta

(Southern Nigeria) the computed total daily intake is 51.99 g.

as compared to 112.33 g. at Jarawaji in Northern Nigeria (Nicol,

1959b, pp. 309-310). The daily food intake in the Southern

Provinces is unbalanced, being heavily biased towards starchy

food such as cassava (Manihot esculenta) cocoyam (Colocasia),

rice (Oryza sativa), and yam (Dioscorea); and lacking in animal

protein. Cassava provides 0.30 g. of protein intake daily and

yam provides 34.01 g. The quality of this protein is of poor

quality as compared with 22.12 g. from fish and 3.47 g. from

beef in the Northern Provinces. Meat (antelope) provides only

0.08 g. at Bero-Okuta. Most of the food eaten in the Southern

Provinces are deficient in some amino acids. For example,

cassava the commonest food, provides 13 mg. of lysine and 2 mg. of

TABLE 1

COMPUTED MEAN DAILY PROTEIN AND AMINO ACID INTAKE OF ADULTS

AT BERO-OKUTA IN SOUTHERN NIGERIA

Foodstuffs	Amount (g)	Protein (g)	Nitrogen (g)	Iso (mg)	Leu (mg)	Lys (mg)	Met (mg)	Sulphur (mg)	Phe (mg)	Thr (mg)	Try (mg)	Val (mg)
1. Cassava (Manihot esculenta)	20	0.30	0.05	9	13	13	2	6	9	9	4	10
2. Cheese (sour)	2	0.70	0.11	41	75	59	19	25	38	33	7	40
3. Green leaves	19	0.48	0.08	23	29	20	4	7	14	8	5	19
4. Groundnuts	3	0.77	0.14	35	77	29	7	21	41	25	10	41
5. Kola nut (Cola Acuminata Schott)	11	0.99	0.19	59	83	47	16	39	60	42	15	56
6. Locust bean (Parkia clappertoniana	4	1.63	0.26	84	161	120	12	22	80	35	14	80
7. Maize (Zea Mays)	24	2.28	0.36	104	292	65	42	71	102	90	14	115
8. Mango (Manfifera indica)	18	0.13	0.02	4	6	16	1	2	4	4	2	4
9. Meat (antelope)	4	0.80	0.13	43	67	71	20	30	33	36	9	45
10. Okra (Hibiscus esculentus)	19	0.61	0.10	24	34	26	8	14	22	22	6	30

TABLE 1 (Continued)

Foodstuffs	Amount (g)	Protein (g)	Nitrogen (g)	Iso (mg)	Leu (mg)	Lys (mg)	Met (mg)	Sulphur (mg)	Phe (mg)	Thr (mg)	Try (mg)	Val (mg)
11. Peppers (Piper Nigrum)	3	0.04	0.01	2	2	3	1	1	3	3	-	2
12. Pumpkin (Cucurbita maxima)	1	0.27	0.05	15	21	12	5	10	15	8	5	14
13. Sorghum (Sorghum Vulgare)	81	8.18	1.31	445	1315	223	141	277	407	293	92	468
14. Tomato (Lycopersicon esculentum)	3	0.03	0.01	2	3	3	-	-	2	2	1	2
15. Yam (Dioscorea)	1417	34.01	5.44	1632	2872	1676	500	620	1496	1153	588	1540
TOTAL		51.99	8.40	2522	5050	2383	778	1145	2326	1763	772	2466

Source: Adapted from Nicol, 1959b, p. 310.

Iso = Isoleucine	Leu = Leucine	Lys = Lysine
Met = Methionine	Phe = Phenylalanine	Thr = Threonine
Try = Tryptophan	Val = Valine	- = Negligible

methionine whereas sorghum which is common in the north provides

1955 mg. of lysine and 1242 mg. of methionine.

The overall food consumption in Southern Nigeria has

been summarized:

> Daily per capita food consumption (1959-61 averages)
> was estimated at 2,450 calories, of which 1,147 were
> derived from starchy root crops (cassava, yams, coco-
> yams, and so on), 768 calories from grain (sorghum,
> millet, corn, rice and wheat flour), and 232 calories
> from vegetable oils (mostly palm oil). Only 27 calories
> were obtained from meat and 7 from fish . . . Though
> the average Nigerian diet is adequate in calories,
> it is deficient in proteins (United States Dept. of
> Agriculture, Economic Research Service, 1972, p. 37).

The affluent minorities of the urban population enjoy balanced

diets. Income level is a major determinant of diet quantity

and quality. Nutritional status is affected by economic prob-

lems arising from low and irregular income and the pressure of

large families (Delgado, et al., 1961, p. 349).

Higher income levels in urbanized areas have important

effects on the pattern of the type of food purchased. Increases

in income results in increased consumption of higher protein

foods. However, there are malnourished urbanites. Mayer (1965,

p. 161) has concluded that the difficulty here lies in the earn-

ing power of the poor in the urban areas. Jeans, et al. (1952,

p. 28) in their study of students' wives in urban areas emphasized

that the students' expectant wives, with a few exceptions, follow-

ed as well as finances permitted the dietary instructions given

by their doctors in their early pregnancy. It is, therefore,

the purchasing power that determines the level of consumption

even in urban areas. "As might be expected, the nutritional status of poor people is generally poorer than that of the wealthy" (U.S. Senate Select Committee, 1974, p. 840).

In the north, the supply of foodstuffs includes Guinea corn (Sorghum vulgare), lima beans (Phaseolus lunatus), millet (Penninsetum typhoideum), meat and milk. Table 2 shows that the mean daily beef consumption in the North provides 3.47 g. while whole milk gives another 3.32 g. (Nicol, 1959b, p. 309). It has been observed that these diets provide the people with about two and a half times the minimum daily protein require-ments (Nicol, 1959b, p. 311).

Mottram and Graham (1941, p. 76) in their analysis con-cluded that foods with less than ten per cent protein should not be considered high quality (protein) foods. This underscores the chronic protein shortages in Southern Nigeria because it ex-cludes all of the leaf, roots, vegetables, and fruits that make up the bulk of the daily diets of most Southern Nigierians. Sup-port for the above statement can be assessed through a nutrition-al analysis that finds similarities between the composition of the human body and those of animal proteins. The analysis con-cluded that:

> Because there is a great similarity between the chem-
> ical composition of the human body and that of animals,
> the eating of animal proteins is a very efficient method
> of acquiring all the essential amino acids. Animal pro-
> teins include meat, fish, poultry, eggs, milk, and cheese.
> Such foods contain the essential amino acids in the
> amounts and proportions required by the human body. They
> are sometimes called complete protein foods. . . . It
> is necessary, therefore, to consume a variety of these

TABLE 2

COMPUTED MEAN DAILY PROTEIN AND AMINO ACID INTAKE OF ADULTS

AT JARAWAJI IN NORTHERN NIGERIA

Foodstuffs	Amount (g)	Pro-tein (g)	Nitro-gen (g)	Iso (mg)	Leu (mg)	Lys (mg)	Met (mg)	Sul-phur (mg)	Phe (mg)	Thr (mg)	Try (mg)	Val (mg)
Beef (fresh & dried)	15	3.47	0.56	183	287	306	87	131	144	155	41	194
Cassava (Manihot esculenta)	11	0.16	0.03	5	8	8	1	3	5	5	2	6
Cow pea (vigna senensis)	13	3.04	0.49	148	229	199	47	87	160	121	29	173
Desert Date pulp (Balanites aegyptica)	3	0.02	-	-	-	-	-	-	-	-	-	-
Egg plant (Solanum melongena)	1	0.04	-	-	-	-	-	-	-	-	-	-
Fish(fresh & dried)	58	22.12	3.54	1122	1671	1940	644	941	821	959	219	1179
Groundnuts (Arachis hypogea)	11	2.82	0.52	134	198	116	29	78	164	87	36	162
Kola nuts (Cola acuminata Schott)	6	0.54	0.10	31	44	25	9	21	32	22	8	30
Leaves (dried)	2	0.48	0.08	23	29	20	4	7	14	8	5	19

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TABLE 2 (Continued)

Foodstuffs	Amount (g)	Pro-tein (g)	Nitro-gen (g)	Iso (mg)	Leu (mg)	Lys (mg)	Met (mg)	Sul-phur (mg)	Phe (mg)	Thr (mg)	Try (mg)	Val (mg)
Milk (fresh & sour)	95	3.32	0.52	212	326	258	81	111	161	153	47	228
Okra (Hibiscus esculentus)	25	3.22	0.52	125	183	138	41	71	118	119	33	164
Onion (Allium cepa)	2.5	0.04	0.01	1	1	2	–	–	1	1	1	1
Peppers (Capsicum)	3	0.45	0.07	17	17	19	6	10	20	18	3	12
Poultry	3.5	0.70	0.11	36	50	60	18	27	27	29	8	34
Sorghum (Sorghum vulgare)	712	71.91	11.50	3910	11546	1955	1242	2438	3577	2576	805	4106
TOTAL		112.33	18.05	5947	14589	5046	2209	3925	5244	4253	1237	6308

42

Source: Adapted from Nicol, 195b, p. 309.

Iso = Isoleucine   Leu = Leucine   Lys = Lysine
Met = Methionine   Phe = Phenylalanine   Thr = Threonine
Try = Tryptophan   Val = Valine   – = Negligible

> foods in relatively large amounts in order to acquire
> the essential amino acids . . . .
> Any reasonable diet containing meat and/or beans and
> milk will provide all the amino acids necessary for
> good health. Unfortunately, amino acids, unlike car-
> bohydrates and fats, cannot be stored in the body for
> future use. Proteins that the body cannot use at any
> given time are excreted. Protein intake then, must
> be continuous (Laplace, 1972, p. 366).

Beef Consumption in Southern Nigeria

Almost all the beef marketed or eaten in Southern Nigeria

comes from the North because the widespread presence and persis-

tence of various species of Glossina restrict animal husbandry

in the Southern Provinces. There are, however, some trypanosome-

tolerant dwarf N'Dama and Muturu varieties in the south. These

animals scavenge for themselves, and as a result they produce

very little meat and milk. These trypanosome-resistant breeds

are not considered useful or productive, rather they are a sym-

bolic mode of investment. The trypanosome-resistant breed is

only butchered on ceremonial occasions; hence scarcity of meat

in the area. As property par excellence of the chiefs and the

wealthy (Dupire, 1968, p. 336), their social value sets their

economic value.

As a result of the ubiquitous tsetse fly that restricts

animal husbandry in the south and the inefficient means of trans-

porting and distributing northern cattle, there is an acute short-

age of meat in the Southern Provinces. Southern Nigerian diets

suffer from shortages of animal proteins. These shortages greatly

affect the physical (and perhaps, the mental) development of most

southern Nigerians. Figure 3 compares the physical development
(weight and height changes) of Nigerian children in rural commun-
ities with those of the highest social (elite) class in Ibadan
as optimum group, and Pankshin children in Northern Ibadan as a
standard.

Children in villages in Southern Nigeria have the lowest
body weight-height changes as a result of protein deficiencies
in their diets. In a survey conducted by Dema (1965), and Collis
and Janes (1967), it was found out that children who live in
rural areas in Eastern Nigeria have body weight-height changes
similar to those in the West. The result of the survey showed
that children in Southern Nigeria have the slowest growth rate
and weight changes in the country. Children in Adiasim, South-
eastern Nigeria show the slowest body weight-height changes.
Children in Ilesha in the West followed, while children from
Maku, Idembia, and Urualla, East Central State follow in the
descending order. The study led to the conclusion that:

> . . . a diet that meets the requirements of the Food
> and Agricultural Organization (FAO) will by itself
> improve growth rates of individual children and also
> groups of children, whether or not infection has been
> prevented, as will be demonstrated (Collis and Janes,
> 1967, p. 56).

The children of the Pankshin group in Northern Nigeria contrast
markedly with those of the rural communities in the Southern
Provinces. From ages two to six children in Ilesha, Maku,
Urualla, and Adiasim are well below the well nourished children
of the Ibadan optimum group in body build. Thereafter, Pankshin
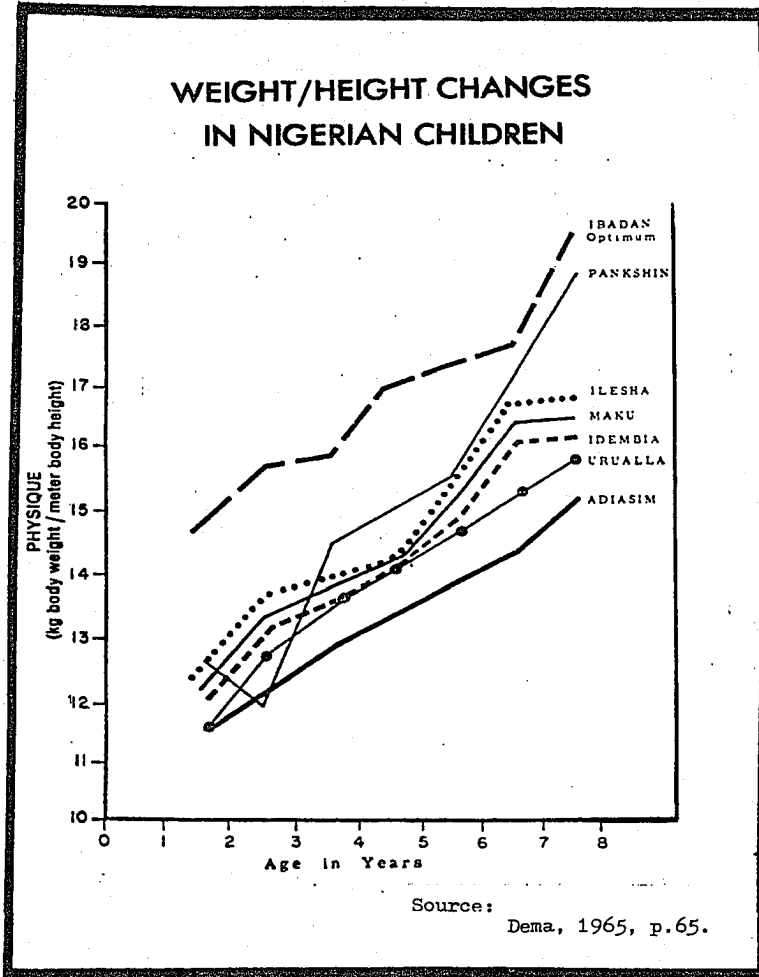
Figure 3

children follow the line of physical development of the child-
ren of the Ibadan group. Protein deficiency in foods accounts
for these differences in the groups. The estimation of physique
by the ratio of body weight to height has been defended as a
means to estimate the amount of soft tissues in relation to the
size of the skeleton. Physique, therefore, is derived simply
as the weight/height index and its measurements are useful in
comparing the body build of different groups of people (Dema, 1965,
p. 73).

The number of cattle slaughtered in a given town is a
good indicator of the availability of meat in that area. Figure
4 plots the number of cattle slaughtered in selected towns in
Southern Nigeria as compared with monthly slaughterings at Kano
for 1973. Port Harcourt had the smallest monthly slaughterings.
Distance from the source of cattle accounts for the small number.
However, fish may serve as a partial protein source near the
coast (Collis and Janes, 1967, p. 60). Slaughterings in smaller
towns may even be less because of long distances from supply
centers or inefficient distribution systems. Slaughtering fig-
ures for rural areas in Southern Nigeria are not available, hence
it is impossible to compare rural slaughterings in the north with
those in the south. Slaughterings for Lagos and Ibadan are high,
though not as high as those for Kano in the north. Lagos is a
capital city and Ibadan is the seat of a university. People
who live here are in the upper income brackets in the country.

Income is an important factor in determining the types

CATTLE SLAUGHTERED PER CAPITA IN
SELECTED TOWNS, 1973 (BY MONTH)
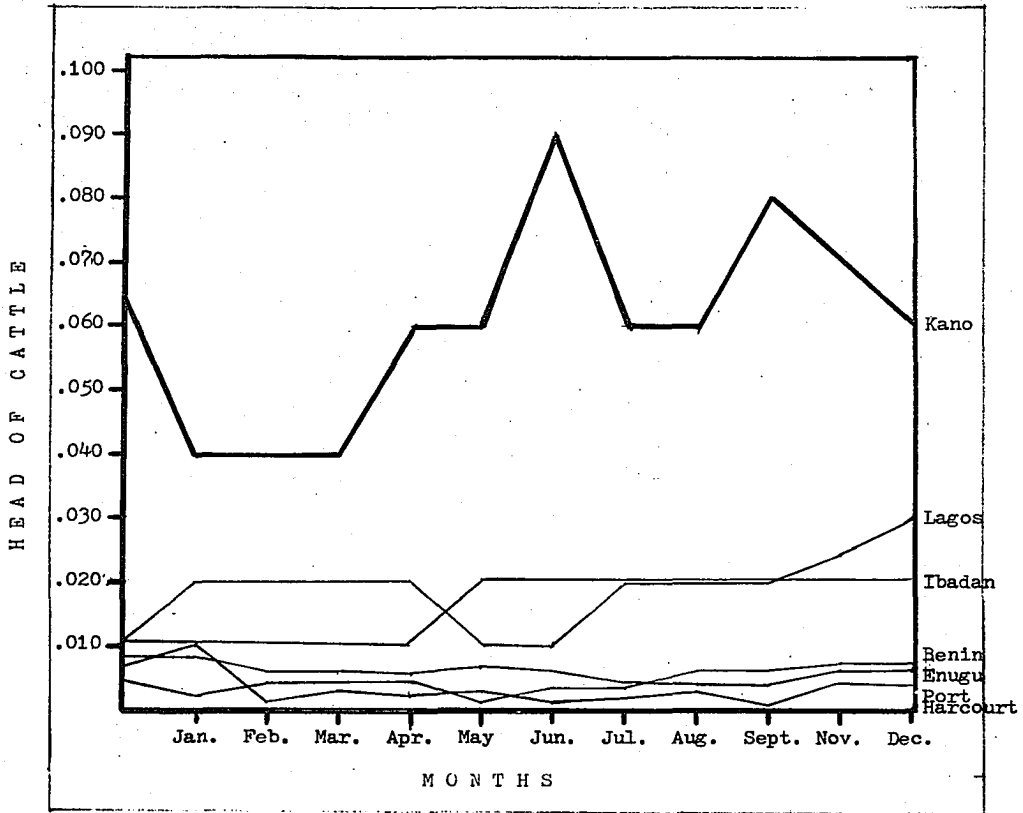
Source: Nigerian Livestock and Meat Authority.

Figure 4

of food purchased. In a survey conducted by the Nigerian Federal
Department of Statistics, it was shown that low-income families
spend the greatest percentage of their income on carbohydrates
with correspondingly less percentage on meat and other food items
which provide better nourishment than staples. This is necessar-
ily so, because staples are cheap. High-income families buy more
nutritious (protein) foods than poor people. Table 3 shows a
summary of the survey taken by the Federal Department of Statis-
tics, Lagos at Akure/Ondo/Owo, Lagos, Onitasha, and Oshogbo/Ife/
Ilesha. This confirms that low-income families buy very few
protein foods including meat because of price and scarcity in
their local markets. The means of transporting and distributing
meat are very inefficient, and rural communities are deficient
in protein food supplies. Table 3 which follows shows the per-
centage of income spent on different food items by three differ-
ent income groups in selected towns in Southern Nigeria.

From the table it can be noted that the lower income
group have no money to spend on protein rich food. After spend-
ing a very high percentage of their income on staples very little
is left for protein foods. For example, at Okure, Ondo, and Owo
the lower income groups (wage earner) spent 45.0 per cent of
their income on staple and 28.7 per cent on meat; the self-em-
ployed spent 49.0 per cent on staple and 32.7 on meat. At Lagos
they spent 55.6 per cent (wage earner) and 59.0 (self-employed)
on staples while meat has only 26.3 per cent and 27.4 per cent
respectively. At Oshogbo, Ife, and Ilesha the lower-income

TABLE 3

PERCENTAGES OF INCOME SPENT ON

DIFFERENT FOOD ITEMS

Towns	Income Group	Staple[1]	Meat	Oil& Fat	Veg. Fruit	Others
Akure/Ondo/ Owo	Lower Income (Wage Earner)	45.0	28.7	5.8	8.9	11.6
	Lower Income (Seof-Employed)	49.0	32.7	5.0	8.8	4.4
	Middle Income	40.0	29.9	7.4	8.2	14.0
Lagos	Lower Income (Wage Earner)	55.6	26.3	4.9	6.4	6.8
	Lower Income (Self-Employed)	59.0	27.4	4.5	6.2	2.9
	Middle Income	38.7	32.6	7.4	9.3	12.0
Onitsha	Lower Income (Wage Earner)	43.6	34.4	4.3	9.9	7.8
	Lower Income (Self-Employed)	47.7	31.7	4.2	7.9	6.5
	Middle Income	39.6	34.2	5.2	10.6	10.4
Oshogbo/ Ife/ Ilesha	Lower Income (Eage Earner)	48.9	28.8	5.0	8.3	9.0
	Lower Income (Self-Employed)	57.4	27.3	3.8	7.1	4.4
	Middle Income	37.4	32.9	7.2	7.9	14.6

Source: Compiled from Federal Department of Statistics,
         Lagos, 1966.

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[1]Staple here includes such starchy foodstuffs as
cassava (maniac), cocoyam, maize, rice, and yam.

(wage earner) spent 28.8 per cent, and (self-employed) 27.3 per cent on meat while staple had 48.9 (wage earner) and (self-employed) 57.4 per cent respectively. With very low income and a very small percentage spent on meat the poor can hardly have enough protein intake.

Figure 5 compares the average quantity of beef eaten (in pounds) per person per month in two Southern Nigerian towns (Calabar and Ibadan) with the consumption at Kano, Northern Nigeria for 1973. Calabarians had less consumption than Ibadan or Kano. From July to September each person in Calabar town ate about 5 lbs. of beef per month. People at Ibadan had between 6 and 8 lbs. of meat each from July and December. At Kano, the inhabitants had between 20 and 30 lbs. per person per month at the same time in that year. Beef consumption in the southern towns is very low because they are too far away from the sources of supply. Rich urban dwellers in Lagos can afford to buy beef at a high price, but supply in the city is poor. Means of transportation and distribution of beef cattle in the country is very inadequate. Calabar is too far away from the center of supply and lacks good communication routes to the interior.

The average daily amount of beef eaten by each Nigerian in each state in 1973 has been mapped. From the Figure 6 it can be seen that only Lagos in the Southern states had a daily beef consumption favorably compared to the Northwestern state. Kano and North Central States came second, while the Northeast was the third. Kwara and Benue-Plateau states had the smallest

AVERAGE MONTHLY BEEF CONSUMPTION, 1973

Figure 5

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PER CAPITA BEEF CONSUMPTION IN NIGERIA (BY STATE), 1973

Gr/Person/Day

1.23 - 10.01
10.02 - 18.78
18.79 - 27.55
27.56 - 36.33
36.34 - 45.10

SOURCE: Nigerian Livestock
         and Meat Authority, 1973.
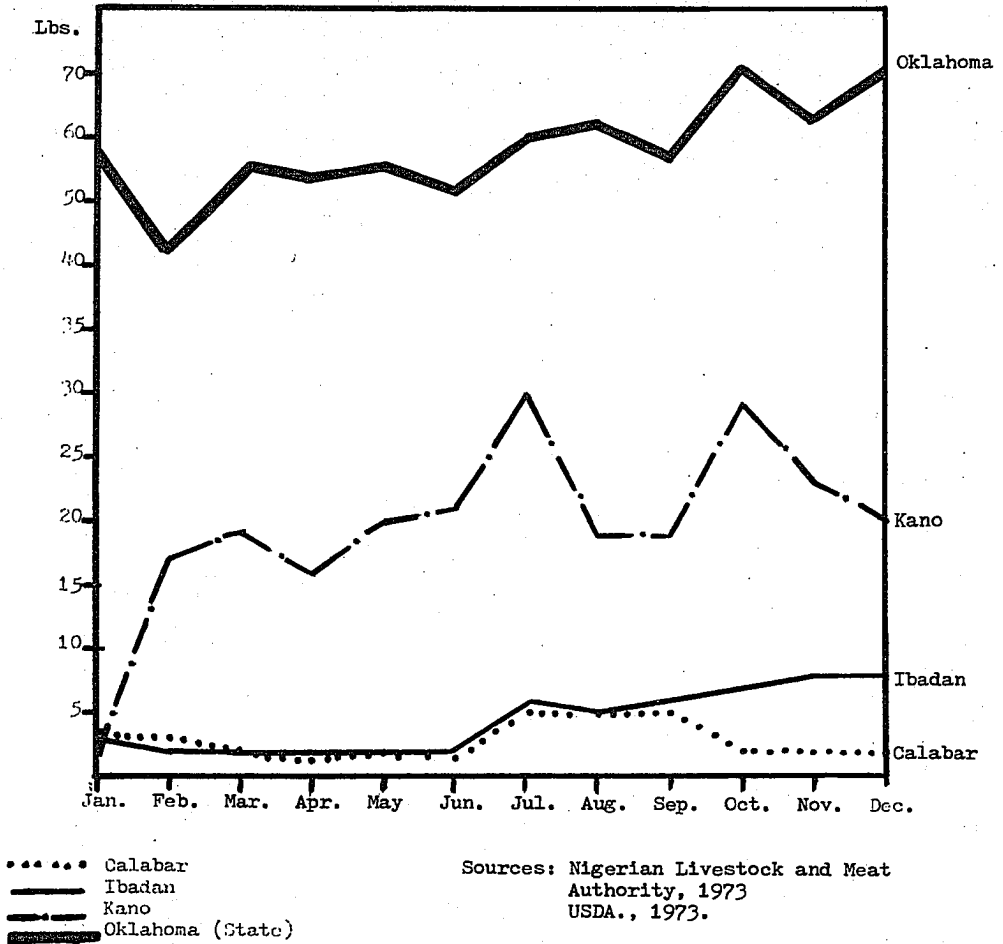
FIGURE 6
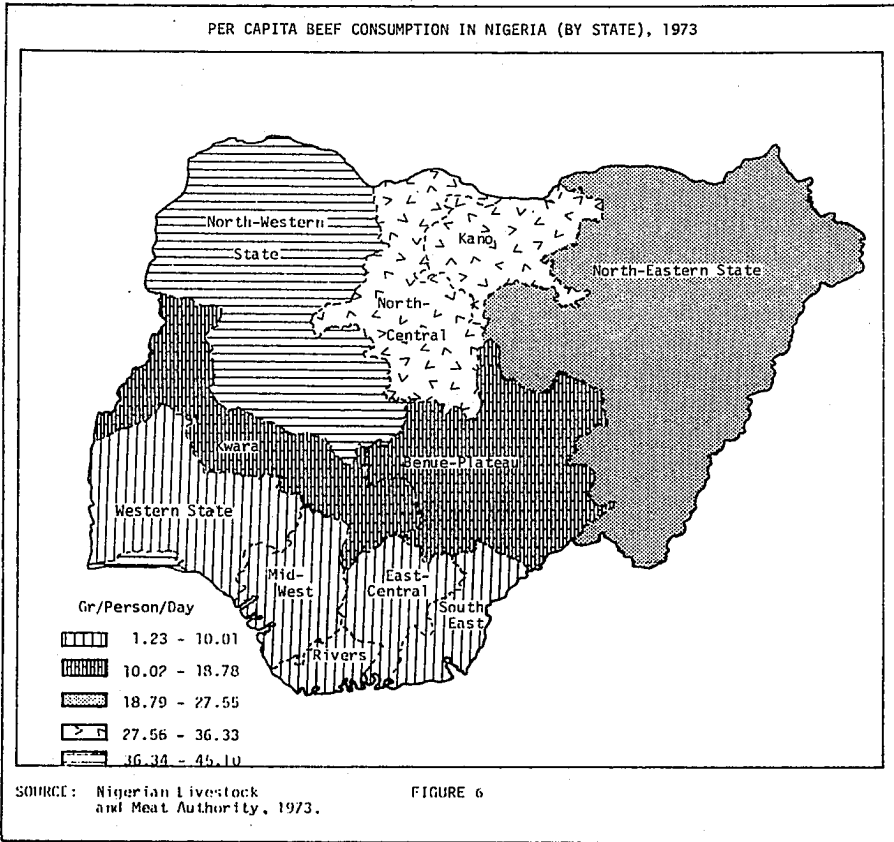
amount of intake in the Northern area. These latter states are

partly in the Guinea forest zone and partly in the northern sav-

annah zone, but the former occupies a greater geographic area.

Tsetse infestation begins to attack cattle in the southern half

of these states. In the Southern Provinces, East Central State

had 1.23 grams per person per day in 1973. People in Rivers

State had 2.0 grams, Southeastern State had 2.45 and the Western

State had 5.22 grams.[1] These states are too far away from the

northern savannah zone where cattle husbandry is practiced.

As a result of scarcity and prices of beef in the south-

ern markets, poor families are deficient in animal protein in-

take. Children in these families may be of stunted growth and

emasciated. Insufficient supplies of protien in the body result

in the use of the little protein available for energy instead of

for body building (Collis and Janes, 1967, p. 55). The mortality

rates of Nigerian children under the age of five are in the order

of 50 per cent in several parts of Southern Nigeria. Studies con-

ducted at Ilesha village in 1959 showed that 12 per cent of the

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[1]The amount of meat eaten (in grams) per person per day in
each state for 1973 was based on: (1) Recorded slaughterings
as reported by the Nigerian Livestock and Meat Authority. It
has been reported that there are unrecorded slaughterings which
amount to an additional 10 per cent of recorded slaughterings
in each state (See Western Nigeria Development Project No. 3,
p. 3). (2) Each slaughtered cattle was estimated to give 340
pounds of meat and edible offals (See Ferguson, 1967, p. 52 for
a brief discussion on the topic). (3) All calculations were
based on the population of each state as recorded in the Annual
Abstract of Statistics, 1972.

child mortality in the village was caused by protein malnutrition

(Dema, 1965, p. 36). Protein malnutrition has been observed as

a precursor to some psychiatric illnesses in some Nigerians.

Protein malnutrition causes lethargy and retardation which ulti-

mately triggers off behavior problems. In this connection it

is stated that:

> A glance at the total physical findings of the two
> groups (psychiatric cases and controls) emphasizes
> the differences. It was in the state of nutrition
> that the divergence was most marked. This calls
> the effect of starvation associated with famine
> edema on subsequent organic brain disease as des-
> cribed by Eitinger in survivors from concentration
> camps (Collis and Janes, 1967, pp. 68-69).

The malnourished adult Nigerian is poorly motivated for increased

productivity and hope for a better world:

> This was clearly seen in the Ekiti farming community
> of Oke-Ile . . . where the people do not have food
> enough to eat, and are therefore not willing to work
> for more than three or four days in the week on farms
> which they fatalistically believe cannot be substant-
> ially improved (Dema, 1965, p. 37).

In order to increase the intake of beef and consequently protein

in the Southern Provinces efficient transportation and distri-

bution systems must be planned and developed.

The Southern Taboos

There are neither widespread religious nor cultural taboos

against the eating of beef in Nigeria. The eating of pork is

scorned by Moslems, but very few observe this Islamic law in the

Southern Provinces. However, there are some local prejudices

against the consumption of meat by certain children on specified

market days. The reason for this is the belief by ignorant

parents that children who are encouraged early in life to eat
meat will steal it if they cannot afford to buy it in later
life. Another reason is the fear that children may become sick
if they eat beef on certain sacred market days when cooking is
prohibited.

Today, the above cultural observations are no longer ob-
served. The only consideration governing meat consumption is
its freshness. Only fresh meat is eaten by a majority of South-
ern Nigerians, This means that only meat butchered on that very
day is eaten by Southern consumers. Meat which has stayed over-
night is not palatable to the local consumers. The reasons for
this are not difficult to understand. In Nigeria, refrigeration
is uncommon. Refrigeration is very important for the storage of
perishable food products. Adequate cold storage facilities are
nonexistent in most Nigerian markets. Even if refrigeration were
provided in all markets, difficulties would still arise over the
purchase of cold or refrigerated meat. Apart from palatability,
many consumers suspect refrigerated meat to be spoiled, or to
come from contaminated animals. The difficulty makes butchers
limit their slaughterings to the numbers that they are able to
sell in a day. If the slaughtered meat is sold out in the early
afternoon, the butcher will not take the risk of offering more
cattle for slaughtering for fear that he will not be able to
sell the meat on that day. Due to these practices, demand for
meat may not be met in the Southern Provinces.

The widespread and presistent occurrence of protein mal-

nutrition in the south can then be viewed as caused by lack of availability of protein-rich foods. This has resulted in protein-rich foods too highly priced for the low-income families to be able to afford. In addition to the development of adequate transportation and distribution systems for the transportation of beef cattle from the north and distribution in the south, there is need for the education of Nigerians on new food habits so that refrigerated meat may be accepted by the masses. Food science education should be viewed as a long-term project because food habits are difficult to change. Efforts should be made to make the already known source of protein foods available to the southern consumers by efficient development of transportation and distribution systems in the country.

The cultural taboo against the consumption of either cold or refrigerated meat in Nigeria has a great effect on the distribution systems in the country. It has held to the driving of live cattle from the Northern to the Southern Provinces. The cattle thus trekked are emaciated, sick and weak; and may not live for more than a few weeks on arrival in the south. This cultural taboo against refrigerated meat has also hindered the development of well organized meat markets in the protein-deficit Southern Provinces. The effects of this cultural taboo has been emphasized:

It is a fact that the absence of organized marketing has considerably accentuated protein deficiencies in the country, since considerable weight loss occurs in slaughtered animals as a result of trekking long distances from the producing to the consuming centers

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under unhealthy conditions. A better organized marketing system will enable live animals to be transported in more humane manner, and the considerable amount of weight usually lost during trekking would be minimized. The use of modern abattoirs and slaughtering techniques would be encouraged by a good marketing organization which could also, more effectively consider the economics, finance and logistics of inter-state trade in chilled meat. A good marketing organization would tackle the problems at present associated with the improper utilization of valuable animal by-products such as bones, hoofs, horns and blood (Fe. Min. of Inf., 1970, p. 122).

Urbanization and Demonstration Effect

Until the post World War II period, there existed very little urbanization in Southern Nigeria. Towns were not unknown in the pre-Western period, especially among the Yorubas, who were traditionally town dwellers. A mid-nineteenth century European traveler once said that there were nine pre-industrial Yoruba towns with populations between 20,000 and 70,000 (Bascon, 1955, pp. 446-456). These ancient towns were mere population conurbations in walled cities or market centers and river crossings. The people were ethnically concentrated in such centers for purposes of defense and protection against tribal incursions. Today's towns are developed for commercial and administrative purposes.

The development of modern urban centers in Nigeria is the result of the introduction of western influences, such as, government, trade, commerce, and industry into the country. Foreign religious centers also led to the opening of modern urban centers (Johnson, 1967, pp. 168-202). Today urbanization is

growing at a very fast rate in Nigeria. The annual rate of urban-
ization has been estimated at 5.8 per cent (Coleman, 1960). Pre-
sently, the rate of urbanization in the Southern Provinces has
been estimated as 7.0 per cent, which is faster than the rate of
population growth.

The opening up of modern towns in Nigeria for purposes
of government, industry, commerce, education, and religious acti-
vities has led to the employment of Nigerians in the highly paid
jobs in the urban centers. Urbanization and the rise in income
levels create some appeal of new and superior goods to the con-
sumers. In his theory of individual consumption function, Duesen-
berry calls this "demonstration effect" (Duesenberrg, 1949, p.
27). The demonstration effect in Nigeria results from the meet-
ing of employed Nigerians with their western colleagues. It is
also noted that Nigerian students trained overseas are introduced
to superior goods and the western styles of life. Their con-
sumption patterns are also affected.

Individual consumption functions are very much inter-
related. They are dependent upon the patterns of close associates
(social groups), such as, neighbors, friends, and colleagues.
This is well illustrated when it is stated that:

> Of necessity then, in view of our social goals, every
> individual makes comparisons between his own living
> standard and those of his associates in higher and
> lower status positions. Every unfavorable comparison
> of this sort leads to an impulse to buy goods which
> will raise the living standards, and eliminate the
> unfavorable comparison (Duesenberrg, 1949, p. 31).

The meeting of Nigerians with western administrators, teachers,

bankers, and industrialists has aroused the desire for social

emulation by means of conspicuous consumption. The contact has

resulted in the consumption of superior goods (in this case, pro-

tein foods) and the adoption of more advanced ways of living by

many urban Nigerians.

The role of cities as the main force and chief locus for

the introduction of new ideas and ways of doing things as well

as new demands, for example, new technology, new consumption and

production patterns, and even new social institutions had for

long been very well attested (Hoselitz, 1953, pp. 195-208). This

role in Nigeria is in no way quite different. Urbanization, com-

mercialization, and demonstration effect combined with a normally

high population density in the southern towns accelerate the grow-

th of internal agricultural trade between the Northern and South-

ern Provinces. Here what Bertil Ohlin calls factor proportions

comes in clearly. The north being savannah region is a substan-

tial net exporter of livestock, cereals, and nuts to the sorthern

urban centers. Conversely, the north imports palm oil, bananas,

oranges, and kola from the south. These developments have led

to a considerable degree of both geographic and ethnic special-

ization in the Nigerian internal trade. One such ethnic special-

ization is represented by the Cattle Fulani who own nearly 96

per cent of the cattle in Nigeria. The difficulty in the deve-

lopment of the interregional trade is the inefficient development

of the transportation and distribution systems which hamper fast

delivery and distribution of the perishable food products from

the north to the new urban focussed population of the south.

Beef Cattle Production in Nigeria

Cattle husbandry in Nigeria is restricted to the northern savannah zone. This northern zone is tsetse free because it is too arid to provide breeding places for tsetse flies. The tsetse thrives well in areas that are humid and have thick foliages. Such favorable places are unavailable in the dry north. Figure 7 shows the cattle raising areas in Nigeria and the distribution of each tsetse species. From Figure 7 it can be noted that the only tsetse free zone in Nigeria is the northern Sahel region. The Jos Plateau in the central part of the country, the Adamawa highlands and the Oban Hill in the eastern part of the country are also tsetse free, but there is no intensive animal husbandry practiced in these areas. More recently a ranch was opened at Obudu (on the Oban Hill Plateau) by the Eastern Nigeria Development Corporation. It has by now been noted that there is an endemic infection of the soil with claustridia group of anaerobic organisms. The infection killed nearly all the animals in the Obudu Ranch in 1965.[2]

In Southern Nigeria, the prevalence of Glossina, which are vectors of trypanosomiases, severely limit the practice of efficient animal husbandry. It is only through very costly

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[2]This information was supplied by letter communication with the assistant manager of the Obudu Cattle Ranch dated March 3, 1975.

INFESTATION PATTERNS OF TSETSE BORNE CATTLE DISEASES IN NIGERIA, 1976
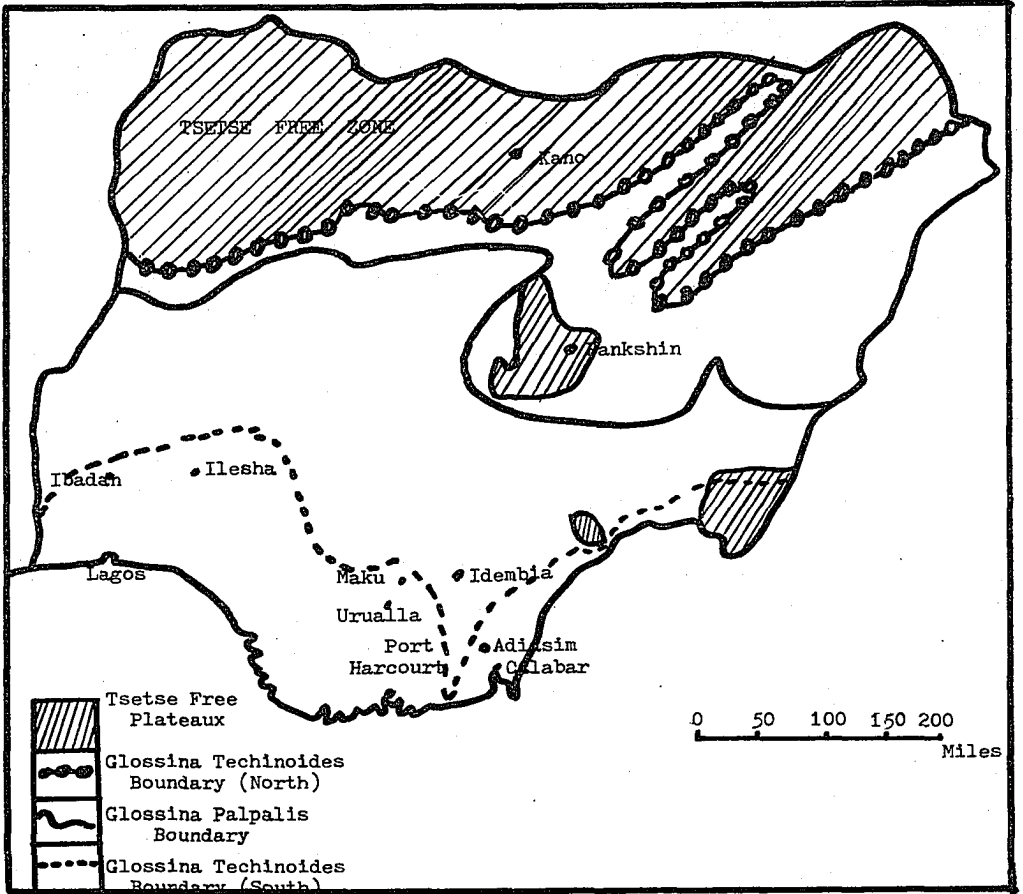
Source: Survey Unit, Kaduna, Nigeria, 1973.

Figure 7

and specially controlled schemes such as the Obudu Ranch, Ogoja

in the Southeast, and the Ogun River Scheme in the West, that

animal husbandry has been successful in the south. Neither of

these has yet reached commercial production levels, but the form-

er provides about two slaughter animals per day. According to

projections, in ten years Upper Ogun will be producing about

1,600 slaughter animals per year (Western Nigeria Development

Project, 1964, p. 13).

In the dry northern zone, the open savannah provides

good herbage for cattle grazing. The scanty rainfall in the

area makes the grazing abundant only in the wet season (November

through April). However, the government has recently drilled

wells to supplement water supplies during the dry season. The

irrigation facilities provided by these wells cannot provide

adequate forage during the long dry periods. The cattlemen have

to rely on the seasonal rhythms for the supply of forage to feed

their cattle. During the dry season, the herdsmen are forced to

migrate southward with their herds in search of water and better

pasture (Federal Ministry of Information, 1970, p. 121).

Seasonal Movement of Cattle

The transhumance nature of animal husbandry has been

practiced by the Fulani herdsmen for centuries. The practices

can be viewed as a spatial movement resulting from different

vegetation and annual precipitation cycles. By long experience

in nomadic pastoralism the Fulani had learned how to avoid try-

panosome infections of their cattle. The southward movement to

the dry season grazings is made slowly with many short stops

depending upon the rhythm of the rain. In years of prolonged

drought, the Fulani cattlemen may take the risk of putting

their herds into known tsetse-infested areas which they would

normally avoid (De St. Croix, 1944, p. 31).

The problems associated with this tradtional way of

cattle raising have been summarily stated:

> The animals emaciate during the long treks and many
> which are forced into tsetse infested areas die of
> trypanosomiasis and other diseases, the most serious
> of which are rinderpest and contagious bovine pleuro-
> pneumonia (Federal Ministry of Information, 1970, p. 121).

There is no regular or fixed sequence of the southward migration

of the herdsmen and their cattle because of the unpredictability

of the weather conditions in the country. In the south, the

cattle are grazed on the generally more watered areas, especially

near large rivers or lakes; or in areas with numerous streams

(De St. Croix, 1944, p. 31).

There are, however, real economic costs involved in this

type of traditional animal husbandry. The transhumance nature

of animal grazing encourages soil depletion and erosion which in

turn creates problems for other types of farming. It is here

emphasized that:

> The "Cow" Fulani, the present nomads, are people of
> considerable grace and beauty, but to the Territory
> they have in effect and in habit, the characteristics
> of the gipsy. Learned in the lore of cattle raising,
> they not only make no contribution to the country'
> agriculture, but their mode of life is quite inimical
> to it (Shaw and Colvile, 1950, p. 36).

Presently, the government is providing pilot irrigation schemes

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that will encourage sedentarization of the nomadic pastoralists
(Annual Report of Animal Husbandry, 1974, p. 6). In Kano, the
state government has increased official grazing acreage for the
Fulani herdsmen from 2,000 in 1968 to 15,000 in 1970, and plans
are on the way to add another 128,000 areas with irrigation schemes
(Ministry of Agr. and Nat. Resources, 1974, p. 24).

The seasonal movement of herds for wet season grazing in
Nigeria takes the animals away from potential markets (F.A.O.,
1966, p. 217). Production is not a decisive factor in the mar-
keting of cattle by the nomadic herdsmen. The Fulanis are sub-
sistence pastoralists with minimal interest in selling their
cattle. The owners value cattle far beyond either utilitarian
or pecuniary worth of the animals. Without any scientific know-
ledge of controlling disease and drought the accumulation of stock
is a recognizable insurance against death and human hunger.

The Fulani herdsmen believe that they hold cattle in trust
for future generations and, therefore must increase their wealth
in cattle (Hope, 1948, p. 26). Their viewpoint does not appear
to experienced veterinarians entierly bereft of good sense because
it is through the large number of cattle that the herd can be re-
constituted after the periodic losses brought about by diseases,
drought, and underfeeding (Dupire, 1968, p. 335). Quite apart
from economic value, ownership of cattle gives membership in
Fulani society and their loss may result in expulsion (Hopen,
1958, p. 27). The social prestige and importance of the cattle
owner is gauged by the number of head owned and not by the in-

dividual quality of the animal (Ferguson, 1967, p. 11). There
is, as yet, little incentive to encourage standard improvements
or trading on livestock. The types of cattle raised are numerous
and the breeds are considerably mixed, but most of them are poor
and multi-purpose in nature. Being a visible sign of wealth,
the Fulani refuse to sell their cattle except during times of
emergencies. Such emergencies include payment of cattle tax
(jangali), buying of salt for the cattle, paying fees for use of
public grazing grounds or pasture, paying veterinary expenses
for immunization, and occassionally, buying food and clothing
for the family (Ferguson, 1967, p. 11). However, there is no
time that the supply of trade cattle is lacking in the northern
cattle markets. The reasons are: (1) at one time or another
some cattlemen must need cash in order to buy their needs, (2)
the Fulanis sell cattle that are old and unproductive, and (3)
a Fulani cattleman due to his old age and without heirs to his
cattle can choose to sell some of his cattle leaving only the
number that he is able to raise properly.

Factors Affecting Regional Specialization

The prevalence of Glassina, vectors of trypanosomiases,
has severely restricted the practice of cattle ranching in Nigeria.
This is why almost all the cattle marketed in Southern Nigeria
come from the tsetse free zone in the Northern Provinces. The
restrictions on cattle farming are related to factor endowments.
This can be analyzed in the context of the Heckscher-Ohlin frame-

work which states that:

> Specifically, the comparative-cost doctrine holds that
> a country (region) possesses a comparative advantage
> in producing those commodities in whose production
> its "real" labor costs (in the sense of the inverse
> of average productivity of labor) are relatively lower
> than those of other countries. On the other hand,
> the Heckscher-Ohlin theory of comparative advantage
> depends on (a) different productive factor endowments
> among countries and (b) different factor intensities
> of production processes for different goods (Moroney
> and Walker, 1966, p. 573).

In Nigeria, interregional trade is based on the fact that pro-

ductive factors for cattle exist only in the north. The immo-

bility of cattle production factors gives rise to the concen-

tration of cattle raising in the northern savannah zone.

Resource and Physical Bases

In his identification of the essential questions concern-

ing the production of any commodity, Chisholm (1966, p. 29) em-

phasized that: "Three interrelated questions underlie a study

of the spatial pattern of production of any commodity: What is

(will be or has been) produced, how much of it, and where?" Why

is the Nigerian cattle production located in the north? In the

Western industrialized nations, a basic assumption is that an

entrepreneur will choose a location where his production derives

maximum profits as the most favorable location for his firm.

This approach is necessarily so because in a competitive economy,

no one production firm can easily achieve minimum costs. The

measure of optimum location then becomes relative and is based

upon some financial returns (profits) that are relative to a com-

petitor's.

The traditional cattle industry in Nigeria is quite different from the profit oriented western firm discussed above. The role of regional resources in the initial stages of economic development need not be over-emphasized here. In the early history of the United States, the regional endowment that contributed to the development of the Midwest was arable land, while metal ore mining was the major factor in the economic development of the mountain region (Perloff and Wingo, Jr., 1972, pp. 215-218). However, it has been shown that abundant resources are not a sufficient cause to fully explain economic development, as Argentina and Burma perhaps prove; but they afford the opportunity for development and support the ongoing process (Kindleberger, 1965, p. 67).

In Nigeria, there is a definite correlation between relative factor endowments and the location of the cattle industry. Natural resources, capital, and labor endowments (among other things) are very important determinants of the comparative advantage of any region. In any case, beef cattle cannot be produced in an area that lacks the necessary natural resources for their production, for example, modern feed lots. The Nigerian cattle industry is greatly influenced by the availability of natural resources rather than by the abundance of either capital or labor. Mittendorf and Wilson (1960, p. 3) have stated that cattle production in Africa is limited by the availability of adequate pasture, water, and the degree of freedom from diseases.

The northern savannah zone, where the Nigerian cattle

husbandry is carried on, is tsetse free. The area is too dry
to support the growth of herbaceous plants which encourages
tsetse fly breeding by providing shade for the flies. In South-
ern Nigeria, trypanosomiasis inhibits the production of quality
cattle. The disease, which is transmitted by various tsetse
fly species interferes with animal productivity. The debilitating
effect of the disease causes live weight losses, reduced rates
of growth and fertility, and high mortality rates in the herd.

Apart from infections with pathogenic trypanosome vivax
which are not encountered in the northern zone, the nature of the
herbage species and the quantities of fodder found in the area
are very important to successful husbandry. Since the herds live
on natural pastures, the availability of digestable and nutritious
forage is very important for cattle production. The northern
zone, though seasonally stricken by drought, provides natural
pasturage for the cattle. With the installation of irrigation
pumps, this area provides considerable security for animal hus-
bandry for the Fulani herdsmen.

Fulani Entrepreneurial and Labor Skills

The fact that labor skills are not evenly distributed ;
spatially makes the availability of skilled labor, especially in
a less-developed country such as Nigeria, very signficant in
the location of any production system. Though the relative
importance of labor factors in the production system varies
greatly from one economic activity to another, yet the locational

pull of labor possessing certain skills is very necessary in

tradtional forms of production. This is put more vividly when

it is concluded that:

> . . . it is often the need for particular scarce and
> spatially localized type of labor possessing certain
> skills that makes many industries especially labor
> sensitive in the modern world. The total value
> added by the contribution of such workers may not
> always be quantitiatively large nor may their total
> impact on costs, but the existence of the enterprise
> in any form may depend heavily upon their sheer
> availability (Lloyd and Dicken, 1972, p. 95).

The Fulani herdsmen are the greatest single cattle-own-

ing ethnic group in West Africa. They are found in a number

of scattered clusters from Senegal (their original home) across

the Savannah belt to the Sudan (Hopen, 1958, p. V; U.S.D.A..,

1972, p. 33). Cattle husbandry has always been the dominant

interest of the Fulani people. They are learned in the lore

of cattle raising (Shaw and Colvile, 1950, p. 36). One author

in describing these herdsmen said:

> Although the [the Fulani] are sentimentally attached
> to their livestock, they live off them physically,
> socially, and morally and if their attitude towards
> them were not realistic they would long since have
> disappeared from the map of Africia (Dupire, 1968,
> p. 337).

As regards skill in cattle raising, the Fulani acquire

their lore from their parents. Before children can walk they

are brought into contact with calves. At about the age of five,

children are given the task of keeping calves away from domestic

supply of grain, and when they are about six years old they tie

up cattle in the evenings so that they may not feed from their

dams (Hopen, 1958, p. 24). Knowledge of cattle raising among

the nomadic Fulani is gained through observation and imitation.
They have learned from long experience how to select succulent
grasses for their cattle.

The Fulani herdsmen have a strong contempt for farming
or any other kind of occupation. In describing them one author
stated that:

> They [Fulani] know neither how to tan hides, how to
> work bone and horn, nor to dig wells. The women make
> butter but not cheese from the milk of their [cattle].
> All their technical knowledge directly concerns tend-
> ing their herds of zebus. This extreme specialization
> makes them dependent on the craftsmanship of their
> neighbors - Hausas, Bellah, Tuareg - and European
> imports (Dupire, 1968, p. 335).

The Fulanis are very confident about their ability in cattle
husbandry (Hopen, 1958, pp. 29-30). Without any scientific re-
search the Fulani know when the dry season is approaching and
when to start the southward trek so that arrival may be in good
time. One author says:

> Prior to moving cattle to another area, one or more
> members of the family will be sent off in advance
> over the route to be traversed, to make full en-
> quiries as to whether there are any outbreaks of
> disease along the proposed route, or in the area into
> which they wish to move (De St. Croix, 1944, p. 32).

Their knowledge of local breeding from long experience has
taught them many things. The best herds which calve regularly
and produce off-springs with high milking qualities are kept
for building up good strains in the herd. Though bulls are
marketed more than cows, promising bulls are kept for breeding
purposes.

Today the Fulani managerial skills do not appear to be

the attractive factor in the location of a modern cattle industry

in the northern savannah region. The single all-embracing fac-

tor is the absence of Glossina, vectors of typanosomiasis, the

prevalence of tsetse fly in Southern Nigeria, that restricts the

development of the cattle industry in the region. However, phy-

sical (ecological), as well as social and economic factors have

all played their part in transforming the northern savannah

region into the Nigerian cattle producing region. Over the long

term, modern research, a wise use of insecticides, and tsetse fly

clearings may prove that the tsetse species can be eliminated in

the south and animal husbandry practiced in that area.

Capital, Inertia, and Economic Rent

Some form of capital is necessary in the successful oper-

ation of any economic activity. Capital then can be defined as:

> . . . all man-made aids to production, that is, all
> tools, machinery, equipment, and factory, storage,
> transportation, and distribution facilities used in
> producing goods and services and getting them to
> the ultimate consumer. Capital goods ("tools") differ
> from consumer goods in that the latter satisfy wants
> directly, whereas the former do so indirectly by fac-
> ilitating the production of consumable goods (McConnell,
> 1969, p. 22).

There exists a wide variation in capital inputs from one industry

to the other. Some industries are labor-intensive, while others

(are capital intensive) require large capital investments. In

Nigeria, the pastoral Fulani have little or no capital investment

for their cattle husbandry. This is the reason why seasonal

mobility is practiced and in many instances a camp may be moved

at about an hour's notice (Hopen, 1958, p. 33). The only capital

required in the practice of the nomadic husbandry is the live-

stock set aside by inheritance:

> First of all, it is set aside for direct heirs, the
> sons, who from the time of their birth, gradually
> receive in pre-inheritance their share of the pater-
> nal herd. . . . The master of the herd cares for live-
> stock over which the members of the polygamous family
> have certain rights of usage or of unalienable owner-
> ship during their minority. In view of these multiple
> obligations one can understand how the portion actually
> belonging to the master of the herd diminishes as he
> grows old and his sons set up for themselves (Dupire,
> 1968, p. 337).

Capital involves the application of labor to the pro-

cessing of resources. This varies according to the level of

technology and organizational practice of the society. The

Fulani herdsmen have wells for watering their herds. Land that

provides pasture is also another asset. These are some of the

sources of phenomena that provide geographical inertia. Still,

the single most important factor that accounts for the location-

al inertia is the absence of Glossina, vectors of trypanosomiases.

Historically, this environmental factor has been a critical fac-

tor explaining the inertia for the Fulani cattle industry.

In the Western countries business decision-makers seek

locations where risks are low and net profits high. More recent-

ly, the location of the market has been recognized as vitally

important in making decisions for not only the location of in-

dustrial and commercial firms but also for public service fac-

ilities. This is necessarily so because both the suppliers and

customers are at the same place, which is the urban area. In

the industrialized nations land resource is not as crucial as

skill and organizational management in the location of produc-

tion. In Nigeria, the location of the Fulani cattle industry can

be seen as a result of the extensive tsetse free land-use patterns

in the north. The location of the market (in this case the con-

sumers in the south) plays no role in the location of the north-

ern cattle production.

The Dualistic Nature of the Nigerian Economy

Regional dualism is one of the distinguishing character-

sitics of less-developed countries. In Nigeria, regional dualism

is clearly present. A dualistic economy is characterized by

different marginal efficiencies of identical factors in different

segments of the economy (kindleberger, 1965, p. 258). There

are differnt kinds of dualism--religious, social and economic

(Furnivall, 1944, pp. 447-465). Kelly, et al., agree that the

existence of dualism can be argued on the basis of differences

in social system (Boeke, 1953), caste or ethnic background

(Furnivall, 1944), production conditions (Eckaus, 1955), demo-

graphic behaviors (Higgins, 1956), consumer expenditure and

savings behavior (Boeke, 1953), and domestic and foreign sec-

tors (Baldwin, 1966). However, in the literature of geography,

dualism is most often referred to as regionalism. Summarizing

this a geographer said:

> Many geographers have used the terminology of
> classification theory in discussing regional systems
> and some have recognized that many of the principles
> of classification are applicable to regions or areal
> classes (Grigg, 1965, p. 472).

Dualism can be defined as:

. . . the existence of a sector or sectors in which
the actual distribution of capital stock and of com-
plementary factors does not permit the market to be
cleared and optimal resource to be effected. Under
such conditions of inequality between the proportions
in which factors are available and in which they are
used, general equilibirum theory becomes invalid and
a distribution theory based on an institutional hypo-
thesis must be applied (Ranis, 1966, p. 15).

Social scientists have recognized the existence of stub-

born persistence of regionalism at all levels of national deve-

lopment (Williamson, 1965, p. 3). This pheonomenon of spatial

imbalance (spatial economic differential) has been referred to

as the "North-South" problem (Higgins, 1968, p. 763). The

North-South problem, for example, the Brazilian Northeast, Italian

South (Mezzogiorno), and the Mexican South, and within many coun-

tries is by now well attested (Keeble, 1967, p. 257). This type

of spatial imbalance becomes even more difficult to explain be-

cause the variation is not only persistent but increasing in the

less-developed countries (Williamson, 1965, pp. 16, 17). In

Nigeria the situation is well illustrated when it is stated that:

Before the Federal government split Nigeria into 12
states in 1967, Nigeria consisted of five regions;
i.e., the North, the East, the West, the Mid-West, and
the federal territory of Lagos. The North is by far
the largest and most populated region, though it is
also the least developed. The East is the most
densely populated region, while the West is the most
urbanized and developed one, mainly due to its cocoa
exports. The Southern regions are relatively more
developed than the North, especially in education,
degree of industrialization and available infra-
structure facilities. The recent discovery of oil
in the East and Mid-West has given these regions a
relatively strong economic position, even compared to
the Western region (Kahnert, et al., 1969, pp. 81-82).

Socio-economic dualism can result from the sudden errup-

tion of twentieth century technology into primitive societies
which adapt only gradually (Hirschman, 1958, pp. 126-132).

This mingling of advanced and primitive cultures results in a
clash of two cultures which brings about social dualism. In
emphasizing this one author states that:

> Social dualism is the clashing of an imported social
> system with an indigenous social system of another
> style. Most frequently the imported social system is
> high capitalism. But it may be socialism or communism
> just as well, or a blending of them. Nevertheless
> even in that case it remains advisable to keep the
> term social dualism because this emphasizes the fact
> that the essence of social dualism is the clash between
> an imported and an indigenous social system of diver-
> gent character (Boeke, 1953, p. 4).

Economic Dualism

In Nigeria, dualism appears in two sectors: One devoted
to peasant agriculture and the other confined to industrialized
operations and included even large-scale agriculture. Dualism
is, therefore, more readily explained in its economic and tech-
nological terms (Higgins, 1968, p. 232).

Socio-economic dualism has both spatial and temporal di-
mensions. The injection of western techniques into Nigeria re-
veals itself in the dual economy of the country. This dualism
is expressed in a geographical distribution pattern which re-
sults in the growth of some localities and regions at the expense
of relative stagnation or regression of others. This is in
Myrdal's (1957) term "regional inequality." There are in less-
developed countries, for example, in Nigeria, characterized
cultural patterns and sectional division of labor based on ethnic

groups be it nationality, caste, tribe, or even clan (Furnivall,

1944, pp. 446-459). Ethnic diversity definitely affects the

geography and economy of Nigeria. How this operates in Nigeria

is well illustrated in the statement that:

> The developments [regional dualisms] have led to a con-
> siderable degree of geographic and ethnic specializa-
> tion in export crops and to a much lesser extent in
> domestic staples. Thus, the Yorubas raise cocoa in
> the southwest, the Edo and other groups produce rubber
> in the southern midwest, and the Ibo in the southeast
> represent the major concentration of oil palm produc-
> tion. In the north, the Hausa and other large groups,
> such as the Nupe and Kanuri, produce most of the peanuts
> and cotton. Another important export crop, sesame seed,
> is grown almost exclusively by the Tiv, who live just
> north of the former eastern region border. The nomadic
> Fulani of the north are the primary source of beef
> (Huth, 1970, p. 161).

In the urban areas, many are engaged in industrial or admin-

istrative jobs. Industrial employment is a typical example

of the intrusion of western economic organization into a trad-

itional society. About eighty per cent of the population, accord-

ing to the 1963 census, are still engaged in agriculture, the trad-

itional sector. Occupations in the various regions are as var-

ied as the ethnic compositions of the country. Akwete is noted

for its weaving industry: the Ijaws of the Niger Delta are re-

nowned fishermen; Ekulu pottery is well known; Ikot Ekpene raffia

weaving is very famous; and Ife sculpture is known world-wide.

Effects of a Dualistic Society

It is a well known fact of the economic and geographic

landscape that economic development does not occur evenly over

a nation. Regional growth differentials exist because of differ-

ences in regional natural resource endowment, levels of educa-
tion, health, capital formation, level of technology, and or-
ganizational ability. Complete elimination of regional inequal-
ities may be impossible, but their intensities can be reduced
through regional planning and investment. The elimination of
regional inequalities is in many cases at cross-purposes with
overall growth of the (GNP) Gross National Product.

In a dualistic society such as Nigeria, it is common to
recognize two divergent sectors--agricultural and industrial.
Though production in both sectors is subject to constant returns
to scale and diminishing marginal rates of substitution, produc-
tion in the secondary sector is more capital intensive than in
agriculture (Kelley, et al., 1972, p. 24). The capital inten-
sive sector is the leading sector while the agricultural sector
lags behind. The Fulani cattle industry is a good example of the
lagging sector of the traditional sector. One characteristic
of dualism is that the traditional or indigenous (agricultural)
sector and the technical, modern or enclave (industrial) sector
may correspond to a rural-urban dichotomy.

The peculiar "lag" characteristic of the Nigerian agri-
cultural sector is due to its redundant labor (disguised unem-
ployment) in the agricultural sector (Lewis, 1954, p. 141).
The contribution of agricultural labor is zero or very negli-
gible to the country's economy. A typical example of this in
Nigeria is the traditional employment in the Fulani cattle in-
dustry. The Fulani cattle industry is so labor intensive that

the marginal productivity of labor is negligible.

The more dynamic industrial sector comes about largely
as a result of foreign investment in capital intensive enter-
prises. In Nigeria, this is due to the exploration of mineral
resources, as there is no foreign-owned plantation agriculture.
The exploitation of tin on the Jos Plateau during the World War
II created a relatively prosperous economic island surrounded by
poor or depressed areas. The exploitation of petroleum at Port
Harcourt has created an affluent society for an employed popula-
tion amidst a very poor peasantry.

In a dualistic society, the two-factor markets[3] can para-
lyze rather than stimulate economic development. The high wages
in the industrialized sector (e.g., in the petroleum industry)
attract nearly all skilled and semi-skilled workers while employ-
ment in the agricultural sector is discouraged. There is a lack
of innovation in the agricultural (lagging) sector. This has
resulted in inelasticities of supplies of agricultural products
(mostly foods). When monetary expansion occurs because of employ-
ment in the industrial sector, or because of salary revisions,
the result is an inflation of prices. Savings become impossible

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[3]The two-factor markets here mean that one section of the
market is modern or industrialized and makes substantial in-
creases in the per capita incomes in that sector. The trad-
itional sector is lagged behind without making any dent in the
problem of poverty in this sector. A greater percentage of the
population in the traditional sector are engaged in agriculture.
The industralized sector comprises a small part of the popula-
tion that may be made up of foreigners or the elites.

because the people have no "common social demand"[4] (Furnivall,
1944, p. 447). This is detrimental to the formation of capital
for any entrepreneurial adventure. Easy chance of getting a job
in the industrial sector discourages innovation in the lagging
sector. Savings in a dualistic society do not accrue because
of limited entrepreneurial spirit in the dominant sector. This
results in the dilution of incentives to save, invest, work, and
restrict family size in an undivided family system (Higgins, 1956,
p. 111).

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[4]Here common social demand includes education, hospitals,
transportation networks, welfare, and development of other
public infrastructure facilities.

CHAPTER III

INTERREGIONAL MOVEMENT

The concentration of population in Southern Nigeria urban
centers has led to the development of a demand for perishable
foodstuffs not produced in local urban hinterlands, including
beef from the north. The southern urban centers have developed
a dependence on such distant areas of food production.

In order to provide the necessary food in the south, in-
terregional trade in perishable food developed. The development
of the interregional trade results not only from regional dif-
ferences in factor endowments and dualism, but also from the
growth of urban centers with concurrent demand for food. Popu-
lation growth, and urbanization in the south and the inability
of the urban hinterlands to produce and distribute foods have
resulted in protein deficit diets in the South.

In this chapter the emphasis will be on the flows of
beef cattle from the north (production region) to the south
(consumption region). The actual flows of cattle by hoof, truck
and rail from the north to the south will be identified. Ways
to remove deficits by changing patterns of transportation and
distribution will be considered. The optimal flows obtained by linear
programming techniques will be compared with actual flow. Finally, regional
investments as a sufficient solution to total distribution planning
will be suggested.

Removing Deficits Through Improvements in

the Interregional Distribution System

The movement of goods from production points to consumption points helps to maximize the value of the delivered goods. Due to transportation costs, perishable goods, are shipped to nearby markets. One difficulty of trying to sell such foodstuffs in the locality of production is that severe losses may be incurred by the local producers because of low income of the local consumers. In the industrialized nations, manufacturers market their goods at considerable distances from the points of production. This is made possible under situations of a highly developed transportation-distribution infrastructure and a workable relationship between supply and demand. Shortages promote sales by competitors or reduce demand by elasticity. Oversupply leads to price reductions, and higher consumption which can bring about a slumping of production.

Due to spatial variations in the factor endowments, production costs vary spatially, even if there is a homogeneous transportation network. These differences in production costs and labor productivity favor low cost regions, leading to a process of regional specialization.

The movement of beef cattle between Northern and Southern Nigeria can be evaluated in terms of complementary supply and demand, intervening opportunities, transferability of the goods, and distribution costs. Cattle are transported from Northern

Nigeria to the Southern Provinces because surplus production

is possible only in the north, while most of the demand is in

the south. Traditionally, trade cattle have been delivered to

the southern consumers by driving live animals along historical

trails.

Spatial interaction caused by regional complementarities

can be prevented or inhibited by trade restrictions or transpor-

tation costs. There are no internal trade barriers between the

northern and southern provinces of Nigeria. The major difficulty

has been the lack of efficient low-cost distribution systems.

Pointing this out one author said:

> Governments of the old regime were either ignorant
> of, or indifferent to, the question of distribution.
> In almost all of the recent plans and programmes,
> the emphasis has been on increasing production and
> productivity without any thought being given to the
> improvement of the distribution of the anticipated
> increases. And until very recently, no government
> past or present, bothered about marketing (Anthonio,
> 1966, p. 80).

In the 1970-74 Development Plan, 21.3 per cent of the national

expenditure was earmarked for the transportation sector (Federal

Ministry of Information, 1970, p. 179). Surfacing of roads and

extension of railways have been attempted, but these improvements

have had little effect on the patterns of cattle movement from

the production areas because total physical distribution planning

has been neglected in the belief that infrastructural investment

in transportation would improve the distribution of beef.

The distribution system in the southern Provinces is also

to be blamed for the deficient protein food supplies in the area.

Concerning the importance of physical distribution in marketing

Drucker emphasizes that:

> Physically, distribution contributes little, it can
> only mar, soil, tear, scratch, or otherwise damage
> or downgrade the product. Economically, however,
> distribution is the process in which physical prop-
> erties of matter are converted into economic value;
> it brings the customer to the product (Drucker, 1962,
> p. 103).

Efficient flow from production of concentration points is very

important in the distribution of goods, especially perishable

goods, to local consumers. Physical distribution, though it con-

tributes little if any to the physical characteristics of a pro-

duct, creates the attributes of time and place (Drucker, 1962,

p. 103). Meeting transaction time requirements and taking ad-

vantage of spatial organizations that allow efficient flows of

goods through the distribution network is the ideal arrangement.

Organizing distribution channels in an optimal manner is the con-

cern of modern business planners:

> Because physical distribution is fundamentally
> concerned with the spatial aspects of business
> operations, it is understandable that primary
> emphasis is placed upon geographical arrangements
> of exchange facilities. This preoccupation with
> georeference is intensified by the array of differ-
> ent markets a typical firm exchange channel must
> logistically support. However, distance alone is
> not adequate in planning an exchange channel
> (Bowersox, et al., 1968, p. 56).

Chronic protein deficiencies in rural Southern Nigeria

may be alleviated if the distribution of beef from urban centers

were better organized. The concentration effect of the present

beef cattle trade is such that the animals are transported from

the north to the southern urban centers without any effort to

redistribute them to rural consumers. Protein deficiencies in

Nigeria are not caused by a dearth of meat producing animals in

the country. Except for large-scale meat producing countries

such as Australia, New Zealand, Argentina, the United States, and

Canada, Nigeria compares favorably in the number of livestock

per capita. Nigeria has 28 cattle per 100 persons as compared

to 27 in Western Europe, and 504 in North America (Oyenuga, 1963,

p. 19). Table 4 shows the growth of local production of cattle

in Nigeria. The number of local production shows a rising kill-

out percentage, an estimate of the number of cattle available

for consumption throughout the country. Cattle sales in the

north are increasing. In 1966-67 local sales amounted to 430,109

while in 1970-71 they increased to 595,729, an increase of 38.51

per cent.[1] Recorded exports by rail and on-the-hoof show declines

because of the civil war in the country from 1967-1970. Trans-

portation to the then Eastern Region of Nigeria was impossible

during the war. Rail transport has declined because dealers

think that it is cheaper, though not faster, to move either by

truck (lorry) or on-the-hoof. The present trade cattle produc-

tion in the north is sufficient to provide more adequate beef

supplies to the coastal zone, where cattle production is not

feasible, in addition to increasing domestic consumption in the

north (De Young, 1968, p. 49). This statement has been confirmed

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[1]Slaughter figures showed a decline because all stations did
not send in their returns as reported by the Nigerian Livestock
and Meat Authority.

Table 4

Local Production of Trade Cattle 1966-1971

		1966/67	1967/68	1968/69	1969/70	1970/71
Recorded Cattle Sales	Local	430,109	464,181	588,274	629,680	595,729
(North)	Imported	253,216	220,684	279,641	279,912	267,603*
	Slaughtered	546,281	574,263	654,763	622,873	532,516**
Recorded Export to the South	Hoof	199,366	193,195	217,115	169,358	188,543
	Rail	175,623	94,845	68,400	82,392	106,450
	Lorry	8,409	17,952	48,771	44,820	49,335
TOTAL		1,613,004	1,565,120	1,856,964	1,829,035	1,740,176

Source: Nigerian Livestock and Meat Authority, Annual Report, 1970-71, p. 3.

*These were imported from Cameroun, Chad, Dahomey, and Niger.

**Returns were incomplete according to The Nigerian Livestock and Meat Authority's accounts.

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by the F.A.O. when it stated that:

> Beef production could, however, be increased even with
> present numbers of cattle, by a higher "harvest ration."
> This would mean that dry-season liveweight losses would
> have to be reduced so that stock of the same weight could
> be off the land at least one year earlier. (F.A.)., 1966,
> p. 228).

A critical aspect of the production-consumption system is the

lack of a modern distribution system for northern beef products.

It is the transportation sector that causes the protein deficiency

in Southern Nigeria because of inability to transport beef cattle

to the south. Table 5 which follows shows the composition of

the Nigerian meat supplies from 1963 projected to 1980.

Table 5

Composition of Nigerian Meat Supply 1963-64 & 1979-80

Type of	1963.64 Quantity (long tons)	Percent	1979/80 Quantity (long tons)	Percent	Increase Percent
Beef	193,000	44.9	300,000	34.3	55.0
Goat	95,000	22.1	180,000	20.6	90.0
Mutton	41,000	9.5	70,000	8.0	70.0
Pork	49,000	11.4	150,000	17.1	206.0
Poultry	52,000	12.1	175,000	20.0	237
TOTAL	430,000	100.0	875,000	100.0	103.5

Source: F.A.O., 1966, p. 229.

From the table, it can be noted that beef consumption

in Nigeria is expected to increase by fifty-five per cent by

1979-80. The increase in beef consumption will need the trans-

portation of more cattle from the north to the south. Other

types of meat were estimated for an increase in production due

to increasing population, urbanization, and rise of incomes in

the Southern Provinces.

The supply of mutton, poultry, pork and goat meat that

comes from the Southern Provinces is very small because of the

attack of tsetse flies and other epizootic diseases, such as

rinderpest and contagious bovine pleuro-pneumonia. The diffi-

culty with stock (goat, pig, sheep and poultry) raising in the

Southern Provinces has been well illustrated with a report from

Obudu Cattle Ranch in Ogoja Province in which it is reported that:

> For instance the severe harmattan ushers in acute
> wilting which renders the grazing scanty and in-
> adequate unless supplemented with some silage.
> . . . the effect of solar radiation on animals
> with unpigmented skins especially after intake of
> leguminous feed leads to hypersensitivity dis-
> orders and skin cancers which leaves openings for
> fungi and other skin infections to get established
> and deal the death blows in the wet months ahead.
> Invariably, the exotic breeds form the category
> most affected by this condition. The wet months
> which are characterized by high humidity precip-
> tate a syndrome of physiological disturbances
> which the lush innutritious grazing due to sea-
> sonality leaching of such nutritients predisposes
> to rapid fermentation causing bloat and metabolic
> disorders. This was acutally the condition
> noticed in the herds which explains why the Ranch
> can never progress with the present technological
> quackery which has no solutions to its problems. . . .
> Another note was sounded against sheep and goat
> breeding on the Ranch due to endemic infection
> of the soil with claustridia group of anaerobic
> organisms introduced into the Ranch when un-
> vaccinated. North Chevoit sheep were imported
> at the commencement of the Ranch, and were all

wiped out by the end of 1965.[2]

Livestock raising in the Southern Provinces to meet increased

demand for meat can now be ruled out because of the unsurmount-

able difficulties outlined above. The immediate solution to the

protein deficiences in the Southern Provinces is the importation

of beef cattle from the Northern Provinces.

Beef cattle production in the north can meet the increased

demand for meat in the south. Presently, the government is taking

serious steps aimed at improving as well as increasing cattle

production in the Northern Provinces. For example, there have

been reorganizations and expansions of the supplementary feeding

schemes to ensure that all cattle owners have access to the highly

subsidized (85%) concentrate feeds for their cattle, and these

schemes have already increased cattle production in the north

(Ministry of Agric. & Nat. Resources, 1974, p. 24). This pro-

duction increase has been markedly noticed in Kano where the

local trade cattle production of 111,192 in 1973 has increased to

160,163 in 1974 (Veterinary Division, 1974, p. 6). This was an

increase of 44.04 per cent over the previous year's production.

Other plans have also been made to increase cattle production

in the north.

More water supply will be provided by drilling artesian
wells and constructing dams in semi-arid areas and grazing
reserves will be established where the nomads will be en-

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[2]The information was contained in a letter communication
OCR/5/2/103 dated 3rd March, 1975, with A. O. Ntia, the assistant
manager of Obudu Cattle Ranch in Ogoja.

couraged to settle and practice better animal husbandry
and mixed farming. Extension work will be directed to-
wards pasture improvements, fodder conservation and
feeding of protein rich concentrates such as cotton seed
and groundnut-cake. Improved animals from Government
Livestock Breeding and Improvement Centers will be dis-
tributed to stock-owners (Fed. Min. of Information, 1970,
p. 121).

Table 6

Regional Annual Growth Rates of Population, Cattle

Production, and Beef Consumption, 1973 & 1974

Regions	Percentage of Population Growth Rate	Percentage of Cattle Production Growth Rate	Percentage of Beef Consumption Growth Rate
Eastern	6.1	1.0	15.09
Federal Territory	5.5	---	9.01
Midwest	4.7	1.0	11.81
Northern	2.7	19.27	5.12
Western	7.0	1.0	16.19
TOTAL	26.0	22.27	56.22

Sources: (1) Caldwell and Okonjo, 1968.
(2) Nigerian Livestock and Meat Authority, 1974.
(3) Food and Agricultural Organization, 1966.
(4) Ministry of Ec. Development and Reconstruction, Benin City, 1970.

It can be noted from the table above that the annual rate of

cattle production in the Southern Provinces is very small (about one

per cent for each region), while the consumption rates are very high.

In the Northern Region, production rate is high and consumption

rate grows at 5.12 per cent. This means that there are enough beef

cattle to take care of the increased consumption demands in the

Southern Provinces. The problem is to modernize transportation

and distribution channels. Though the kill ratio or extraction

rate[3] of the Northern cattle is small, there is always surplus

cattle for export to the south.

> There is, therefore, a surplus of 52,000 cattle a year
> available for sale from each 1,000,000 of the cattle
> population; or a rate of output of from the total herd
> of 5.2% annually (Shaw and Colvile, 1950, p. 63).

The Food and Agricultural Organization (1966, p. 223)

has estimated an extraction rate of 10.7 per cent for the northern

herds. On the other hand, it (F.A.O.) concluded that if the

government estimated cattle population is correct, the off-take

would be 18.3 per cent. The author in this study has calculated

an off-take rate of 19.27 per cent. Only seven per cent of the

extraction rate is marketed in the Southern Provinces (Mittendorf

and Wilson, 1961, p. 101). A higher percentage of this can be

exported to the Southern Provinces if efforts are made by both

private and government sectors to improve cattle transportation to the south.

Mere transportation is not enough. The beef cattle must be redistributed

from the concentration points in the Southern urban centers to rural con-

sumers. The importance of distribution of products has been

stressed in these words:

> Perhaps the single most important lesson the
> generation-old G. M. approach still has to teach
> us is that distribution policy and distribution

---

[3]Extraction rate is the percentage of cattle population
marketed annually. In Nigeria, the extraction rate is about
9.2 per cent as compared with twenty eight per cent in the
United Kingdom and forty per cent in the United States
(Oyenuga, 1963, p. 21).

system must take into account the entire flow of
the product regardless of lines of ownership and
legal responsibility (Drecker, 1962, p. 265).

The possible high extraction rate of the Nigerian cattle

has no meaning unless a reasonable off-take number is transported

and distributed in the markets in the Southern Provinces. It has

been concluded that the function of transfer constitutes the

mechanics of collection and dispersement and that goods must be

physically transported in order to achieve temporal and physical

value (Bowersox, 1969, p. 99).

Evaluation of the Present Transportation Modes

The movement of cattle from Northern Nigeria to the south

by the Fulani had been going on before the arrival of Europeans

in West Africa in the early seventeenth century. However, the

cattlemen never penetrated into the coastal south until the

arrival of the British colonial government and the maintenance

of settled conditions that Michael Gleaves calls the "Pax Britannica"

(Gleaves, 1965, p. 131). During the pre-colonial days, the trans-

humance movements were mostly connected with seasonal grazing

in the better watered portions of the southern savannah around

Tiv and Ilorin. Today, cattle movements into the southernmost

parts of the country are mostly connected with trade; but there

are some cattle led into the south for pasturing during the dry

season.

The Fulani cattlemen have never understood the demands

of urban cattle markets. Often, they graze their cattle too

far away from market centers (F.A.O., 1966, p. 217). For this

reason, itinerant cattle traders act in a liason role between

the cattlemen and the traders known as "middlemen." The activities

of these itinerants have been condemned when it is concluded that:

> The entire notion of loosely aligned middlemen
> seems to condemn distribution channels as being
> inherently endowed with duplication, waste, and
> inefficinecy. The social justification for in-
> termediaries has always appeared in doubt leading
> to the general belief that one road to increasing
> marketing efficiency depended on elimination of
> middlemen. Despite this condemnation, special-
> ized middlemen have survived and increased in
> importance (Bowersox, 1969, p. 95).

The itinerants move from one cattleman to another in order to

buy cattle from herdsmen who want to sell their cattle for

cash which is needed to pay for pressing items such as jangali

(cattle tax), salt for the cattle, and clothes for the family.

The number of cattle sold by the herdsman depends upon the price

and the need for immediate cash that forces him to offer his

cattle for sale. In other words, the Fulani sell their cattle

only when cash is needed and not in an orderly sequence of any

kind.

The cattle brought by the itinerant traders are taken to

local periodic markets in the north where they are in turn bought

by middlemen. The middlemen in turn sell their cattle to Hausa

dealers at such central markets as Bauchi, Gombe, Jos, Kano,

Katsina, Sokoto, and Zaria, etc. These dealers hire the cattle

trailed to the Southern Provinces to be sold to local agents or

butchers. A neglible number of Yoruba and Ibo dealers also buy

cattle directly from the middlemen and have them herded to the

south.

Transportation Modes

The dealers after buying the cattle in the north ship

them to southern markets by either foot, truck or rail. With

the development of Kianji (Niger) Dam river transport may be

used. However, the practicality of this may not be very soon

because of the large capital investment required for the purchase

of barges and its entire operation. Air transport which is us-

ually uneconomical, unless the plane can carry seventy-five

per cent of its capacity both ways, is not used in beef cattle

trade in the country (Ilorin, 1972, p. 61). In this section the

three widely used means of cattle transport in the country will

be analyzed.

On-The-Hoof

On-the-hoof means of transporting beef cattle is very

widely used in the country. It is very slow and labor intensive

but requires little capital. The practice is for a Hausa cattle

dealer to send his cattle through a drover, after obtaining a

permit from a control or inspection post, to herd the cattle to

the destined markets in the south (State Marketing Service, 1st

Ed., pp. 11-21). The practice has been described:

> The herd is driven by hired Fulani drovers, an average
> of one drover for every twenty-five head. The herd
> owner walks with his cattle as far as Ilorin, where
> he usually parts with the caravan and starts a recon-
> naissance trip, by lorries and mammy wagons, along the
> ninety-five miles route to Ibadan, stopping at the
> cattle markets in Ogbomosho and Oyo, and also at other
> smaller towns choosing the most advantageous place to
> sell. The more southerly the place, the higher the
> price, but the greater the hazards to the health of

        the cattle and the longer the period in which the
        capital is engaged (Cohen, 1965, p. 9).

Table 7 shows the number of cattle moved by hoof in 1973 and 1974

from the north. It can be noted from the table that movement by

hoof accounted for about sixty per cent of all recorded cattle

transported from the north to the south in 1973 and 53.82 per

cent in 1974. The decrease in 1974 might have been due to in-

crease use of the truck. Table 8 shows the origins and destina-

tions of the shipments. The greatest receiver was Lagos whose

supplies originated at Kano. Benin City was next with supplies

from Adamawa Province. Abeokuta had its supplied from Ilorin.

        One disadvantage of the trek is the complete loss of fat

in the cattle. The nutritional quality of the beef is very much

deteriorated before the cattle arrive in the southern markets.

The trek is only possible with cattle that are 7-9 years old.[4]

This helps to limit the harvest ratio of the Fulani cattle avail-

able for shipment to the south. However, it can be seen from

Figure 15 (the actual flow of cattle by hoof) that movement by

hoof is the only means that delivers cattle to rural consumers.[5]

All other means concentrate on cattle movement to urban centers.

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    [4]Only cattle that are 7-9 years old are able to undertake
the long and tedious journey from North to South (sometimes
nearly 1,000 miles).

    [5]During overnight stops or stops to allow the cattle to
drink or graze a little the cattle that are sick or unable to
continue the journey are sold to local butchers. In this way
villages along the cattle trek route obtain irregular and meager
supply of beef from drovers. On-the-hoof also herds cattle to-
wards urban centers except for emergency sales en route.

TABLE 7

Cattle shipment by Hoof 1973 and 1974.

		1973		1974	
Loading Points		No. Shipped	Percentage* of shipment	No. Shipped	Percentage* of shipment
1.	Adamawa	20,891	100	26,522	99.55
2.	Bauchi	2,917	27.40	2,287	16.22
3.	Benue	19,776	99.76	22,553	99.41
4.	Bornu	60,744	59.61	8,137	9.45
5.	Ilorin	37,389	97.63	48,760	99.83
6.	Kabba	3,322	100.0	5,724	100.0
7.	Kano	128,017	59.97	96,077	51.01
8.	Katsina	23,956	50.06	21,224	43.37
9.	Niger	3,121	29.58	19,109	65.12
10.	Plateau	10,457	99.11	20,622	94.47
11.	Sardauna	35,251	100.0	22,093	97.58
12.	Sokoto	26,396	92.53	100,527	90.15
13.	Zaria	4,549	39.00	3,531	31.75
		376,786	59.57	397,166	53.82

Source: Nigerian Livestock and Meat Authority, Marketing
Information Service: Quarterly Livestock Market
Survey, 1973 and 1974.

*The percentages are based on the total number of beef cattle
shipped at the station by hoof, truck, and rail for the year.

TABLE 8

Actual Cattle Shipment by Hoof 1974

Shipped from		Shipped to	
1. Adamawa	26,522	1. Benin City	23,028
		2. Calabar	82
		3. Ogoja	994
		4. Owerri	2,418
2. Bauchi	2,287	1. Oyo	2,287
3. Benue	22,553	1. Abakabiki	10,055
		2. Enugu	9,441
4. Bornu	8,137	1. S. Oyo	2,226
		2. Port Harcourt	5,911
5. Ilorin	48,760	1. Abeokuta	20,030
		2. Ibadan	18,629
		3. Ondo	10,101
6. Kabba	5,760	1. Abeokuta	4,602
		2. N. Oyo	1,122
7. Kano	96,077	1. Lagos	96,077
8. Katsina	96,077	1. Ibadan	14,366
		2. Umuahia	4,858
		3. Delta	2,000
9. Niger	19,109	1. S. Oyo	5,774
		2. Umuahia	13,335
10. Plateau	20,622	1. Calabar	6,254
		2. Enugu	8,215
		3. Owerri	6,153
11. Sardauna	22,093	1. Calabar	2,093
		2. Onitsha	20,000
12. Sokoto	100,527	1. Ibadan	34,207
		2. Lagos	66,320
13. Zaria	3,531	1. Benin	2,164
		2. Enugu	1,367

Sources: (1) Nigerian Livestock and Meat Authority
(2) State Ministries of Economic Development and Reconstruction.

ACTUAL CATTLE MOVEMENT BY HOOF, 1974

Figure 8
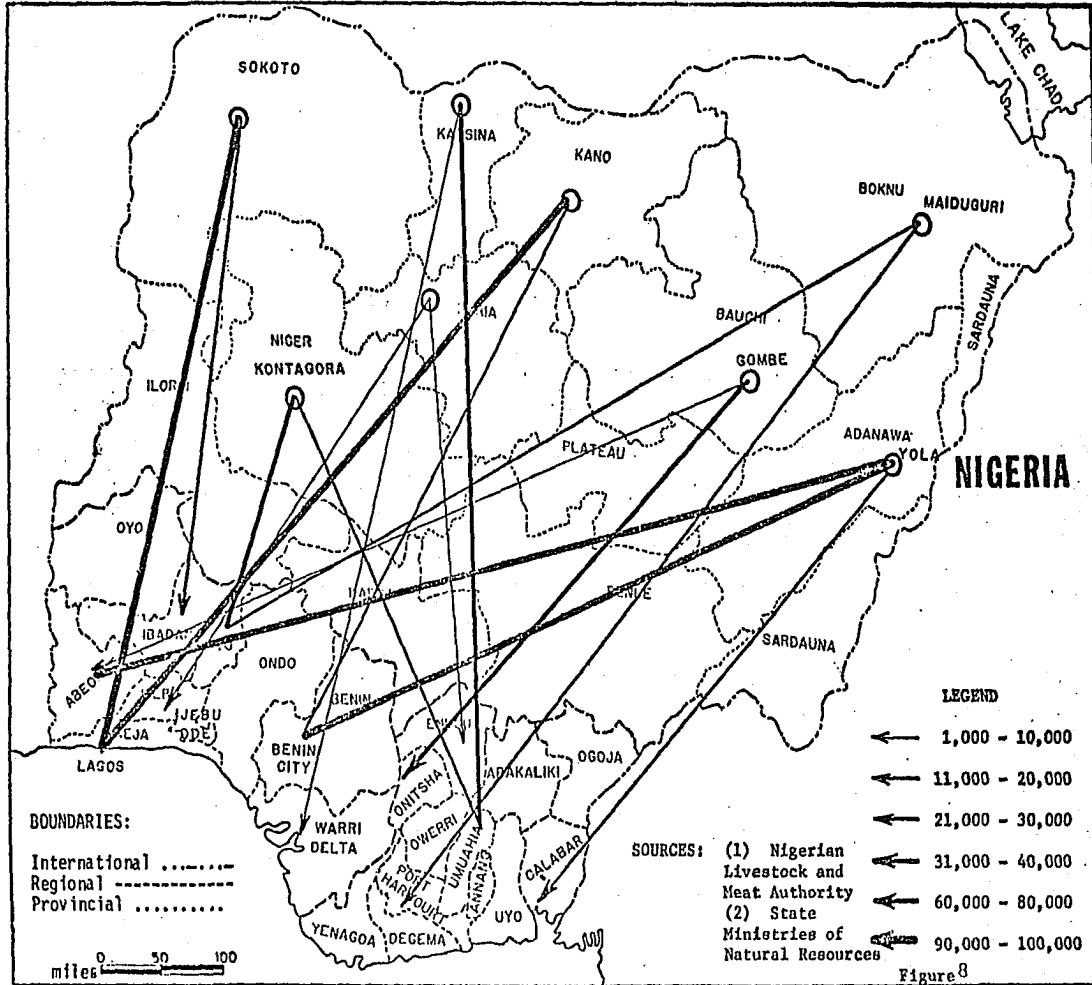
Rail transport cannot deliver cattle to many provinces in the

Midwest and Southeastern States because no railroads connect

towns in these states.

Truck Transportation

Transportation by lorry (truck) is a modern way of shipp-

ing the cattle. It takes three to four days to ship cattle by

truck from Kano to Lagos, a distance of about 712 miles. The

difficulty with truck shipment is that both roads and trucks are

badly maintained and there are no maintenance facilities on the

way. Many hours are lost by drivers who must repair their own

vehicles. Some of the roads are unimproved and many roads are

closed to traffic for several hours after rain begins to fall

(U.S.D.A.; 1972, p. 7). There are accidents on the road due to

either lack of sleep or rest by drivers.

From Table 9 it can be observed that shipment of cattle

by truck is increasing. It increased from 24.47 per cent in

1973 to about 31 per cent in 1974. Figure 9 shows the actual

flows of cattle from the trading points in the north to the south

in 1974. It can be seen from the flows that the trucking indus-

try delivers cattle only to the urban areas, while the rural con-

sumers are left without any regular delivers. This reveals one

major cause of protein deficits in the rural areas. Table 10

shows the origins and destinations of truck shipments in 1974.

Lagos and Ibadan received the greatest shipment from Kano. Benin

City had the next largest shipment from Bornu (see the table for details).

TABLE 9

Cattle Shipment by Truck, 1973 and 1974

Loading Points	1973 No. Shipped	Percentage* of Shipment	1974 No. Shipped	Percentage* Shipped
1. Adamawa	----	----	121	0.45
2. Bauchi	2,268	21.30	5,675	40.26
3. Benue	47	0.24	134	0.59
4. Bornu	41,160	40.39	78,010	90.55
5. Ilorin	908	2.37	81	0.17
6. Kano	75,969	35.59	89,204	47.36
7. Katsina	23,895	49.94	27,709	56.63
8. Niger	7,431	70.42	10,234	34.88
9. Plateau	94	0.89	1,208	5.53
10. Sardauna	----	----	547	2.42
11. Sokoto	2,132	7.47	10,966	9.85
12. Zaria	880	7.57	4,654	41.86
	154,737	24.47%	228,543	30.96%

Sources: Nigerian Livestock and Meat Authority, Marketing Information Service: Quarterly Livestock Market Survey, 1973 and 1974.

*The percentage are based on the total number of beef cattle shipped from the station by the three different modes (hoof, truck and rail).

TABLE 10

Actual Cattle Shipment by Truck, 1974

Shipped from		Shipped to	
1. Adamawa	121	1. Ogoja	121
2. Bauchi	5,675	1. Calabar	1,597
		2. Enugu	4,078
3. Benue	134	1. Port Harcourt	134
4. Bornu	78,010	1. Benin	28,410
		2. Enugu	12,256
		3. Onitsha	15,472
		4. Owerri	8,183
		5. Umuahia	10,009
		6. Uyo	3,680
5. Ilorin	81	1. N. Oyo	81
6. Kano	89,204	1. S. Oyo	1,500
		2. N. Oyo	1,447
		3. Ondo	250
		4. Onitsha	6,516
		5. Lagos	50,125
		6. Ibadan	32,559
7. Katsina	27,709	1. Lagos	20,855
		2. N, Oyo	6,854
8. Niger	81	1. N. Oyo	81
9. Plateau	1,208	1. Annang	423
		2. Port Harcourt	785
10. Sardauna	547	1. Calabar	547
11. Sokoto	10,966	1. Abeokuta	8,193
		2. Lagos	2,773
12. Zaria	4,654	1. Ijebu	1,127
		2. S. Ondo	330

Sources: Nigerian Livestock and Meat Authority, 1974.
State Ministries of Economic Development and
Reconstruction, 1974.

Figura 9

SOURCES: (1) Nigerian Livestock
and Meat Authority
(2) Field Data
(3) State Ministries of
Economic Development

BOUNDARIES:
International ―――――
Regional ――――
Provincial ···········
0   50   100
MILES

1,000-5,000
6,000-10,000
11,000-20,000
21,000-30,000

During the time of the cattle travel from the production
points in the north to the south, the cattle are given neither
enough food nor water. They stand on their feet throughout the
journey. The rough trip causes severe bruises to animals enroute
(Ilori, 1972, p. 59).

Rail Transport

This mode is employed in the cattle trade, but its use
in Nigeria has definite shortcomings. The locomotives are de-
signed for a maximum speed of 60 m.p.h. (Nigerail, 1973, p. 1).
The speed is quite slow and it takes about three days to travel
from the north to the south. One authority attributes the dif-
ficulty facing the railroad in Nigeria to inability of obtaining
additional stock, the old age of the equipment, and a very rapid
program of Nigerianization (Hance, 1964, p. 190). Table 11 gives
the number of cattle moved by rail from northern rail points to
the south in 1973 and 1974. In 1973, train carried about 16 per
cent of the cattle shipped (by hoof, truck, and train) to the
south, but in 1974 it carried only 15.22 per cent. Table 12
illustrates this.

The rise in the number of automobiles and buses made
possible by consumer credit has deprived the Nigerian Railway
of most of its short passenger hauls. In any case, it is un-
economical for a railroad to be engaged in short distance freight.
The Nigerian Railway, which is a statutory public corporation,
can hardly compete with the private truck owner in the country
whose aim is to make as much profit as possible from the daily

TABLE 11

Cattle Shipment by Rail, 1973 and 1974

		1973		1974	
Loading		No. Shipped	Percentage* of Shipment	No. Shipped	Percentage* of Shipment
1.	Bauchi	5,462	51.30	6,134	43.52
2.	Bukuru	5,541	100.0	9,898	100.0
3.	Funtua	1,744	100.0	1,063	100.0
4.	Gombe	----	----	8,692	100.0
5.	Gusau	5,262	100.0	3,116	100.0
6.	Kafanchan	1,141	100.0	1,455	100.0
7.	Kano	9,476	4.44	3,076	1.63
8.	Maiduguri	37,527	100.0	38,917	100.0
9.	Makurdi	4,863	100.0	10,866	100.0
10.	Minna	----	----	11	100.0
11.	Nguru	22,734	100.0	23,188	100.0
12.	Zaria	6,230	53.43	2,934	26.39
13.	Zonkwa	1,967	100.0	2,949	100.0
TOTAL		101,947	15.96%	112,299	15.22%

Source: Nigerian Livestock and Meat Authority, Marketing
Information Service: Quarterly Livestock Market
Survey, 1973 and 1974.

*The percentage are based on the total number of beef cattle
shipped from each station by the three different modes (hoof,
truck and rail).

TABLE 12

Actual Cattle Shipment by Train, 1974

Shipped from		Shipped to		
1.	Bauchi	6,134	1. Abeokuta	5,472
			2. Enugu	426
			3. Umuahia	236
2.	Bukuru	9,898	1. Ibadan	9,898
3.	Funtua	1,063	1. Oshogbo	75
			2. Port Harcourt	988
4.	Gombe	8,692	1. Enugu	8,692
5.	Gusau	3,116	1. Lagos	3,116
6.	Kafanchan	1,455	1. Port Harcourt	1,455
7.	Kano	3,076	1. Aba	1,041
			2. Ibadan	2,035
8.	Maiduguri		Ibadan	6,674
			Lagos	32,173
9.	Makurdi		\ba	1,377
			,nugu	4,020
			'ort Harcourt	5,469
10.	Minna		Oshogbo	11
11.	Nguru		Ibadan	2,075
			2. Umuahia	21,113
12.	Zaria	2,934	1. Port Harcourt	2,934
13.	Zonkwa	2,949	1. Oshogbo	2,949

Sources: Nigerian Livestock and Meat Authority
State Ministries of Economic Development and
Reconstruction.

operation of his truck (Barbour, 1967, p. 27). The government statutory corporation has no need to strive for profits. A glance over the Nigerian railroad schedule shows that passenger trains do not leave any station daily. For example, a train departs from Kano on Mondays, Wednesdays, and Fridays, and at Bukuru, a train is available once a week (Nigerian Railway Corporation Time Table, 1971). Figure 10 shows the actual flow of trade cattle by rail from the north to the south. It can be noted from the figure that many provinces such as, Abakalika, Annang, Benin, Calabar, Degema, Delta, Ijebu, Ogoja, Ondo, Onitsha, Uyo, and Yenogoa are not connected by railroad. These areas rely on either foot or truck for their sporadic supply of beef cattle. Table 12 shows the delivery of cattle to southern markets. The largest importer was Lagos. It received 32,173 from Maiduguri and 3,116 from Gusau. Ibadan came second with 9,898 from Bukuru and 6,674 from Maiduguri.

Present Regional Interaction Patterns

The present shipment of beef cattle from northern Nigeria to the southern provinces by hoof, truck, and train has some spatial patterns. Certain areas depend on certain modes. For example, figure 8 shows that movement by hoof originates mostly from the northwest and the north central parts of the country. Shipments from these areas go to the western provinces and the Federal capital of Lagos. A limited amount of shipment goes to the eastern provinces. The spatial pattern of the cattle movement by foot can be accounted for historically. Cattle

TABLE 12

Actual Cattle Shipment by Train, 1974

Shipped from			Shipped to	
1.	Bauchi	6,134	1. Abeokuta	5,472
			2. Enugu	426
			3. Umuahia	236
2.	Bukuru	9,898	1. Ibadan	9,898
3.	Funtua	1,063	1. Oshogbo	75
			2. Port Harcourt	988
4.	Gombe	8,692	1. Enugu	8,692
5.	Gusau	3,116	1. Lagos	3,116
6.	Kafanchan	1,455	1. Port Harcourt	1,455
7.	Kano	3,076	1. Aba	1,041
			2. Ibadan	2,035
8.	Maiduguri	38,917	1. Ibadan	6,674
			2. Lagos	32,173
9.	Makurdi	10,866	1. Aba	1,377
			2. Enugu	4,020
			3. Port Harcourt	5,469
10.	Minna	11	1. Oshogbo	11
11.	Nguru	23,188	1. Ibadan	2,075
			2. Umuahia	21,113
12.	Zaria	2,934	1. Port Harcourt	2,934
13.	Zonkwa	2,949	1. Oshogbo	2,949

Sources: Nigerian Livestock and Meat Authority
State Ministries of Economic Development and
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movement by foot can be accounted for historically. Cattle

ACTUAL CATTLE MOVEMENT BY TRAIN, 1974

FIGURE 10
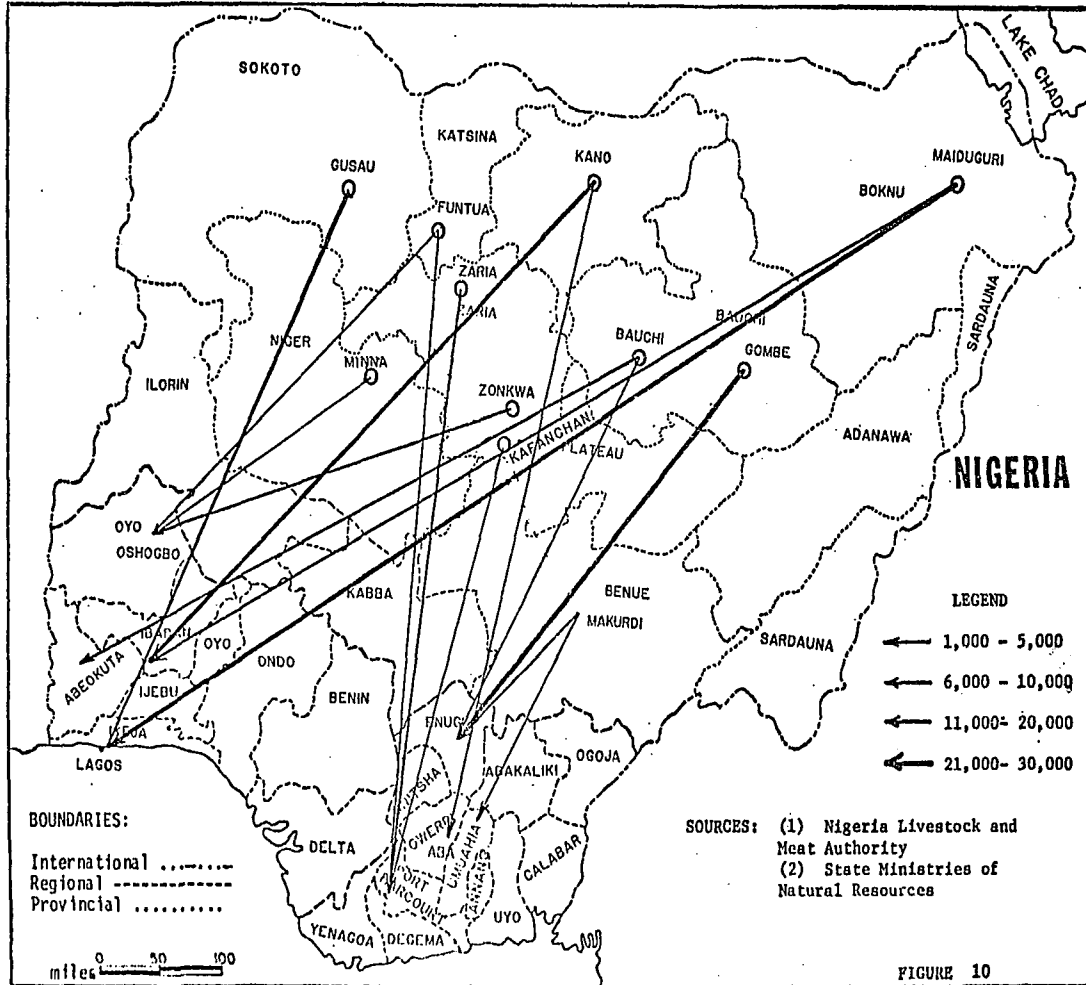
trails have for long been cleared and demarcated in those dir-
ections (Kwara State, 1972, p. 1).

Cattle movement by truck originates from the northeast
and north central parts of the country. Shipments from these
areas (Kano, Katsina and Zaria provinces) go to the west while
shipments from Bauchi and Bornu provinces go to the eastern and
midwestern provinces. There are some shipments from Niger pro-
vince to the east and midwest as well. The pattern created by
truck shipment in 1974 is illustrated in figure 9. The flow
patterns created by truck may be attributed to the orientation
of the Nigerian highway system. Figure 11 which follows shows
the road and railroad network systmes in the country. It can
be seen from this figure that the roads have a north-south orien-
tation because they were designed during the colonial government
to serve in carrying goods to the sea ports. The orientation
of the highway networks also determine the spatial pattern of
all truck shipments. The present domicile of truck owners creates
the spatial patterns of truck movements. Drivers shipping goods
from the north deliver the goods to markets that are near truck
owners'residence. This informs the private truck owners of the
arrival and departure of their trucks.

It can be noted from figure 10 that cattle shipment by
train originates mostly from the northeast. There are small
shipments from the north central provinces (Bauchi, Kano, Katsina,
Niger, and Plateau) and Sokoto in the northwest. The delivery
of these shipments produce two market regions in the south.

HIGHWAY AND RAILROAD NETWORKS

LEGEND

— HIGHWAYS

++ RAILROADS

--- COUNTY LINES

FIGURE 11
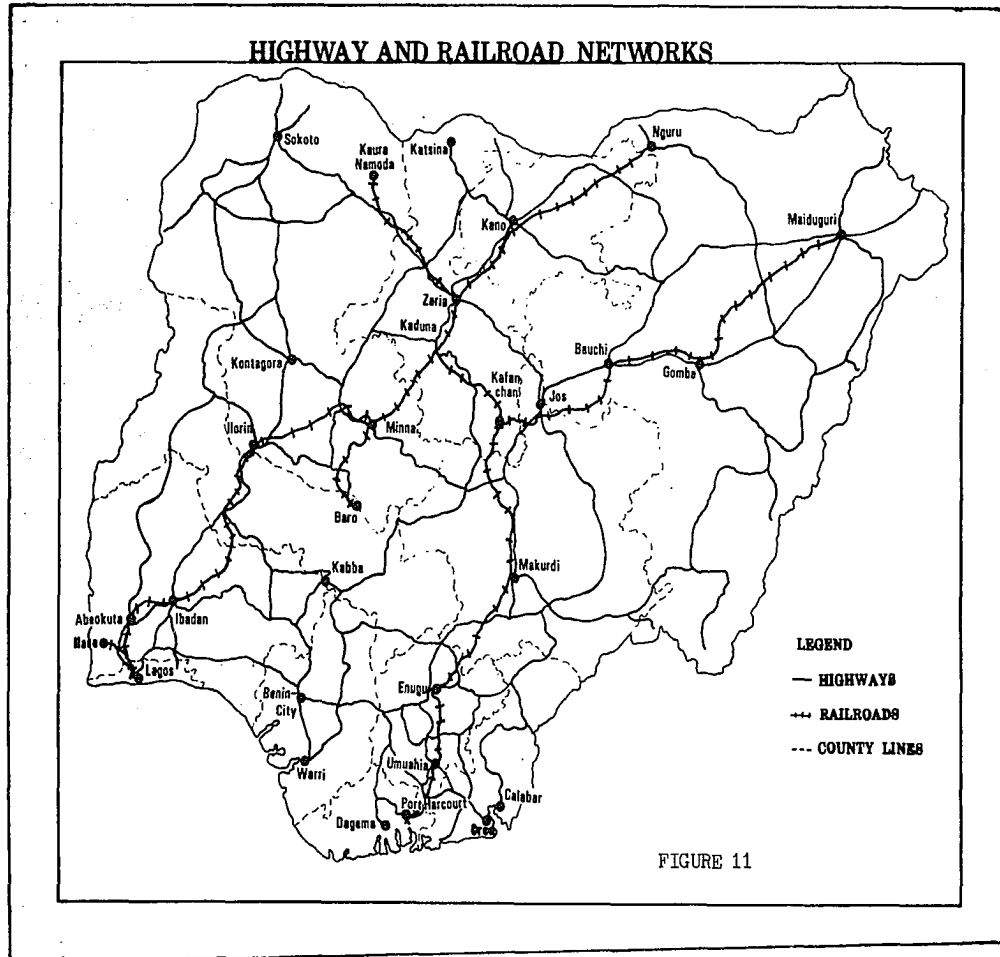
This market region in the east is made up of Enugu, Owerri,
Port Harcourt and Umuahia provinces. In the west it includes
Abeokuta, Ibadan, Federal Capital of Lagos, and Oyo. The re-
strictive two market regions is caused by lack of railroad
connections in the other provinces. This restrictive nature of
the train delivery market region suggests that the government
should build new railroads to give access as well as quicken
beef cattle delivery from the north.

Figure 12 shows graphically the percentages of beef
cattle exported from each area in the north for the 1973 market
year. One hundred per cent of the cattle exported from Adamawa,
Kabba, and Sardauna Provinces went by hoof. Very high percent-
ages were also moved at Benue (99.76%), Ilorin (97.63%), Plateau
(99.11%), and Sokoto (92.53%) Provinces. Rail loading points
are remote in these areas. Here the cattle dealers hire Fulani
drovers to herd their cattle to the south. Where there are more
cattle at the railroad station than the train can ship in a short
time the cattle dealers hire drovers to herd their cattle to the
south. Such a situation is common at Zaria where the train (in
1973) carried 53.43 per cent, on-the-hoof thirty nine per cent
and truck 7.57 per cent. Train movement was important at Bukuru,
Funtua, Gusau, Kafanchan, Maiduguri, Makurdi, Nguru and Zonkwa,
where it carried one hundred per cent of all the cattle exported
from each of the areas. However, the number of cattle carried
by train is small compared to those moved by foot and truck. In
1973 drovers carried 59.57 per cent of all the cattle shipped

CATTLE MOVEMENT AND THEIR MODES, 1973

SOKOTO 7.47%
92.53%

KATSINA 49.94%
50.00%

KANO 35.59% 4.44
59.97%

NGURU 100%

40.39%
59.61%

BOKNU
MAIDUGURI 100%

SARDAUNA 100%

GUSAU

FUNTUA 39.4

7.42 ZARIA
75 3.43%

NIGER 70.42%
29.58

BAUCHI 99.11%
.89%

ILORIN 97.63%
2.37

ZONKWA

WATRAU 7

ADANAWA

NIGERIA

OYO

KABBA 24
99.62%

WATRAU 51.30 2.30
27.44

100%

IBADAN OYO

ONDO

BENIN

BENUE

MAKURDI

SARDAUNA 100%

ABEOKUTA

IJEBU

ENUGU

IKEJA

LAGOS

DELTA

ADAKALIKI OGOJA

ONITSHA
OWERRI
PORT
HARCOURT UMUAHIA
ANNANG
CALABAR
YENAGOA DEGEMA UYO

BOUNDARIES:

International ....
Regional -----------
Provincial ....

miles 0 50 100

SOURCE: Nigerian Livestock
and Meat Authority

200,000
100,000
40,000

1,000

5,000
10,000
30,000
40,000

TRUCK RAIL

25% 25%
50%

ON-THE-HOOF

Figure 12

110

to the south; the truck moved 24.47 per cent, while 15.96 per

cent was carried by train.

It takes about five weeks for a drover and the cattle

from the north to arrive in a Southern Nigeria market, such as

Ibadan, a distance of about four hundred miles (Cohen, 1965,

p. 9). The routes on which the trade cattle trek are cleared

and well demarcated and there are some drovers' shelters built

on the route (Veterinary Division, 1972, p. 1). Throughout

the journey from north to south, the cattle are very meagerly

fed, if at all. Poor feeding coupled with long trek makes the

cattle weak and susceptible to diseases, especially trypanosomiases.

The trypanosome attacks begin to take place at the Ilorin

cattle-holding grounds where the tsetse species of Glossina M.

submorsitans and Glossina technoides with a few Glossina palpalis

are abundant (Jordan, 1965, p. 275). The cattle that have been

herded to the south have a life expectancy of only two weeks after

arrival, whereas cattle that travel by train can live for about

two and one half months (Cohen, 1965, p. 9). Apart from mortality

losses, the weight and quality of the meat from the trade cattle

decline after arrival. Godfrey, et al., (1965, p. 266) report a

loss of 9 kgm. on the experimental cattle trekked from Jibija

to Ilorin (a distance of 415 miles). Unsworth and Birket (1952)

calculated an average loss of 13 kgm. on the trekked cattle body

weight. A loss of 12.5 per cent was reckoned for on-the-hoof

cattle from Kano to Ibadan, a distance of about 630 miles (Werhahn,

et al., 1966). The loss of 220 lbs. on a 400-pound cattle

walked from Kano to Umuahia in Eastern Nigeria has been recorded
(Jones, 1946, pp. 36-37). Jones-Davis (1967, p. 330) has re-
corded an average body-weight loss of 13 per cent on cattle trekked
from Jibija to Ilorin.

Rail transport accounted for about 16 per cent in 1973
and 15.22 per cent in 1974. Trucking is on the increase. In
1973, it carried 24.47 per cent and in 1974 it transported about
31 per cent. Beef trade cattle transportation by train seems to
be declining. For the 1973 market year, trains carried nearly
sixteen per cent of the cattle shipped to the south; while in
1974 it carried only 15.22 per cent. The declining importance
of the Nigerian railroad has been noted in the transportation of
other goods. In passenger as well as goods transportation, this
state-owned railroad competes with the private truck-owners
whose interest is to make as much profit as possible; and in order
to maintain a high profit the truck-owners keep their vehicles
on the road as many of the twenty-four hours each day as they
possibly can (Barbour, 1967, p. 26). The layout of the Nigerian
railroad is often blamed for its inefficient use because it has
a very limited access to most areas. For example, very many re-
gional centers (states and provinces) have no railroads that
connect them with other areas. However, it should be noted that
the initial motives that the British colonial government had in
the construction of the Nigerian railroad were more political
than economic (Taaffe, et al., 1963, p. 510). Moreover, during
the early nineteenth century, emphasis was on long hauls of heavy

exports from the far interior to the coast as economically as
possible without trucks (Niven, 1970, p. 68). Though beef cattle
movement by train is declining it is cheaper than either truck or
on-the-hoof. A comparison of freight costs per cattle per mile
by foot, truck and train on appendixes A, B, and C reveals that
shipment by train is the least expensive.

Linear Programming

Important considerations in the decisions of the live-
stock (or meat) industry in Nigeria should be the optimal flow
of live animals (and in the near future dressed meat). These op-
timal flows can be obtained by using a special form of linear
programming, the transportation model. In linear programming
the standard transportation problem involves the selection of
shipping routes for transferring known quantities of a single
commodity from a number of specified destinations so that the
total transportation cost may be minimized (Kriebel, 1961, p.
67; Dano, 1965, p. 61).

Though optimal shipment patterns might not have been
achieved under the existing institutional structures and phy-
sical distribution management, they do portray the potentials
that exist in the trade. The organization of the interregional
cattle trade in the past may serve as a guide to physical dis-
tribution management decisions and probably trading patterns to
achieve adequate flow of cattle to southern Nigeria. In this
study interregional optimal flows for hoof, truck, and rail are

presented. The problem can be formulated:

Minimize $\qquad Tc = \Sigma i \ \Sigma j \ C_{ij} \ Y_{ij} \ Z_{ij} \ X_{ij}$ $\qquad\qquad\qquad$ (1)

$\qquad\qquad i =$ Cattle delivery points in the production

$\qquad\qquad\qquad$ region

$\qquad\qquad j =$ Cattle delivery points in the deficit area

$\qquad C_{ij} \ Y_{ij} \ Z_{ij} \ =$ Transportation cost coefficients for train,

$\qquad\qquad\qquad$ truck, and on-the-hoof

$\qquad\qquad \Sigma_i \ X_{ij} \ =$ Number of cattle delivered from i to j

Subject to: $\qquad\qquad X_{ij} - ki$

$\qquad\qquad i =$ Points 1,2,3,4, . . . i (surplus area)

$\qquad\qquad ki =$ Capacity of points i

$\qquad\qquad X_{ij} \ = \ rj$

$\qquad\qquad j =$ Points 1,2,3,4, . . . j (deficit region)

$\qquad\qquad rj =$ Demands of j

$\qquad\qquad$ The shipments (variables) cannot be negative

$\qquad\qquad X_{ij} \ = \ \gtrless 0$

and C_{ij} 70 for i $\neq$ j; $C_{ij} = 0$ for i = j $\qquad\qquad\qquad$ (2)

Cost of transhipment from a point to itself is zero for all points,

Where:

$\qquad\qquad\qquad\qquad N$

$\qquad$ Supply (S) $\qquad \gtrsim \Sigma \ rj$ $\qquad\qquad\qquad\qquad\qquad\qquad$ (3)

$\qquad\qquad\qquad\qquad j = m+1$

$\qquad\qquad rj = 0$ for j = 1 . . . . M

$\qquad\qquad ki = 0$ for i = m+1 . . . , N

$\qquad$ Following the above procedures an adaptation of linear

programming will be used to generate routes from the distribu-

tion points. The empirical data requirements are:

$\quad$ 1. the distribution networks of existing modes.

2. the distances in miles among the shipping and distri-

    bution points.

3. costs of hauls by the different networks.

4. size of shipments (number of cattle) by each line haul.

5. the delivery time required by each mode.

6. demands in each of the deficit areas.

    Economists have suggested the important determinants of

the level of demand as:

1. increase in the consumer's money income.

2. changes in the prices of other goods (substitutes).

3. tastes and preferences of the individual consumer.

4. a growth in population which can increase the total market

    demand for a product (Samuelson, 1961, pp. 434-435).

5. transaction costs, (ICP) Information-contractual-policing

    cost (Rogers III, 1971, p. 1921).

In Nigeria the above determinants are spatially differentiated,

thus giving rise to a wide variety of demand conditions and demand

intensity for perishable protein foods in the Southern Provinces.

Since demand must spring from the consumers, the mechanism for

the production-distribution of fresh perishable protein foods

in Nigeria is not responsive to demand as it is generated because

of low purchasing power.

    The United Nations Statistics Yearbook reports that

Nigeria had a per capital income of $211 in 1973 (U.N., 1974,

p. 644). This is too low to provide a good purchasing power for

the daily staple plus high priced perishable protein foods.

Many Nigerians earn far less than the per capital income cal-
culated by the United Nations Statistical Division.

In order to determine the best possible distribution
routing solution to the transportation problem in Southern
Nigeria, there is need to know the demand of each point in the
system. A linear regression analysis was used in predicting the
demand. Using the linear regression model, a sample of about
forty communities in the Southern Provinces was used to develop
the predicitve equation model.

The model requires a linear regression analysis formu-
lated as below:

$Y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4$ in pounds per community

Y = Demand (number of beef cattle)

a = intercept

b = slope

x_1 = Population

x_2 = Per capita income of the community

x_3 = Distance in miles between the communities

x_4 = Price per pound of beef (in Naira)

The results of the predictive model are given here below:

$Y = 179.20 + (10.94809)x_1 + (0.09125)x_2 + (-13.43174)x_3 + (22.66252)x_4$

The estimated demand function here assumes that the quantity of
beef variable is dependent or adjusting variable to price. This
study also suggests that demand varies with population density.

Dependent Variables

The expected per capital consumption of beef per community for 1974 was used as the dependent variable. This was the mean calculated from the F.A.O. (1964) minimum and maximum requirements to achieve the necessary protein intake.

Price

Since the quantity of beef demanded depends upon the price of beef per pound weight, the cost of beef in Southern Nigeria as published by the Nigerian Livestock and Meat Authority was obtained for the different communities.

Income

The disposable incomes of the Nigerian consumers were calculated from the Urban Consumer Survey published by the Federal Department of Statistics.

Population

Since the size of the community affects demand it was necessary to include the population of each of the communities as a variable. The population of each community was as published by the Digest of Statistics, Federal Office of Statistics, Lagos, January, 1974.

Distance

The distance (in miles) separating the various communities from their regional center was chosen as a variable because consumption of protein foods in a traditional society varies with distance from the source of beef due to perishability.

Solving the equation with the use of linear regression it is found out that an analysis of the raw data produced a multiple correlation coefficient of 0.9827 which explains 96.57 per cent (R^2) of the variation in community beef demand from the 1973 beef cattle slaughters. The use of this model in the analysis is emphasized: "One of the major applications of regression is in interpolation and prediction" (Hammond and McCullough, 1974, p. 221). The table that follows gives the step that each variable entered into the stepwise regression analysis and the contribution that each makes in order to explain the demand variance.

Table 13

Multiple Correlation Summary

Step entered	Variables	R	R^2	Increased R^2
1.	Number of Cattle	0.7043	0.496	0.4961
2.	Population	0.9896	0.9794	0.4833
3.	Per capita income	0.9918	0.9837	0.0043
4.	Distance	0.9921	0.9842	0.0005

The annual requirements for each province are given on Table 14. The number of cattle slaughtered in each province in 1974 has been subtracted from the requirements to point out the deficits. It can be noted here that the deficits are great. Since the demands for each area are calculated it is possible to find optimal solutions to the transportation model by the application of linear programming.

TABLE 14

Estimated Annual Beef Cattle Demands for Southern
Nigeria

	Provinces	Estimated* Requirements	No. Slaughtered in 1974**	Deficits
1.	Abakaliki	116,282	15,194	101,088
2.	Abeokuta	87,831	8,193	79,638
3.	Annang	73,179	2,436	70,743
4.	Benin	124,900	42,644	82,256
5.	Calabar	22,724	8,022	14,702
6.	Degema	85,729	---	85,729
7.	Delta	106,365	7,541	98,824
8.	Enugu	136,073	13,138	122,935
9.	Federal Territory	142,500	141,150	1,350
10.	Ibadan	250,486	80,876	170,410
11.	Ijebu	52,601	20,237	32,364
12.	Ogoja	36,134	3,057	33,077
13.	Ondo	213,913	25,904	188,009
14.	Onitsha	143,779	4,132	139,647
15.	Owerri	196,577	3,571	193,006
16.	Oyo	137,893	23,409	114,484
17.	Port Harcourt	70,309	10,843	59,466
18.	Umuahia	114,372	21,113	93,259
19.	Uyo	213,733	2,286	211,447
20.	Yenogoa	30,175	---	30,175

**Source: Nigerian Livestock and Meat Authority, 1974.
* The annual requirements have taken into consideration the F.A.O.
protein requirements of 0.33 g/kg/day (minimum) and 0.88 g/kg/day
(maximum). One cattle weighs 700 lbs in the north providing meat
and edible offals of 361 lbs.

Optimal Flows

Linear programming techniques were employed to obtain op-
timal distribution patterns of cattle from the north to the south.
Optimal flows data by hoof were obtained from a 34 x 34 regional
matrix. The cost of shipment per cattle per mile is shown on
Appendix A. The results obtained from the optimal flow are
shown on Appendix D and mapped in Figure 12. Compared with
Figure 8 (actual movement by hoof) it can be seen that optimal
flows can serve not only the large urban centers but the isolated
areas, such as Degema and Yenogoa, that received nothing as recorded in
the past. There is no direct shipment of cattle from the north
to Abak, Ikot Ekpene, Oron, and Uyo in the Southeastern Provinces.
Cattle slaughtered in these places are transhipped by foot from
from the train. Often cattle are bought at Enugu, after they
arrive from the north, and moved to Ikot Ekpene, a distance of
131 miles. The long trek by cattle after they arrive by train
exposes the animals to tsetse attacks. The animals become sick,
emaciated and die a week later.

The same linear programming techniques were used in a
33 x 33 regional matrix to obtain optimal flow data by truck.
The costs of shipment per cattle per mile by truck are shown
on Appendix B. The results of the optimal flows are shown on
Appendix E and mapped on Figure 13. Compared with actual flow
patterns on Figure 9 it can be noted that actual flow patterns
coverge on the urban centers such as Abakaliki, Benin City,
Ibadan, Lagos, Onitsha and so on. The reasons for this are:

OPTIMAL CATTLE MOVEMENT BY HOOF

NIGERIA

BOUNDARIES:

International ....
Regional -------------
Provincial ....

```
←  1,000 - 5,000
←  5,999 - 10,000
←  10,999- 20,000
←  21,000- 30,000
←  31,000- 40,000
←  41,000- 50,000
←  60,000 and over
```

SOURCES: (1) Nigerian
Livestock and Meat
Authority
(2) State Ministries
of Natural Resources

miles 0 50 100
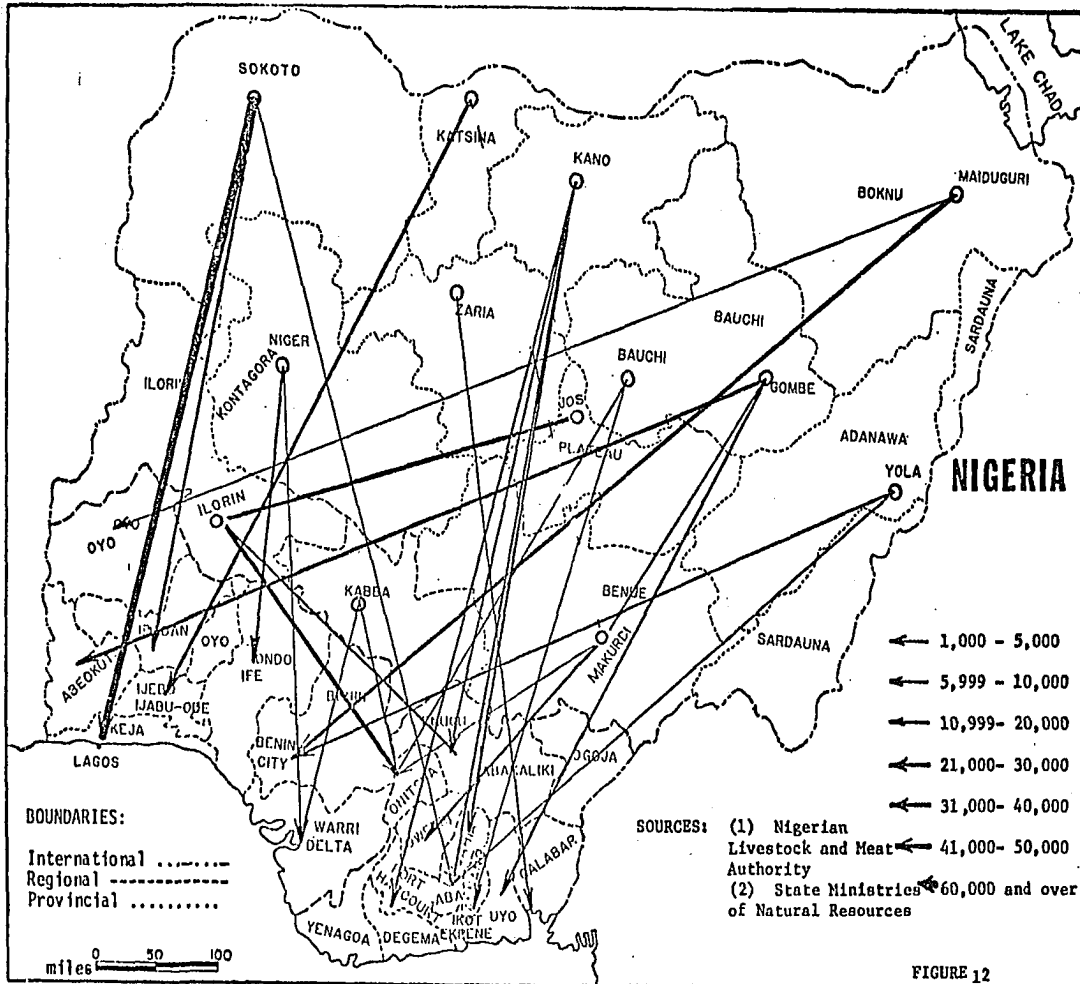
FIGURE 12

OPTIMAL CATTLE MOVEMENT BY TRUCK

Figure 13

BOUNDARIES:

International ....
Regional -----------
Provincial ....

miles 0 50 100

LEGEND

⟵ 1,000 - 10,000
⟵ 11,000 - 20,000
⟵ 21,000 - 30,000
⟵ 31,000 - 40,000
⟵ 41,000 - 50,000

SOURCES: (1) Nigerian
Livestock and
Meat Authority
(2) State Ministries
of Economic Development

(1) truck drivers deliver their cattle to the agents who live in the urban areas; (2) there are consumers with buying power in the urban areas; (3) cattle dealers prefer marketing their cattle in the urban areas where they make the highest possible profit. This causes the neglect of the rural areas; and (4) the truck owners who live in the cities like shipments between the north and the market near their homes.

The optimal flow data by train were obtained from a 31 x 31 matrix of the linear programming techniques. The results of these flows are given on Appendix C and mapped on Figure 14. Differences between actual and optimal flows by train were and are small. The only outstanding flows differences between the two are flows from Nguru in the northeast to Ibadan in the west and Umuahia in the east. The little difference is necessarily so because most of the culled cattle, which are always sent by rail, are used for making dried beef which is shipped by train to the Western Provinces. Nguru is a greater center for the preparation of dried meat. In practice little or no live cattle are shipped from Nguru. Secondly, the train is a modern mode of transportation in the country, and its use should be efficient but for lack of adequate physical distribution management in the country. The optimal flow figures for train are shown on Appendix F.

The Dual of the Transportation Problem

The dual of the transportation problem is to maximize the value added to the product by transfer between (1)

OPTIMAL CATTLE MOVEMENT BY TRAIN
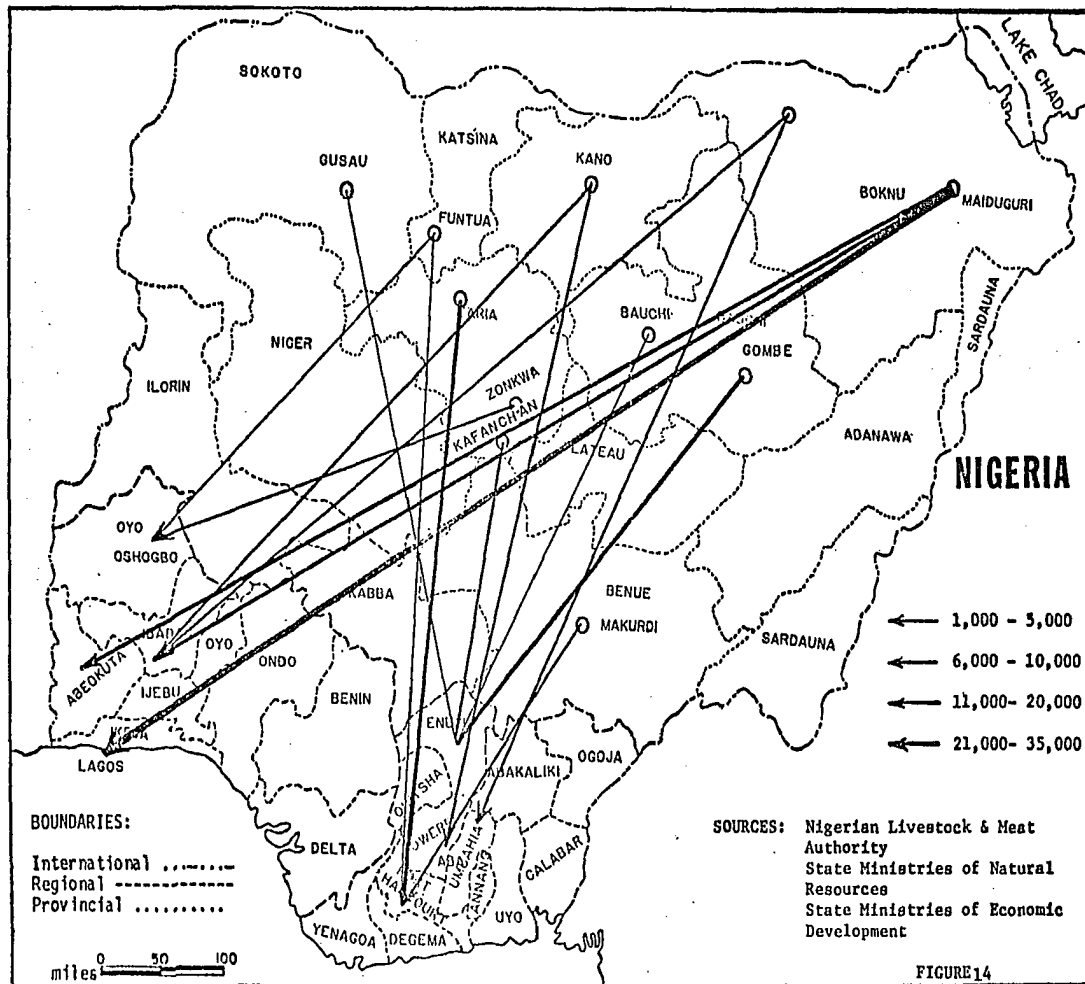
FIGURE 14

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The Dual of the Transportation Problem

The dual of the transportation problem is to maximize

the value added to the product by transfer between (i)

OPTIMAL CATTLE MOVEMENT BY TRAIN

NIGERIA

← 1,000 - 5,000
← 6,000 - 10,000
← 11,000 - 20,000
← 21,000 - 35,000

BOUNDARIES:

International ..—..—..
Regional --------------
Provincial ....

miles 0 50 100

SOURCES: Nigerian Livestock & Meat
          Authority
          State Ministries of Natural
          Resources
          State Ministries of Economic
          Development
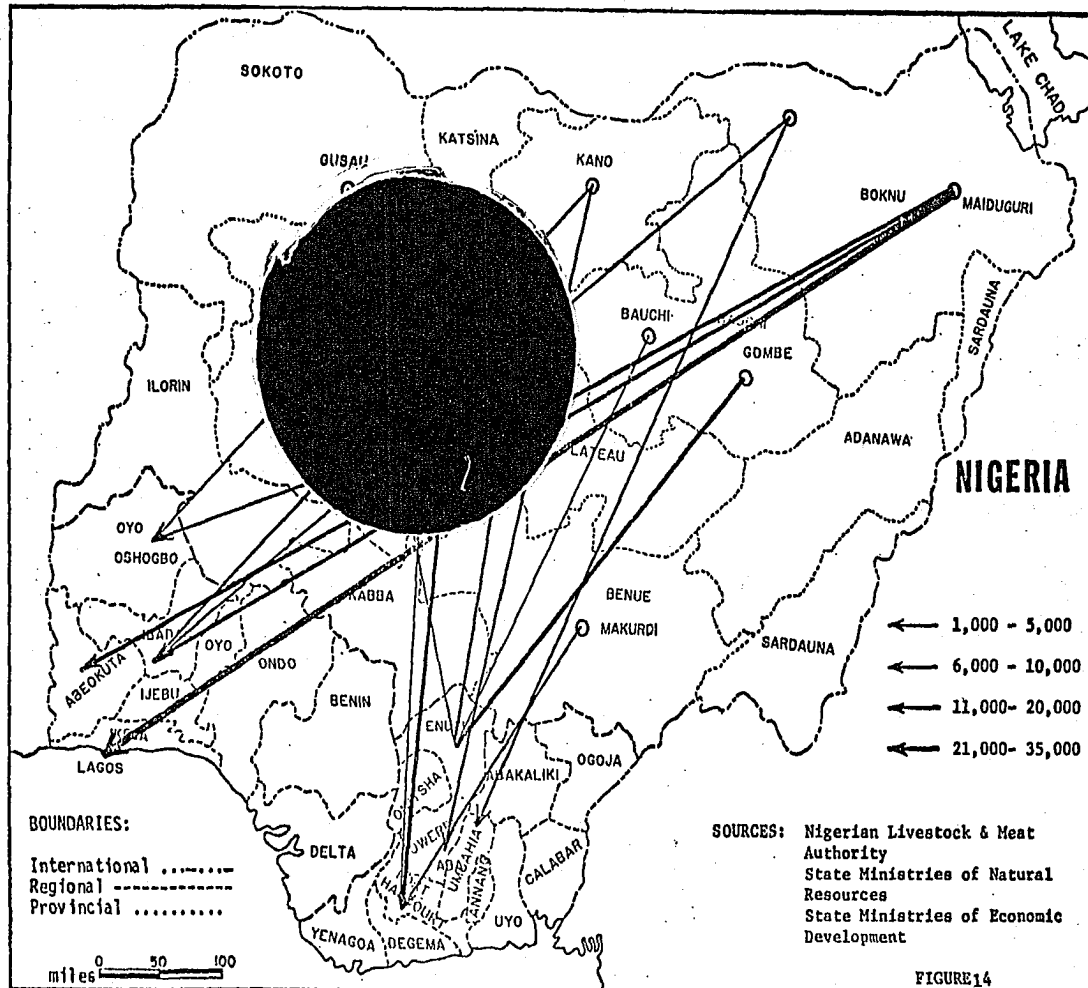
FIGURE 14

source and (j) destination (Taaffe and Gauthier, Jr., 1973, p.
169). Barr (1968, p. 174) defines the dual of the transporta-
tion problem as a technique for estimating relative differences
in factory price and marketed price among different producers
and consumers.

However, the economic implication of the dual is to
maximize for all (i) sources and (j) destinations the (S) value
added to the product at j minus the production cost at i.

In 1974 the recorded cattle shipment by all the three
modes totaled 738,008 and the truck was the most expensive.
Train was the least costly of all. If the train shipped all
the cattle from north to south there would have been a saving
of about 48 per cent in the total transportation cost. The
delivered values for the three different modes are given on
Appendixes D, E, and F. However, further investigations of
the spatial price system of the Nigerian beef cattle trade is
beyond the scope of the present study and must be left for
future analysis.

Flows and Inventory Replenishment

In recent years the industrialized nations have paid in-
creasing attention to all forms of flows, order-processing-trans-
mittal, and logistical operations. Businessmen who operate on
a profit know that delay in inventory replenishment increases
the probability of an out-of-stock condition at the retail store.
Elapsed time and delay in inventory flow is extremely critical

to total logistical performance (Bowersox, 1974, p. 283).

The first classical study of the importance of flows, time and delay of inventory on industrial performance was under-taken by Jay W. Forrester in 1958. In his investigation the im-portance of time lags in amplifying inventory and distribution requirements within an over-all distribution channel has been illustrated (Bowersox, 1974, p. 284). The kinds of relationships that are needed in the production-distribution functions can be illustrated in equation form:

$$UOR.K = UOR.J + DT \ (RRR.JK - SSR.JK)^6 \qquad (1)$$

i.e., the levels of unfilled orders at time K are equal to unfilled orders at time J plus the new orders received during the interval JK, minus shipments sent during the interval JK

$$SSR.KL = UOR.K/DFR.K \qquad (2)$$

Similarly, shipments sent from retail are the ratio of unfilled order to the delay in filling orders at retail.

$$K/(FAR.K/RSR.K) \qquad (3)$$

The delay in filling orders at retail depends on the size of the inventory relative to the ordering rate. As inventory gets

---

[6]A complete computer write up of this program is presented in Appendix G. The program follows Alexander L. Pugh III very closely. The program is Dynamo II (Dynamics Models). The pro-gram can deal with flow of goods into inventory, men into labor force and current into a capacitor. It shows the process that relates a quantity to the time rate of change of that quantity. The symbols are standard industrial dynamic symbols for levels, rates, sources, and sinks.

smaller, the delivery delay gets larger, the smaller inventories
being less able to fill an order from stock. The argument here
follows Pugh III (1973) very closely.

Figure 15 shows the interrelationships among the different
components of sales, inventory stocks at various distribution
channels, and production output. From the figure it can be
seen that a sales increase of ten per cent occurs in January.
It reaches a peak of sixteen per cent in March because new orders
received have been added to the retail level to increase inven-
tories as well as raise the level of orders and goods in transit
to correspond to the ten per cent in sales rate. The factory
output peaks at plus 40 per cent in June. In April the distri-
butors order reaches a peak of 28 per cent, not only because of
the 16 per cent increase for orders and goods in transit between
distribution and factory. The reverse is also possible. Retail-
ers who satisfy their inventory requirements decrease their order
rate. Factory output must, therefore, be decreased as in this
case - 13 per cent below the current retail sales.

These fluctuations in sales and distribution are possible
in the advanced economies of the world. In the less-developed
countries the peasants do not operate on profit margins and this
accounts for the reason why this kind of relationship among sales,
inventory stocks at various levels in the distribution channel,
and production output cannot be supplied in the case of the
Nigerian beef cattle trade between the Northern and Southern
Provinces.

PRODUCTION-DISTRIBUTION SYSTEM RESPONSE TO A SUDDEN
TEN PER CENT INCREASE IN RETAIL SALES
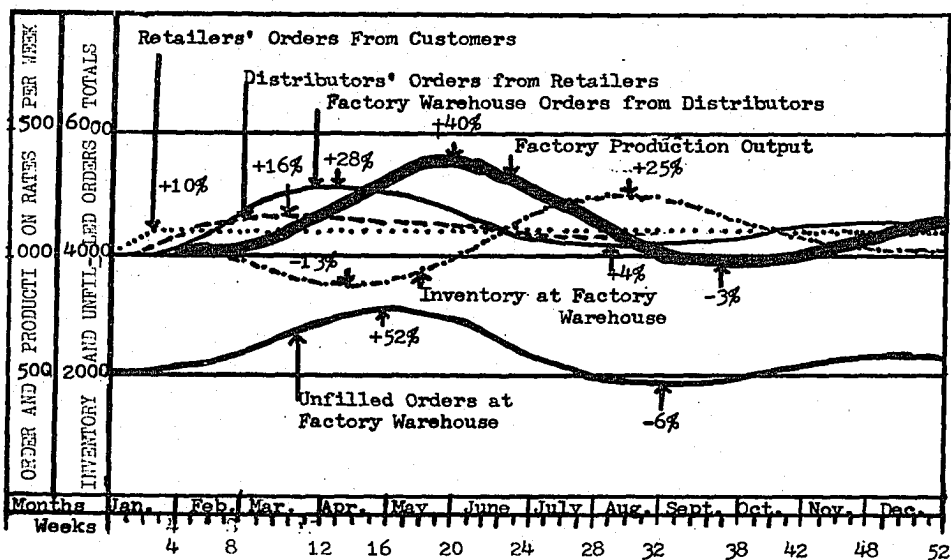
Figure 15

Ways to Improve the Effectiveness of the System

The protein shortages in Southern Nigerian diets are not caused by low cattle production in the country. It results from inefficient transportation development and the inability of the markets in the south to redistribute the beef received from the north. However, the kill-out-percentage (KOP) of the Nigerian cattle is low. It is about 9.2 per cent as compared with 28 per cent in the United Kingdom and 40 per cent in the United States (Oyenuga, 1963, p. 21). This low extraction rate is caused by the unwillingness of the Fulani herdsmen to sell their cattle unless forced to do so by certain emergencies. The maturity period for the Fulani cattle is four or more years as compared to one or one and a half years in the United States. These factors, plus poor physical distribution management if solved could result in alteration of the protein shortages in Southern Nigeria.

Cattle production in Nigeria is high enough to provide the needed nutrition to the people. Protein shortages occur "because means of communication with and transportation (of trade cattle) to consuming centers are still completely lacking" (Mittendorf and Wilson, 1961, p. 17). There is a discrepancy, such as the 'mai gida' credit arrangement, in the Nigerian cattle trade that helps to prepetuate low intake of animal production in Southern Nigeria.

Credit Arrangements

Most of the cattle that are transported to Southern

Nigeria have difficulty in reaching the vulnerable consumers

because many butchers are unable to obtain credit for the pur-

chase of cattle before butchering. Though a butcher does not

need much capital to stay in business, the entry of a new per-

son into the trade is difficult. Since cattle do not live for

long periods after arrival in the south, dealers always sell

their cattle immediately on arrival. They can do this only

through the granting of credit to local butchers.

The mai gida credit system, which grants cattle to a

butcher on credit, requires guarantee from the gida (cattle

broker) before the dealer can give out the cattle on credit to

the butcher. The gida will only act as a guarantor to a butcher

who does not owe money to any other cattle dealers. The butcher

must also be a regular customer, since the local law requires

that each butcher slaughters, at least, one head of cattle per

week in order to stay in business in the area.

The agreement of gida (or sarki) is necessary before any

cattle can be sold on credit to a local agent or butcher. The

cattle dealer does not always come to collect the loan. It is

the duty of gida (risk insurer) to see to it that the local

agent or butcher pays the cost of the animal bought to the dealer

during the next visit. Should the agent fail to pay his debt,

the gida who guaranteed the credit takes it upon himself to

collect the money. If the gida fails to collect the money, he

pays the money to the cattle dealer so that he may be able to

maintain his position as a cattle broker in the local cattle market.

The mai gida credit system is very unreliable. It leads
to losses on the part of the dealer in the case of the butcher's
death as it becomes impossible to collect the money from either
the deceased relatives or the risk insurer (gida). A local
butcher who owes a dealer, no matter how reliable he had been
in the past, cannot obtain any new credit in the cattle market.
Any debt no matter how small may put a local butcher out of
butchery business.

The dangers inherent in this kind of credit system can
be eliminated if a modern system of financial institutions is
established to handle or take over the present primitive credit
system. However, the absence of such a credit institution has
been recognized by the Nigerian Federal Government. In 1973,
the government under the auspices of the International Bank for
Reconstruction and Development (IBRD) opened the Nigerian Agri-
cultural Bank (NAB). One of the objectives of the bank is to
grant loans for agricultural production (for example, animal
husbandry, fisheries, forestry and timber production) and for
purposes of storage, distribution and marketing connected with
such production (NAB., Ltd., 1973, p. 3). Presently, many states
have taken advantage of the new developmental project. In the
past two years, the bank (N.A.B.) has granted loans to pro-
spective farmers in almost all the states (N.A.B., Ltd., 1973,
p. 5).

Cooperatives

As an agricultural marketing innovation, the Danish co-operative movement is often cited as a European example. This cooperative movement, which came into existence in the 1880's took place in a Danish rural environment. Is such cooperative marketing possible in Nigeria so that the peasants can pull their resources together for the promotion of reliable interregional and intraregional trade on beef cattle in the country? The work of the farmers Cooperatives in the United States can be pointed to as another example. The Farmers Cooperatives helps to transport, store, as well as promote the products of its members. The cooperatives efforts to minimize costs of marketing have served to build up cost-consciousness among its members, and this in turn has helped to hold down costs to consumers (USDA, 1972, pp. 28-29).

In some African countries, consumers/producers cooperatives have brought about active and conscious participation of the local communities in government's developmental plans. The reason for this has been summarized:

    This is partly because the method of organization and ad-
    ministration of a producer's cooperative are in accord-
    ance with the traditional African concept of a group
    working together for mutal benefit, while at the same
    time having a trustee or trustees appointed to manage
    the communal property in the interest of the groups as
    a whole. There is a clear parallel here between the
    managing committee of a co-operative society and the
    tribal elder or group of elders who take charge of the
    allocation of the use of the land (F.A.O., 1966, p. 361).

The establishment of cooperatives would lead to the establishment

of improvement measures such as regulations to suppress specific
abuses, maintenance of fair sales practices, provision of market-
ing information and facilities, grading systems, and the forma-
tion of new bodies to engage in marketing in competition with
existing marketing channels (Mittendorf and Wilson, 1961, p. 85).

Though the development of transportation infrastructure
is a public concern, cooperative organizations can help to re-
direct the beef cattle trade toward the vulnerable members.
Cooperative marketing has a distinctive economic advantage of
by-passing a number of middlemen so as to increase the rewards to
each member (F.A.O., 1966, p. 361). Since Southern Nigerians
have no means of preserving meat, and beef must be used as soon
as possible, it will be the place of the cooperative marketing
system to deliver live cattle as close to the final comsumption
areas as possible. This will hold down the price added by chill-
ing and freeze-drying that helps to put the price above the ability
of low-income consumers. Furthermore, canning, chilling, and
freeze-drying methods produce new food items that definitely
encounter strong consumer resistance in many parts of southern
Nigeria.

CHAPTER IV

INTRAREGIONAL MOVEMENT

Transportation network development in less-developed
countries has often been blamed for the continuing economic orien-
tation towards overseas markets (EAC/FAO., 1972, p. 42). The
most important phase in the transportation development in such
countries was the emergence of major lines which penetrate from
the seaports to the interior. Three principal reasons for build-
ing these lines of penetration from the coast to the interior have
been established: (1) the desire to connect an administrative
center on the seacoast with an interior area for both political
and military control, (2) the desire to reach areas of mineral
exploitation, and (3) the desire to reach areas of potential
agricultural export production (Taaffe, et al., 1963, p. 506).

In the past the political and administrative motives were
the most important. In West Africa these motives led to the con-
struction of railroads from Apapa to Kano in Nigeria, and from Cape
Coast to Kumasi in Ghana. Today, it is the desire for the exploi-
tation of mineral and agricultural raw products that dominates
railroad expansion in Nigeria.

In this chapter the shipment of beef from southern urban
centers to village markets will be examined. A simulation model
will de designed to represent the situation as well as allocate

beef from regional centers to village markets following the per-

iodic cycle of the rural markets. The incentives necessary for

rural marketing of beef will be considered. Finally, the dif-

ficulties associated with the introduction of refrigerated meat

and protein substitutes will be analyzed.

In Nigeria, today, the beef cattle trade has not departed

much from the traditional external market orientation. Beef

cattle leave the port of Lagos quite regularly for Accra, Ghana

(Ferguson, 1967, p. 30). Within the country, beef cattle trade

is oriented towards the urban centers.

The increase in the consumption of beef in the urban

centers has aroused the interest of some governmental bodies in

the country. For example, the Western Nigerian government

studied the possibility of establishing a central abattoir at

Ibadan (Arthur Little, Inc., 1964). The Federal Government has

taken surveys of consumption in urban centers.[1] The rural con-

sumers seem very much forgotten.

The reasons for urban consumption interest are not dif-

ficult to understand. Urban consumers can afford to pay higher

prices for beef. Average incomes in the urban centers are much

higher than those in the rural areas. The presence of foreigners

also stimulates the beef cattle trade in the urban centers. Most

wealthy Nigerians also live in the urban areas. Businessmen are

---

[1]The reports of the surveys are published in booklets titled
Urban Consumers Surveys. They are published by the Federal
Department of Statistics, Lagos, Nigeria.

interested in sales where they make the greatest profit.   In

rural areas consumers are too poor to support the business of an

ambitious entrepreneur.   Beef cattle are rarely transported to

rural markets, and as a result the rural populations are resigned

to an existence of the very scantiest amounts of animal protein

in their diets.   What is needed at the present time is a program

that will deliver beef cattle not only to the Southern Nigeria

urban centers but to rural areas as well.

Removing Deficits by Improvements in the
Intraregional Distribution Systems

A factor influencing perishable food supplies in Nigeria

is the effectiveness with which the traditional marketing systems

distribute the available products to rural consumers.   The absence

of an efficient marketing and distribution system is a great

barrier to improved nutrition, in rural areas of Southern Provinces.

Though most Nigerians are subsistence farmers and produce sufficient

staples for the needs of their families, southern producers who

cannot raise livestock are deficient in animal proteins in their

diets.   The important consideration here is that in cases where

the farmers do not raise cattle they should have the income neces-

sary for the purchase of meat.   A great percentage of the popula-

tion cannot afford to buy the food needed to meet their basic

nutritional requirements.   Since consumer prices in the country

are maintained at levels based on ability to buy, most rural

consumers cannot purchase the needed protein foods.

In order to encourage food consumption in the rural areas, marketing systems must be organized to provide fast and effective distribution not only in the urban areas but in the rural areas as well. The government has the primary respon- sibility of developing good transportation and marketing systems. The view has been stressed when it is stated that:

> These government responsibilities imply viewing good marketing as an essential and productive part of the economic system that "adds value" in the same sense as the production of food products on farms. Govern- ment should do everything possible through research, education, service, and regulation to promote the most efficient marketing system at lowest possible cost (President's Science Advisory Committee, 1967, p. 542).

Beef marketing in Nigeria, schematically described in Figure 16, has been broken down into three sections, namely, pro- duction, processing, and distribtuion and sales, with a number of subsections in each service area. The first two services are performed in the north while the last one is performed in the south. The work of the primary and secondary activities, as well as that of the mai gida (sarki) was described previously. The concern is the marketing of beef (cattle) in the Southern Provinces and why there is widespread protein deficiency despite the cattle slaughtered in the urban areas in the south. One problem can be isolated--inefficient transport and marketing systems.

When the butcher is able to obtain credit (i.e., after the Gida had guaranteed his credit before the cattle dealer) the butcher slaughters his cattle on a slab in or near an urban

MARKETING BEEF TO SOUTHERN NIGERIA CONSUMERS
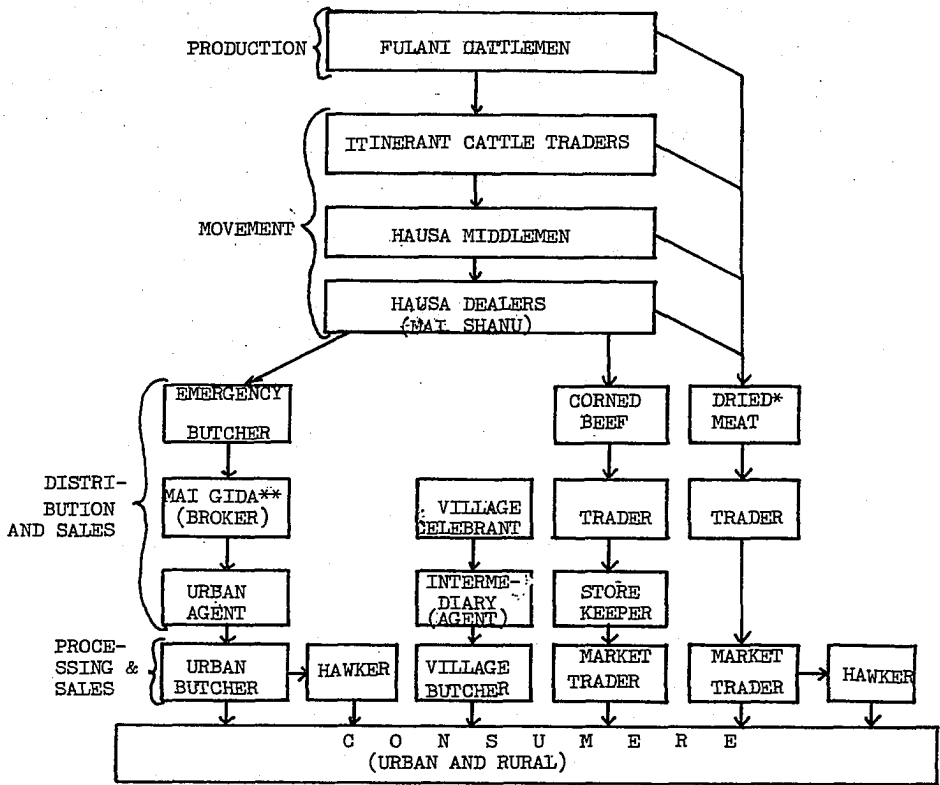
FIGURE 16

*The dried meat industry, an ingenous way of marketing meat from culled cattle, has its supply of cattle from all sources of the beef market industry. Dried meat is mostly sold in Western Nigeria.

**These people act as landlords and guarantee credit for the cattle dealers. In short, they act as middlemen between the dealers and the agents or butchers. They can be called "cattle brokers".

market. The meat is not separated into steaks, roasts, etc.,
as it is done in the United States; rather it is deboned and
cut into cubes (USDA., 1972, p. 33). There is little or no
difference in price among the cuts. This greatly affects the
low income consumers who can least afford to buy meat. The
situation has been described:

> In North America and Europe prices of the various
> cuts of a carcass differ considerably, especially
> as between the fore and hindquarters, in reflection
> of consumer preference. In Africa, such differentials
> have hardly developed because of the generally low
> consumption of meat, and because of the cooking
> methods employed. Most of the meat is deboned, cut
> up and cooked in small pieces. The quality of muscle
> is then more important than the quality and cut.
> Meat rarely is grilled; only the higher income groups
> are shifting to such cooking methods. The low meat
> consumption also favours the consumption of offals
> which Africans like to eat and of which the sale
> generally presents no difficulty (Mittendorf and
> Wilson, 1961, p. 28).

The deficiencies of animal protein in Southern Nigerian
diets should not suggest the absence of slaughtering operations
in that region. Slaughtering is carried on regularly in the
urban centers. A study conducted for the Western Nigerian
government testifies that:

> There are at present seven slabs being operated by
> the Ibadan City within the city limits and an
> additional fourteen slabs operating in the outlying
> districts. Approximately 110 cattle are slaughtered
> daily, seven days a week on the seven city slabs and
> sixty-five to seventy-five at the peripheral slabs
> (Arthur Little, Inc., 1964, p. 2).

The sale of beef is carried out by the wholesale butcher who
splits up the carcasses among retail butchers. Local consumers
buy their supply of beef from retail butchers. In the urban

areas, beef markets open early in the morning. If by the after-
noon all the meat in possession of a retail butcher is not sold,
the prices of the meat in the stalls will be drastically reduced
to stimulate sales. The meat that is still for sale after the
early morning rush is of lower quality. High income housewives,
who have the money for the purchase of meat, usually buy the good
parts of the beef during the early hours of the morning (Arthur
Little, Inc., 1964, p. 27). Low-income families normally buy
their meat supplies in the evening markets.

Some retail butchers may leave the urban markets for
village markets during the afternoon time. They do this because
they have to sell all the meat in their possession by the evening
on the day of slaughter. Any meat left overnight cannot be sold
because of stiff competition from retailers offering fresh meat
in the urban centers. There is also a difficulty of lack of re-
frigeration to keep the meat fresh for the following day (Mittendorf
and Wilson, 1961, p. 28). One of the greatest drawbacks to selling
cold beef is that the local consumers prefer their meat fresh.
This is necessarily so because Southern Nigerians desire fresh
flavor more than tenderness. The slaughter of cattle in the south
is, therefore, geared closely to daily demand (Western Nigeria,
N.D., p. 5). The local butchers try not to butcher more cattle
than they can sell on the day of slaughter. This practice has
helped to keep the price of beef high in the south. If there are
more daily customers than usual looking for beef to buy, the re-
tail butchers raise the price of beef instead of slaughtering more

cattle. The system of beef cattle distribution in Nigeria is
such that only the large towns in the Southern Provinces are
supplied with beef. The smaller towns (or villages) near the
cattle trails can get beef supplied occasionally when animals
that are unable to stand the strain of a long trek are sold en
route; occassionally, some cattle are slaughtered en route in
order to pay local tolls (Western Nigeria, n.d., p. 4). Villages
which are not near cattle trails have no beef delivered to them.
Protein deficiency in such villages is chronic. A dramatic
revision of the intraregional distribution of beef cattle in the
Southern Provinces is the only means for solving the non-beef
cattle delivery in the remote areas of the south.

In order to illustrate the intraregional movement of beef
from the southern urban centers to village markets, a simulation
model of the regional has been developed. The flow chart (Figure
18) gives a schematic description of the model. The model uses
19 towns as regional market centers and 114 villages as the dis-
tribution points. Using the demand model in Chapter II the pro-
gram distributes beef cattle from the regional centers to their
surrounding villages and specifies the number of cattle that
should be delivered per trip in order to achieve the required num-
ber of cattle that the consumers need for each month of the year.
A typical example of this is shown in Calabar Division in South-
eastern Nigeria. In 1973 the number of cattle slaughtered in
the division for a population of about 267,015 was 5,543 (South-
eastern State, 1973, p. 72). Some beef shipped from the central

Intraregional Demand Allocation Flow Chart
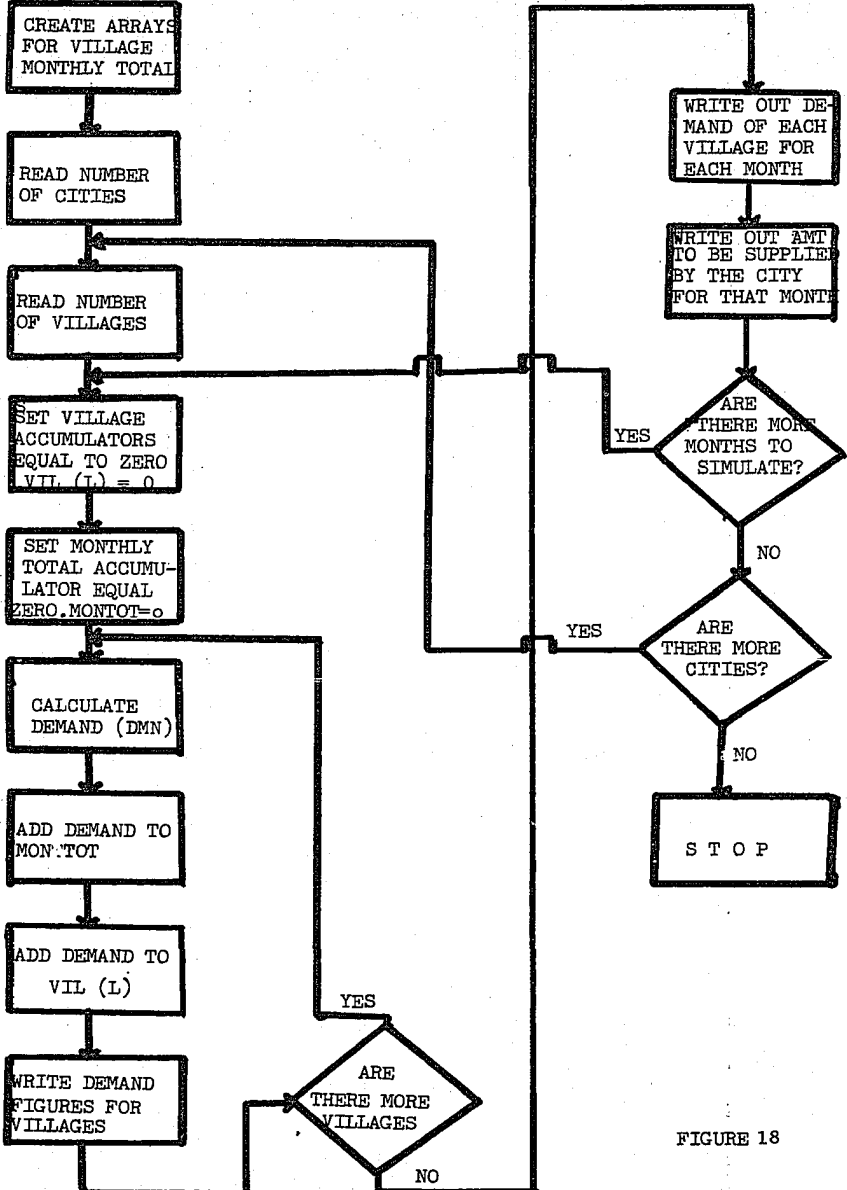
FIGURE 18

city (Calabar) served the surrounding villages. Six of these
villages have been selected for the present survey. Based on
population, distance from the central market (Calabar), cost of
cattle per head, and per capita income, the number of cattle that
each village would need per trip, per month and in a year was
determined. Each village market is visited about five times
each month based on either eight-day week or five-day cycle of
the periodic local market. Table 15 gives a list of villages,
the number of trips, the number of cattle delivered to each
village per trip, and total requirements for the month.

Gravity Model

In transportation researches the gravity model has usually
employed two masses, one at the origin and the other at the des-
tination. This model can be written:

$$I_{ija} = \frac{P_i P_j}{d_{ij}^{\beta}}$$

Where: I_{ija} = Interaction between i and j for
commodity 'a'

$P_i P_j$ = Measure of size i and j (No. of cattle
per trip)

d_{ij} = Distance separating i from j

β = Perishability factor

This formulation is based on the postulate that the potential in-
teraction existing between a beef consumer and the butcher's stalls
in Southern Nigeria varies with the distance separating the con-

TABLE 15

Periodic Cattle Allocation to Villages

in Calabar Division

Month	Villages	No. of Trips Per Month	No. of Cattle Per Trip	Requirements Per Month
January	1. Aningeye	5	12	59.8
	2. Atimbo	5	5	23.6
	3. Ikang	4	1	4.3
	4. Ikat Nakanda	5	5	23.0
	5. Mbarakom	5	4	20.9
	6. Oban	5	3	15.5
				147.1

The central market (Calabar) needs 130 head of cattle per month
for its urban population. The deliveries shown above are
made for each of the twelve months of the year. Other regional
centers and villages were treated in the same way but their
requirements are not listed here because of lack of space.

sumers from the butchers' stalls. Solving this for Atimbo
village market which is five miles from Calabar central market
with a high perishability factor because the trade is by foot
it is:

$$\frac{130 \times 23.6}{5 \times 10} = 61.36$$

This kind of regional market centers interaction with their sur-
rounding villages has been illustrated with four central markets
in the east in Figure 19.

There are, however, some common limitations associated
with the gravity model. It has been argued that the gravity con-
cept is an empirical notion with very little, if any, theoretical
substance (Olsson, 1964, p. 48; Hammond and McCullagh, 1974, p.
265). Huff (1961, p. 20) thinks that the gravity model tells
nothing about why observed regularities occur as they do under
various conditions and, as a consequence, leaves one at a loss
when unexplained discrepancies occur. Hammond and McCullage
(1974, p. 266) have encouraged the use of this technique in geo-
graphic studies because it helps in the prediction of future
effects of the location of a new town on the retail trade and
services of the neighboring towns; and it also helps to provide
information that can be mapped to describe a spatial distribution
pattern.

Since fresh meat can only stay fresh for about four hours
without refrigeration it has a very high perishability (e.g., 10
above) and the interaction is very low. Trade beef by foot is only

INTRAREGIONAL BEEF CATTLE FLOWS

N O R T H E R   N I G E R I A

⊛ Regional Market Center
→ Village Flow Lines
1 Abakaliki
2 Calabar
3 Port Harcourt
4 Onitsha

0   50   100
—————— Miles
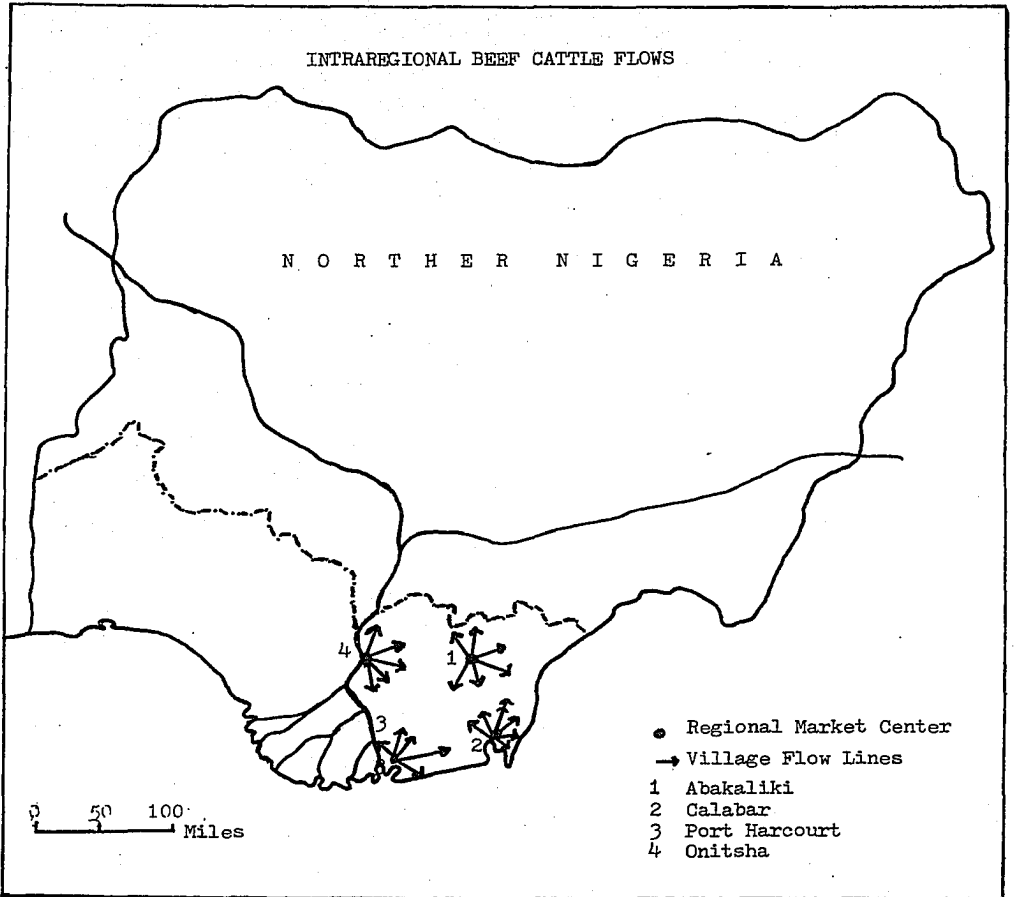
FIGURE 19

possible if the distance to be covered is about five miles. By
bicycle beef can be traded as far as fifteen miles, and by truck
it is possible to go as far as 50-60 miles. This is so because
Nigerian consumers think that fresh beef remains fresh for three
or four hours after it is butchered. After this time deteriora-
tion sets in. The area that can be covered in beef trade by
foot, bicycle and truck without refrigeration is shown on Figure
19. Trade by foot can only sell a limited amount of beef between
B_1 and B_2. By bicycle the area increases to P_1 and P_2 but with
a little large amount of beef. The truck can carry much larger
amounts of beef and can also cover a longer distance, but it
still needs about four hours to sell its unrefrigerated meat before
it deteriorates.

The solution presented by the model is that fresh beef
shipment from regional centers in the south to rural markets
would make it possible to maintain reasonable slaughtering as
well as distribution costs through the introduction of efficient
transportation and marketing systems. The reduced distribution
costs will increase the per capita consumption of beef in Southern
Provinces greatly needed to supplement the low protein intake
especially of the low-income consumers (Arthur Little, Inc., 1964,
p. 4). It would be possible to implement efficient meat in-
spection and sanitation controls because closer coordination can
be established between live and dressed carcass inspections before
the meat is shipped to the local markets. It would be possible
to arrange regular beef delivery to surrounding rural markets

MEANS OF TRANSPORTATION AND TRADE AREA
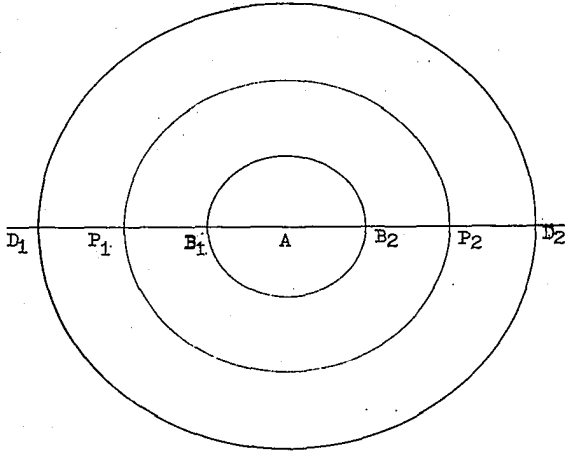
Figure 20

A = Abattoir (Butcher's stalls)

B_1-B_2 = Extent of peddler's distribution area (by foot)
P_1-P_2 = Area served by bicycle
D_1-D_2 = Distribution area of non-refrigerated truck

from an organized central location. Retail butchers who would
try to deviate from rural to urban markets can easily be checked
or tracked down. Consumption of animal protein foods can be
increased in Southern Nigeria urban as well as rural areas if
transportation is planned and developed.

Incentives to Rural Trade and Marketing

The role of the government in economic planning in a
free enterprise economy involves the provision of the necessary
infrastructure for the economic well-being of the country.
Government provides certain indispensable public services without
which community life would be hampered or rendered impossible.
By their very nature these functions cannot be left to private
enterprise. The traditional role of government in the provision
of these services has been listed as:

> . . . first, the provision of "public goods," such as
> police and fire protection, national defense, flood
> control, public health measures, roads, bridges, parks,
> and so on, where use by one consumer, up to very high
> limits, leaves unchanged the amount of the good avail-
> able for others; second, the construction of schools,
> hospitals, and possibly housing, where there are external
> economies in consumption and the consumer is compelled
> (as in elementary education) or encouraged to adopt
> appropriate standards; third, the prevention of external
> diseconomies by private concerns, in erosion, pollution
> or depletion of natural resources, the proliferation of
> standards, with consequent lack of interchangeability;
> fourth, the prevention of wasteful competition, such as
> duplicate railroads between two cities, or duplicate
> electric, gas, or telephone companies (Kindleberger, 1968,
> p. 125).

There are, however, some services that the government cannot pro-
vide by itself. A typical example is the monopoly franchise

granted to a public utility. In granting the utility company a

complet monopoly, the government steps in to protect the consumers

by setting maximum rates. "In setting such prices, it has long

been customary to pick prices that will try to give the company

a fair return on its capital" (Samuelson, 1961, p. 558). Viner

in supporting this commented that:

> Whether government should intervene, says Bentham,
> should depend on the extent of the power, intelligence,
> and inclination, and therefore the spontaneous ini-
> tiative, possessed by the public, and this will vary
> as between countries. "In Russia, under Peter the
> Great, the list of sponte acta being blank, that of
> agenda was proportionally abundant." Government
> has special responsibilities for providing security
> against food shortages as well as military security.
> He approves of government aid in the construction of
> roads, canals, iron railways, of public hospitals
> for the sick, hurt and helpless, of public establish-
> ments for the "occasional maintenance and employment
> of able-bodied poor," and, as we have seen, of public
> health activities on a scale still unknown (Viner,
> 1949, p. 371).

The argument for government behavior here should be that of in-

determinate benefits. Government can spread the risk over the

economy as a whole rather than concentrate on the hands of a

few entrepreneours. Since government has better access to in-

formation than private enterprise, it may be advantageous for

it to take the risk in innovation and decision making, and it

has the added advantageas regards ability to recruit highly

talented men into its services. Government can easily attract

intelligence, training, and energy in many countries in ways

which private enterprise cannot (Kindleberger, 1968, p. 127).

In all these, it is assumed that the government will avoid over-

centralized decision-making, maximization of the wrong variables,

and monumental projects.

In Nigeria, cooperative marketing societies might be formed

as a solution to dispersing government subsidies to encourage

cattle delivery to the rural consumers. This would lead to the

fulfillment of the Nigerian philosophy of planning which succinctly

stated reads:

> The ultimate goals of economic development is the welfare
> of the individual. The focus of our policy objective
> should, therefore, be on how the ordinary citizen is to
> be affected by the resulting set of action programmes
> and projects. The prospect of the citizen in the pro-
> cess of economic development and social change should
> not be determined by the mere accident of the circum-
> stances of his birth. He should be able to have equal
> access to all the facilities and the opportunities which
> could help him realize his potential and develop his full
> personality. A sense of self-reliance and a sense of
> national pride are worthy objectives which the Govern-
> ment believes the average Nigerian wishes to cultivate.
> But he can only do so in an atmosphere of expanding
> opportunities for full employment, for education and
> for self-fulfillment. The nation will, therefore,
> remain fully committed to the achievement of these
> objectives at all times(Fed. Min. of Information, 1970,
> p. 33).

The livestock and Meat Authority under the auspices of the Federal

government can regulate cattle slaughter in the urban areas. Pre-

sently, there is no regulated cattle slaughtering in the rural

areas.

Slaughtering Cattle Near Final Consumption Areas

One of the requirements of beef consumption in Nigeria is

that the meat be fresh. This is due to lack of refrigeration and

the suspicion that people in less-developed countries attach to

new technologies. In Nigeria, many people think that refrigerated

beef comes from "culled" cattle, especially those that are too

sick to travel to the Southern markets (Ferguson, 1967, p. 35).

Fresh beef is preferred in the Southern Provinces because of its

flavor. Fresh meat preference in Nigeria may be due to the way

in which it is traditionally cooked: most of the meat is deboned,

cut up into small pieces and cooked for use in stews with roots

and grains (USDA., 1972, p. 33). In this case, the freshness of

the meat is more important than the cut. This has been stated

in these words:

> Fresh meat is often preferred to chilled or frozen
> meat. It is not clear, however, how far this is
> due to mishandling during chilling and freezing, and
> the ignorance or misunderstanding of these ways of
> preserving meat. The lack of a refrigerated market
> channel from the abattoir to the consumer is the main
> obstacle to the introduction of frozen meat.
> There is also the question of how far the natural
> process whereby the meat matures after slaughtering
> has been interrupted by chilling. It may be that when
> chilled meat was offerred on the market it was not
> so tender as fresh meat (Mittendorf and Wilson, 1961,
> p. 28).

Since there is reluctance on the part of consumers to

buy cold or refrigerated meat, the marketing system should be

made to deliver live animals as close to the consumption areas

as possible. This suggests that it is necessary to slaughter

cattle near the point of final consumption. This can become

possible only if the government subsidizes transportation to the

rural markets because unsubsidized transportation would make

beef too costly for the most vulnerable consumers. The question

raised here is whether subsidized markets for meat can be per-

fectly competitive or not. The answer to this can be found in
the statement that subsidization can be used as a means to neutral-
ize or reduce resource misallocation under certain conditions
(Cumberland and Beek, 1967, p. 255). An action taken by the
government, in the short-run, to develop human capital may not
necessarily be consistent with a perfectly competitive allocation
of resources. In the long-run, the market should become subsidy-
free and competitive. However, the government can choose to make
promotional subsidies without government ownership. The govern-
ment can also create incentives so that the private sector will
eventually take over management of the distribution systems on
a profit basis. In Nigeria, government subsidy is very necessary
if cattle traders are to be encouraged to deliver cattle not to
only urban centers, but to the rural markets. Stressing the need
for links between separted markets Fromm said:

> Transportation is the link between geographically
> separated markets, whose growth can maintain a
> balance only if transportation is provided in
> efficient amounts and at efficient rates.
> Efficient pricing of regionally separated activities
> requires that the difference between the prices of
> homogeneous goods at different locations should not
> exceed the marginal cost of transporting these goods.
> In other words, if the difference equals the marginal
> cost of transportation, an interregional commodity
> flow will take place (Fromm, 1965, p. 120).

Refrigerated Meat Transport

The beef cattle marketing system has been criticized for
being wasteful and costly to consumers in Southern Nigeria. Its
wastefulness is caused by weight and quality losses due to in-

efficient means of transportation from north to the Southern Provinces. The transportation of meat from the urban to rural markets can be made more efficient by the use of refrigerated trucks and rail cars, trailers, and van containers. Such methods, might be a better distribution alternative to the present means of moving live cattle on-the-hoof, truck, and train. A large-scale operation of refrigerated meat trade would cut down the unnecessarily large number of middlemen that help to raise the price of the beef to the local consumers. "In some cases, meat is sold directly from the first level retailer to the consumer; in other cases, meat may pass through as many as three retailers before reaching the consumer" (Arthur Little, Inc., 1964, p. 25). Shrinkages and weight losses incurred during live cattle movement are almost eliminated.

Refrigerated meat transport saves feeding and labor costs because only the marketable carcasses and offals are transported to the consuming region. In an experiment in South Africa, weight losses on refrigerated carcass amounted to only 1.5 per cent (Mittendorf and Wilson, 1961, p. 59). In Nigeria, live weight losses of 10 per cent, 12.5 and 13 per cent on cattle trekked from Kano to Ibadan, Kano to Ilorin, and from Jibiya to Ilorin had been reported (Jones-Davies, 1967, p. 330 and Werhahn, et al., 1966, pl 23.). Apart from weight losses, live cattle transport by rail and truck causes severe bruises to animals en route (Ilori, 1972, p. 59).

Presently, there is a small scale trade on cold meat from the central abattoir at Kano to the southern urban areas where foreigners and some urban Nigerians patronize the trade. The abattoir handles only 400 cattle daily, and has a cold storage capacity of about 25 per cent of daily slaughter (Ministry of Agriculture and Nat. Resources, 1974, p. 21). There are a number of obstacles to the expansion of this trade, which is limited to the urban areas because cold storage is available only in such towns as Lagos, Ibadan, Enugu, and Port Harcourt. There are many foreigners and some educated Nigerians who buy the refrigerated meat. In rural markets, cold storage facilities are not available (F.A.O., 1966, p. 223). Most southern Nigerians are very skeptical about the technology of beef refrigeration. They complain about the taste of refrigerated beef.[2]

The use of refrigerated trucks, rail cars, trailers, and van containers in the transportation of beef from Northern Nigeria and distribution in the Southern Provinces may make the cost of beef much more expensive than it is at the present time.

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[2]In rural areas in Nigeria, ice is mystical and refrigeration is uncommon. Rural consumers in Nigeria are, therefore, afraid of eating refrigerated meat. The consensuses of local opinion are that:

(1) refrigerated beef comes from sick cattle that are unable to travel to the south:

(2) fresh beef is associated with fresh blood and the fact that refrigerated meat has no fresh blood means that it is not fresh before local Nigerian consumers:

(3) refrigerated meat is not as tender as fresh hot beef, and the test of refrigerated meat is not very appealing to local consumers.

In order to operate interregional and intraregional refrigerated truck service cheaply, there must be some return load from the consuming area. Such a backhaul would include avacado (Persea americana), banana (Musa sp.), cocoyam (Colocasia spp.), pawpaw (Carica papaya), pineapple (Ananas sativus), pumpkins (Cucurbita maxima), and yam (Dioscorea). Another difficulty with this trade is the technology. Nigeria does not produce refrigerated trucks, rail cars, trailers, or van containers. Though the trucks, trailers and vans can be purchased from abroad, mechanically refrigerated trucks are very expensive and the effects of possible breakdowns without mechanics to repair them must be taken into consideration.

However, the greatest obstacle to the use of mechanically refrigerated trucks, trailers, and van containers is the attitude of the southern consumers who prefer hot fresh beef to cold, re- frigerated, or chilled meat. An entrepreneur who ventures into large-scale refrigerated beef trade in the country now is likely to fail. For an enterprise to succeed there must be a demand for its product. Most of the protein-deficit groups in Southern Nigeria would not eat cold beef. To change this attitude needs some time for a new food consumption education, through extensive government advertisement programs. Some alternative meat sources have been suggested as a means of increasing protein intake in the area.

New Food Products

The need to make sure that any food consumed in any

significant quantities has the necessary nutritonal value has
led to the consideration of new products. The production of
new foods such as freeze-dried meat, canning, sausages, fortification,
meat analog, as well as improved plant hybridization techniques,
purchase from abroad and fishing have even been mentioned. Each
has its merits and demerits, costs and benefits.

Freeze-dried Meat

Following indigenous methods,[3] meat could be freeze-dried
in the cities before being shipped to markets in the rural areas.
Freeze-dried meat can be produced without reliance on weather and
scale economies can be practices. (1) The difficulty is that
electricity for processing freeze-dried meat is very expensive
in Nigeria. (2) Also, freeze-dried meat can easily be subjected
to spoilage because of high humidity. (3) Dried meat is con-
sumed only in the Western Provinces, and there may be insufficient
demand for a large-scale enterprise to operate profitably.

Canning

Meat can also be canned and then transported in tins or
cans to the consumers. Presently, there is a limited number of

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[3]There are local and indigenous dry meat centers at Maiduguri
and Nguru, which use cattle that would die in transit if walked,
trucked, or railed to the south. The local meat drying takes
place during the dry season from October to April. The procedure
is very ancient and small-scaled. The meat is first flayed, cut
into cubes, boiled, dried in the sun, and then smoked over a
wood fire. The bulk of the dried meat is shipped to the Western
Provinces.

beef canning plants in the country. In 1973, one of the plants,
the Nigeria Canning Company at Kano, shipped 56,755 cartons of
corned beef and 5,250 cartons of "jollof" rice-beef to the
southern markets. The factory used approximately 6,740 head of
cattle that year for its production.[4]

Canned beef has a limited market in Southern Nigeria be-
cause of the value added by manufacturing. Low income makes it
impossible for rural consumers to buy corned beef.

Sausages

The production of sausages has been suggested as a means
of supplying the local people with preserved beef. A new food
product can only be accepted by the people if it calls for a
minimum change in eating habits. Sausage is quite a new food
product to rural consumers. This should be considered as a long
term project that cannot solve the immediate protein malnutrition
problem in the country.

Fortification

Fortification of starch foods (cassava (manioc), corn,
rice, yam, etc.) has been suggested as the most promising im-
mediate possibility for improving protein nutrition (Jansen,
1974, p. 41). The nutrtional value of cassava, a very important

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[4]This information was obtain by letter communication with
Mr. James Frederick Trew, the general manager of the Nigeria
Canning Company at Kano. A carton of corned beef contains
approximately 15 pounds of beef and a carton of jollof rice
contains about 6 pounds of beef.

staple food in Southern Nigeria, can be improved by the addition
of protein concentrates. For example, the introduction of en-
riched rice in Japan has made beriberi a minor factor in mortality
rates (Mitsuda, 1969, p. 215). Commenting on cassava foritifica-
tion Jansen said:

> Concentrates are also of value in serving as a supple-
> mental source of protein in cassava-based diets where
> little protein is normally present. In such situations
> almost all the protein will be supplied by the concen-
> trate thus justifying concern about the amino acid
> pattern of the concentrate per se (Jansen, 1974, p. 67).

Fortification of protein vegetable foods would remove the
propensity of meat products to shrink and spoil, if kept for a
long time. The removal of these risks means that the foods can
compete favorably with other foodstuffs in the market. Fortified
(package) protein foods are easy to store for a long time and this
means that seasonality of protein food supply is eliminated.

Fortified food products have some difficulties. Protein
supplements, generally speaking, have adverse effects on accept-
ability of the final products (Jansen, 1974, p. 107). It may be
difficult to make rural consumers to buy fortified foods, because
changing the eating habits of man is always an unrewarding ex-
perience. Many Nigerians like the taste of beef. The fact that
it contains protein which is an essential ingredient in body
building is secondary to the people. In Nigeria consumers em-
phasize palatability rather than nutrition, and for any nutritional
program to be effective Goldblith has concluded that:

> . . . in order to be effective for a maximum group of

> people, a method of providing protein must do so with
> a minimum of change in the food and dietary patterns,
> in cultural practices, or in food habits. Any remedy
> in malnutrition which involves a change in food habits
> is likely to be ineffective in the short run. In the
> long run (i.e., certainly a generation's time hence or
> more) the increasing trend towards urbanization while
> creating an increasing number of problems related to
> urban living can also make it easier for more effective
> communications and education and advertising and thus
> can be helpful in beginning to change dietary customs
> (Goldblith, 1970, p. 26).

There is an added transport cost which must be passed unto the

local consumers who are the least able to pay.

Meat Analogs

Meat analogs resemble meat in some functional character-

istics, such as flavor, texture, color, and appearance. Meat

analogs can be both palatable and acceptable. However, the new

textured protein foods will demand a higher price in the market-

place than the raw commodities from which they are made (Altschul,

1974, p. 410). The high cost of this product would eliminate

the most vulnerable consumers who need high quality protein the

most. Other difficulties associated with meat analog have been

summarized when it is stated that:

> An essential point to be borne in mind in any case is
> that the addition of synthetic amino acids will only
> improve the quality of the protein without increasing
> the concentration of the protein in the food or the
> diet, whereas the need to increase the latter is often
> the most important problem in many developing areas
> (Altschul, 1974, p. 41).

The quality of amino acids added to meat analogs may deteriorate

during the course of enrichment, drying, and cooking.

In view of the problems involved in attempting to find

protein-rich mixtures to supplement deficient diets, the best option, presumably, lies in using the protein-containing materials (beef) direct as food rather than turning them into protein concentrates or meat analog (Aylward and Jul, 1975, p. 64). Owing to limited resources and the urgent need for establishing priorities, there should be less involvement on the development of new food products. Emphasis should be led on finding ways to reach the people with the already known and available protein sources. "Development is for the people and the current wants of the people should not be ignored for the sake of raising per capita output in the future" (Higgins, 1968, p. 367).

Alternative Meat Sources

More recently consumers in the Southern Provinces have been encouraged to eat fish, mutton, pork, and goat meat in order to increase their protein intake. The difficulties that each source suffers precludes further development. Though outside the scope of this paper, each source is considered briefly below without any close examination.

Fishing

In Southern Nigeria fishing operations are very traditional. They are conducted from tree-trunk dugout canoes which are propelled by poling. In some areas fishing is conducted from floating isl-

lands.[5] The fishing equipments in the country comprise simple
home-made basket traps, small throw nets, spears, and hooks of
bent wood and bone (Floyd, 1969, p. 241). The catch is very
small per person per boat. It has been estimated that the aver-
age catch in Nigeria per fisherman per annum is about one ton by
weight (Hance, 1964, p. 194).

Since the catch in the Southern Provinces is very small,
trade in banda (smoke-dried fish) from Lake Chad area, has deve-
loped but the journey from that area to the Southern markets takes
about seven to ten days (Nzekwu, 1963, p. 248).

In an effort to keep the fish in good condition until
they arrive in the southern markets traditional curing is prac-
tised. The technique is so crude that when the fish arrive in
the southern markets they are infested with insects, particularly
beetles, and the protein losses amount to about forty per cent.
The situation has been clearly depicted when it is stated that:

> Fish is cleaned and cut up into small pieces. Grass,
> sometimes not perfectly dry, is collected and the pieces
> of fish are spread on it. The grass is then set on fire
> and while it burns, the pieces of fish are partly
> smoked, partly cooked, and partly burnt but they are
> still far from dry. They are then spread out in the
> sun until they are completely dry. It is during this
> process of drying in the sun that the insects which
> are not wanting in banda and which reduce into a pulp

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[5]The roots of papyrus plants which grow on the shores of
Lake Chad bind the top soil together. During a storm some
suckers with roots break off the main body and float on the
lake. Often the Budumas chop off portions of the paprus bush
in order to obtain a floating island from which they can fish.
A floating island can be as large as fifty feet in diameter
(See Nzekwu, 1963, p. 250).

or powder the flesh of the fish find their way into
the pieces. The insects increase and multiply during
the long wait for tansport to take the fish from the
lakeside villages to Maiduguri (Nzekwu, 1963, pp. 249-250).

Presently only twelve pounds (66,000 metric tons) of

fish is consumed per head per year in the Southern Provinces

(Floyd, 1969, pp. 239-240). It is only by using improved fishing

techniques that the Nigerian fishermen can make substantial con-

tributions to ward off protein malnutrition in the country. This

can only be possible through the development of pond-fish culture,

the construction and stocking of artificial ponds with young fish

and fingerlings. The development of marketing facilities which

include transportation-distribution infrastructures are very im-

portant for any improvement in fish protein intake in the country

in any forseeable future.

Mutton, Pork, and Goat Meat

Mutton, pork, and goat meat--all contain proteins in vary-

ing amounts. Can they substitute for beef in the south? In the

Southern Provinces the ubiquitous tsetse flies, through the para-

sites they transmit, restrict all livestock raising. The breeds

of sheep, pig, and goats, are small and the rate of mortality

is very high (F.A.O., 1966, p. 216). At maturity these animals

yield carcasses that are rather lean and masculature. Some of

the runimants are tethered, but most of them roam about the villages,

over fallow lands, and even amongst the oil palms and coconut trees

of the large plantations. The indigenous pigs are mostly scaven-

gers and the ardent Moslems in the west do not look on pork as

clean meat. The F.A.O. (1966, p. 224) Report concludes that con-

sumption of these meats is hindered by the extent to which these

local animals suffer from intestinal parasites. Perhaps, because

of insect infestation that makes cattle raising unproductive,

people in the Southern Provinces are not stock-minded and they

depend on cash and plantation agriculture. Beef cattle from

Northern Nigeria presents a more immediate solution to the pro-

tein shortages in the south.

CHAPTER V

GOVERNMENT POLICY, PRODUCTION, AND DEMAND

The problem of wide disparities in levels of income and
economic development among nations and regions has increasingly
become a concern of economists and policy makers in the post
World War II period (Cumberland and Beek, 1967, p. 253). The
problem of protein nutritional disparities, has not been seriously
viewed by Nigerian development planners. However, income levels
have strong effects on the type of food consumed. In this chapter
the strategies of policy implication in the promotion of beef con-
sumption will be developed. The development of human resources
as a distinctive and important feature of the economies of the high
income industrialized western nations has led to some focus on pro-
tein consumption not only by food scientists but also by social
scientists. It is echoed that:

> Much of what we call consumption constitutes investment
> in human capital. Direct expenditures on education,
> health, and internal migration to take advantage of
> better job opportunities are clear examples. . . .
> In these and similar ways, the quality of human
> effort can be greatly improved and its productivity
> enhanced. I shall contend that such investment in
> human capital accounts for most of the impressive
> rise in the real earnings per week (Schultz, 1961,
> p. 1).

Decision to improve the diets of all Nigerians (urban and rural)
should be viewed as an integral part of economic development,

and can only be achieved through the development of transportation-distribution-marketing systems properly designed to emphasize the interrelationships between north and south, producers and consumers. This has been emphasized when it is said, "Physical distribution may be viewed in a passive way as the backup capability to support the marketing objectives of the firm" (Bowersox, et al., 1968, pp. 24-25). The goals of Nigerian society, expressed through the Federal government on the Second National Development Plan 1970-74 are the acceleration of the rate of economic development and improvements in the standard of living through the maximum use of national, financial, and human resources for the expansion of the economy (Fed. Min. of Information, 1970, p. 33).

Once a rise in per capita income is established, the problem of initiating and intensifying protein food consumption in spatial terms is concerned with funneling fresh protein foods from production regions to consumers in the more remote parts of the country. Time-cost constraints which stem from poor, inefficient, and unreliable transportation-distribution links between separated regional markets severely hamper perishable protein food consumption in Southern Nigeria thus accentuating protein malnutrition not only in the periphery but also in the urban centers. Presently, per capita incomes in Nigeria are so low that the malnutrition problem can only be solved by government intervention through the provision of transportation subsidies to provide an adequate distribution system.

Subsidies

Since the disposable incomes in Nigeria are so low that people cannot afford to pay for high cost protein foods, it is the place of the government to alleviate the protein malnutrition dilemma. This can be done by subsidization of cattle movement from north to the southern markets. "Livestock is available from the north to increase slaughterings as fast as the demand for meat increases" (Arthur Little, Inc., 1964, p. 5). Table 16 gives the quarterly total production for 1974 (i.e., the number of cattle that was available for sale from Northern Nigeria). Local production was lowest during the third quarter because during the rainy season, cattlemen do not sell their cattle. There is grazing for the herd. Above all, during this time, cattle drovers, the greatest carriers of cattle, are unable to trek with cattle to the south. In 1974, local cattle production was highest during the second quarter (April-June) the heart of the dry season when grazing is scanty and the herdsmen have to move with their cattle to the more watered savannah areas in the south. Compared with 1971 local trade cattle production it can be seen that production is increasing. In 1971 there were 595,729 trade cattle as compared to 675,682 in 1974. Commenting on the increased production it is stated that:

> . . . it can be seen that 185,646 head of locally
> produced trade cattle were recorded during the second
> quarter of 1974. This shows an increase of about
> 26.0% more than the figures of the second quarter
> of 1973 (Nigerian Livestock and Meat Authority, 1974,
> p. 2).

TABLE 16

QUARTERLY TRADE CATTLE PRODUCTION IN NORTHERN NIGERIA, 1974

Provinces		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Total
1.	Adamawa	2,377	4,348	8,793	6,520	22,038
2.	Bauchi	3,586	8,039	7,194	-	18,819
3.	Benue	5,476	6,751	7,792	6,004	26,023
4.	Borno	57,848	61,675	47,124	63,728	230,375
5.	Ilorin	14,865	24,835	3,590	1,161	44,451
6.	Kabba	1,454	1,630	1,919	707	5,710
7.	Kano	35,693	34,877	19,984	38,470	129,024
8.	Katsina	7,544	3,825	5,243	7,011	23,623
9.	Niger	1,953	7,443	13,930	3,764	27,090
10.	Plateau	6,741	6,787	10,426	6,847	30,801
11.	Sardauna	3,596	5,507	7,061	6,838	23,002
12.	Sokoto	22,188	17,129	22,608	20,563	82,488
13.	Zaria	1,610	2,800	4,102	2,373	10,885
	TOTAL	165,931	185,646	159,766	164,339	675,682

Source: Nigerian Livestock and Meat Authority, 1974.

The practice of attracting a special development project to a cer-

tain locality by means of inducements or subsidies is very old

(Cumberland and Beek, 1967, p. 254). The devices of tax exemption,

leasing of sites or plants at a low rental and subsidization of

transport costs, all mean that the enterprise is not required to

pay the full value of the transfer costs (Moes, 1962, p. 3).

The Nigerian government can eliminate protein deficiencies

in the Southern Provinces by subsidizing beef cattle transport to

the most vulnerable areas. This can be done by either direct fin-

ancial assistance to cattle dealers who deliver their beef cattle

to rural areas, or it can subsidize transport costs which will in

turn bring down the cost of beef per pound in the rural areas.

The government can build slaughtering slabs and cattle inspection

units in the rural areas so that cattle dealers do not have to

travel far for these services before slaughtering the cattle.

Some economists have rejected subsidization as unwarranted

government intervention with the efficacy of resource allocation

(Cumberland and Beek, 1967, p. 254). Various governments have

granted subsidies for purposes of generating high returns on the

subsidies to the local community (Moes, 1962). The major factor

is the desire of the government to insure that adequate and

efficient transportation is available to serve the public needs.

In the early nineteenth century, the United States government

granted vast acreages for the development of railroads and canals

(Luna, 1971, p. 92). Typical examples of such subsidized enter-

prises are the Interstate Highway programs in the United States

and the government owned rail system of western Europe and Nigeria.

Since the early part of the twentieth century, almost all coun-

tries have extended subsidies to the air transport industry (Luna,

1971, p. 109; Pergrum, 1973, p. 468).

The question often asked is whether the industries receiving

subsidies are likely to be competitive. Subsidization does not

necessarily encourage perfectly competitive allocation of resources,

but correction of the misallocation of resources requires inter-

vention by government (Cumberland and Beek, 1967, p. 262). In

Nigeria, regional dualism prevents pure competition for equal dis-

tribution of resources. Subsidization is, therefore, very necessary

as an incentive because capital and entrepreneurial skills are

scarce. Commenting on this Helleiner (1966, p. 145) said. "The

bottleneck to development in the modern sector is not labor, but

capital, skills, and entrepreneurship." In Nigeria, the develop-

ment of distribution facilities for public use should be started

by government initiative within the framework of government control.

Japanese experience in this respect is invaluable. The

early industrial development of Japan was planned and carried out

by the state. When the initial difficulties were overcome, the

state handed over the projects it had started to the private

sector. Summarizing this, Spengler concluded that:

> The government, moreover, offset the lack of an adequate
> enterpreneurial class by performing many of the functions
> of this class and facilitating the accomplishment of
> others through the use of appropriate monetary, fiscal,
> and related policies. By 1930 the relative number of
> workers engaged in agriculture and fishing had fallen

to about 50 per cent from an estimated 85 as of 1873
(Spengler, 1951, p. 44).

In Nigeria, the government can subsidize and supervise the trans-
portation and distribution of beef cattle from the north to the
south.   The private sector which invests in the projects should
be allowed to make some profits on their investments so that
there may be room for expansion and improvements.   Complete
government control under the auspices of statutory government co-
operation may be counter productive.   Most of the agricultural
projects in the country that have failed can be traced to total
government control under the auspices of Government Provincial
Farms, Farm Settlements and Regional Development Corporation.
The establishment of independent privately owned companies for
transporation, distribution and marketing of beef from the north
should be encouraged and, this author believes that private business
with profit motive is the only reasonable solution to proper
handling of the beef cattle trade.

Taxation

Since the beef cattle trade from north to south converges
on the southern urban centers, the Nigerian government, apart
from the provision of infrastructure, granting of subsidies,
and supervision of the trade, can also regulate beef cattle
slaughtering in the urban areas.   It can set a limit on the
maximum number of cattle that should be slaughtered in each town
per day.   Any additional cattle slaughtered above the maximum

number set for the town should be taxed; the tax progressively

higher as the number of cattle above the maximum increases. The

tax thus collected should be used in the subsidization of cattle

transport to the rural markets. The tax income can also be used

in paying supervisors (sanitarians), who look after the proper

handling and slaughtering of the beef cattle.

This kind of tax policy has been commented upon by a

number of experts:

> In some countries inducement policies are combined
> with a policy of discouraging further expansion of
> highly developed, fast growing, metropolitan regions,
> through a system of building controls as in England
> and France (Cumberland and Beek, 1967, p. 253).

The situation has been diagramatically illustrated in Figure 21.

OP is, the population that would have enough protein if OQ is supplied.

Either because of scarcity or high costs of OC, consumption is

reduced to OM. At OM only the affluent population is well fed

while MP is deficient in protein supply. Local subsidy of OB

permits consumption MN (i.e., ON). If extra consumption by OM

is taxed, a subsidy of AC is generated. This is the difference

between maximum OC and the marginal consumption OA by the popula-

tion OP. What is available now can be given to NP which means

all are fed, or OP has adequate protein intake.

The taxation of cattle slaughtered above the authorized

maximum number in the urban areas would be a means well devised

to release some cattle directed to urban centers for slaughtering

at the rural markets. Butchers who would choose to slaughter

their cattle or retail slaughtered carcasses in the rural markets

Subsidization by Taxation

Number of People Receiving Meat
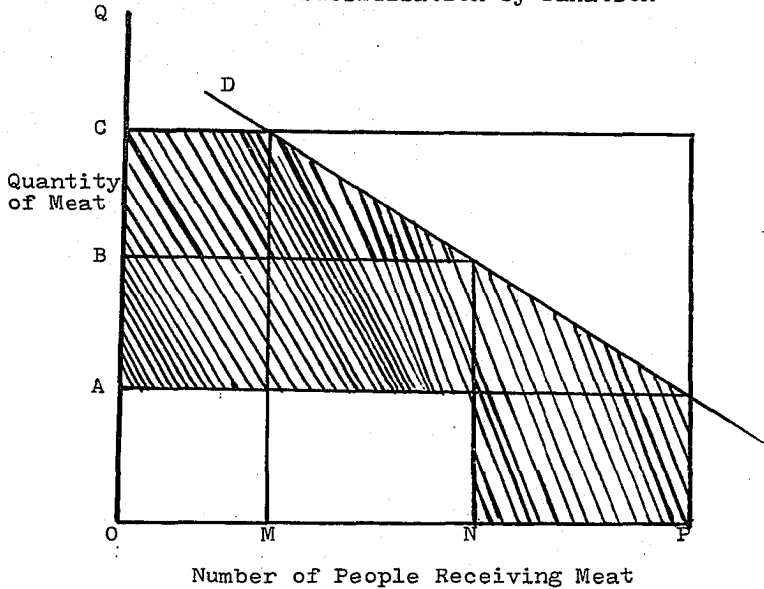
Figure 21

OP = People Receiving Protein Foods (Meat)

OQ = Quantity that would give adequate nutrition
High cost at OC reduces consumption to OM
(Affluent population)

OB = Local Subsidy permits consumption by MN (i.e., up to ON)

AC = Subsidy provided by taxing above maximum consumption
by OM. This provides extra for consumption by NP.
The entire population (both rich and poor) are now
supplied with sufficient protein foods.

/// = Area moved by government subsidization policy.

should be exempted from the tax, and this would be an incentive
for retail butchers to sell their meat at the rural markets.

The difficulty in this policy is that it would lead to
corruption in the beef cattle market. Butchers would try to sup-
press the number of cattle that they are allowed to slaughter in
the urban centers by offering bribes to the tax collectors so that
they may be allowed to butcher more cattle than the maximum num-
ber set up for each day in an urban area. The number of cattle
allowed for each urban center would be based on its population;
but the regulated cattle slaughter and sale would make no pro-
vision for people with poor purchasing power in each urban cen-
ter. Perhaps the taxation policy would lead to the setting up
of an elaborate department for its collection. This would need
some time for training and development. However, all the cattle
inspected and slaughtered in all registered slabs in the country
are charged some fees for the services and there seems to be no
trouble with the operation of the system. At Ibadan, the charge
for the use of the facilities and services is (N1) one Naira
(US $1.60) per cattle (Arthur Little, Inc., 1964, p. 2). Should
the policy be implemented upon there will be protein foods avail-
able to the people no matter whether they are urban or not. This
would mean elimination of protein deficiency even among the most
vulnerable groups in both rural and urban areas.

Putting More Cattle Into the System

The taxation of cattle slaughtered above the authorized

maximum number in the urban areas will release some cattle that
arrive in the urban centers to rural markets. In order to
avoid the taxes butchers will choose to slaughter their cattle in
the rural markets. Presently, the Fulani cattlemen pay some
taxes (jangali) per head of their cattle (Ministry of Economic
Planning, 1970, p. 107). In Southern Nigeria cattle are not taxed.
The cattle tax works against cattle raising in the north, and as
a result the Fulanis try to evade taxation by not allowing their
cattle to be counted or by hiding them (Min. of Ec. Planning, 1973,
p. 107). The retrogressive effects of the cattle tax has been
recognized by the former head of state when he said:

> Government has agreed in principle to abolish through-
> out the country, the age old cattle tax, otherwise
> known as Jangali. This will bring some relief to the
> Fulani cattle owner on his capital and encourage him
> to keep his cattle within the country (Gowon, 1975, p. 6).

The government should not tax breeding stock. Cattle that
are kept above the breeding age should be taxed. This kind of tax
may be to persuade people to avoid hoarding (Higgins, 1968, p.
524). To do this, the average breeding age should be established.
The number of cattle to be grazed on available acreage depending
upon season should also be established. Defaulters should be
taxed accordingly. The cattlemen who refuse to pay the tax should
have the option of giving a certain percentage of their cattle to
the government that will eventually release them for sale. The
cattlemen can, if they like, sell their cattle to the government
at a cost that will meet the tax expenses. In this way, the govern-
ment does not force any cattlemen to do anything, but give him a

number of alternatives.

There should be programs to settle the Fulanis. Settle-
ment will lead to urbanization and the introduction of luxury
living. The longing for luxury living due to demonstration effects
in urbanized areas will force the cattlemen to sell their cattle.
The children in the families should be made to go to school by
means of compulsory primary education. The need for higher educa-
tion will force the parents to sell their cattle in order to pay
the children's fees, buy books, and pay for their room and board.
The educated children will come to appreciate higher living
standards and this will encourage selling some cattle to meet
high costs of living.

Food Science Education

Though the real cause of protein malnutrition in Southern
Nigeria is inadequate transportation-distribution-marketing channel
of the existing beef cattle, the problem of ignorance on the part
of the local consumers needs immediate attention. Protein intake
in the Southern Provinces can be improved if food science educa-
tion goes hand in hand with all other attempts aimed at correct-
ing the protein malnutrition problem. Nutrition education will
be effective if it is extended to all members of the community.

If the present protein sources in the country were pro-
perly distributed and fully utilized, no protein malnutrition
would exist (U.N., 1971, p. 24). It is the effort to promote
not only proper transportation and distribution, but also effi-

cient utilization of the available protein sources that the
need for educational and promotional programs are necessary.

In order to educate local consumers on the need for
adequate protein intake, nutrition should be included in the
overall planning for economic development. This means that
national nutrition policies should be developed. There should
be pilot project centers set up to help in the improvement of
national nutrition policies.

Since protein malnutrition is more prevalent among the
young, nutrition education should be planned also for mothers
and housewives in maternity, child care and mother-craft centers
(President's Science Advisory Committee, 1967, p. 84). Though
lack of purchasing power is a constraint to good nutrition, it
may also be due to an information gap (Berg, 1973, p. 74). In
the mother-craft centers information can be easily spread and the
introduction of refrigerated beef into meals can be encouraged.
Old food habits may be changed in that way, though they are most
difficult to change.

> Old habits may be difficult to change, but it must be
> recognized that nearly all of the major and popular
> food items used today were introduced into Nigeria
> mostly from other countries. As per capita incomes
> and the general level of edcuation rise in Nigeria,
> and as nutritionists convince people of the need for
> improved diets, a fairly rapid adjustment in food
> preferences may develop (Johnson, et al., 1969, p. 38).

School lunch programs may be valuable in furnishing the
children with the needed protein meals and in teaching them the
essentials of adequate diets. Lessons in schools about nutrition

will help the children to practice balanced diets at home,
especially after school life. Community feeding centers should
be opened for demonstrating and disseminating information on the
use and preparation of protein foods. The local community should
be encouraged to take active part in the centers' programs.

Protein foods should be encouraged in all restaurants.
Advertisement programs should be promoted by radio, television,
and newspapers. For more effective nutrition programs, extension
officers should be trained in universities and other institutions
of higher learning so that they may go out into the local com-
munities to demonstrate as well as supervise the established
community protein nutrition centers.

CONCLUSIONS AND SUGGESTIONS FOR NIGERIA

Most of the less-developed countries (of which Nigeria
is one) are engaged in strenuous, even frantic struggle for econ-
omic development. In concluding this treatise it is wise to
examine some of the wider implications of development for
Nigeria. In order to sustain economic growth in the country the
amount of protein intakes, in the Southern Provinces must be in-
creased. Why is it necessary to increase protein intake in the
country in order to promote economic development? Increase pro-
tein intake in Nigeria will avert the malnutrition problem that
causes infant and young child mortality, stunted growth, pre-
mature aging, reduced life span, reduced work capacity, and im-
paired learning and behavior in later life.

The overall effect of malnutrition is that it retards econ-
omic as well as social development. The advantage of increased
protein intake is that by augmenting the supply of the essentials
of life it enables many people to choose life rather than death;
i.e., it enables more children to live out their lives and it ex-
tends man's life span. The reduction of protein malnutrition in
Nigeria can be seen as a prerequisite for the development of
human resources. Adequate nutrition is a fundamental as well as
a basis for all economic and social development (U.N., 1971, p.
12). In Nigeria the development of human capital is necessary

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for the economic development of the country.

In the past, the Nigerian government has tended to treat protein malnutrition as a problem of the individual family. Today the complexity of the protein malnutrition problems coupled with their interrelationships with all other aspects of social and economic development have demanded that the country should (a) plan and develop efficient transportation-distribution systems of beef cattle from the Northern to the Southern Provinces; (b) develop a national protein nutrition policy to serve as a guide to the country's national administration; (c) develop protein nutrition projects in the field of food and nutrition including consumer nutrition education; (d) set up institutions for the training of sufficient professional personnel in science and technology related to food nutrition; (e) subsidize movement of beef cattle from the production region to the rural areas in the deficient areas where the most vulnerable consumers are least able to buy beef because of poor purchasing power; (f) build new railroads to link all the provinces in the south with those in the north. The links should also make it possible to move from east to west by rail; and (g) improve as well as build highways that will make it possible to move perishable foods in the country without undue delays.

In the Western countries the development of improved distribution systems or distribution methods has a generally beneficial effects on the entire distribution channel. Most large companies that embark upon a comprehensive distribution program have also a physical distribution service division with the pri-

mary mission of coordinating customer systems with supplier

systems (Bowersox, et al., 1968, p. 27). Improvements in beef

distribution in Nigeria can be considered in terms of improvements

in the physical distribution management. An efficient physical

distribution management will lead to elimination of on-the-hoof

movement of cattle, modernization of truck movement, and the

effective use of the railroad. Adequate provision of rail cars

are necessary in order to avoid unnecessary delays for the ship-

ment of cattle at the railroad stations.

An efficient distribution management will also help in

the redistribution of beef cattle when they arrive at the south-

ern regional centers to the rural markets. The vulnerable groups

in Southern Nigeria cannot improve their protein food intake

unless the foodstuffs are delivered to them at a price that they

can afford to pay.

Insights for Interaction Theory in Geography

Traditionally, geographers have assumed that interregional

trade takes place because of areal differentiation in the resource

base and economic specialization. Today it is clear that differ-

entiation and specialization alone do not necessarily result in

interaction between places. Close examination indicates that,

particularly in the less-developed countries, there are many

different production and consumption regions that have little or

no interaction with each other, even though situated in close

proximity.

It is true that improvements in transportation increases
interactions between places, but improvements alone cannot be
held as truly accountable (responsible) for the interactions.
Interaction between places occurs (and increases) as the rela-
tive advantage increases.   There is a mutual interdependence in
all forms of interaction.

Geographers like to think of river valleys as natural
routeways and the reason why highways, railraods, and even foot-
paths pass through them.   In a study of the Great Australian
Divide as a barrier to railway communication, Appleton (1963, p.
114) observed that a natural routeway provides an opportunity
for communication, but does not, necessarily, provide demands.
Taaffe, Morrill, and Gould (1963, p. 516) in their study of the
development of transportation in less-developed countries pointed
out that variations in the physical landscape are relatively unim-
portant in determining transportation development.   Before th
arrival of the Europeans in West Africa there was trade across
the Sahara between the Arabs and West Africans.   The great ex-
panse of desert did not prevent the movement of goods from the
Guinea Coastal lands to the Arabian territories.   The movement
of commodities can, therefore, be seen as a response to a set
of stimuli rather than as alternatives or substitutes.

Areal differentiation is a great generator of spatial
movements.   The above example can help to illustrate that for
movements to occur between any two places there must be, at

least, demand (pull forces) in one place and supplies (push

forces) in another. Then the movement may be generated through

areal differentiation based on natural or cultural causes, or on

economies of scale. In the less-developed countries natural en-

dowments are the major forces promoting movements. In the indus-

trialized nations cultural (or technological) forces and economies

of scale are the main forces behind all movements. It can here

be emphasized that heavy investments in infrastructures promote

interregional trade while technological advancement allows for

global movements (or international trade).

This is typified in the case of chemical fertilizers and

other manufactured goods that are moved enormous distances from the

United States to markets in West Africa, Asia, and other parts

of the world. Manioc is not moved from South America to the

Guinea Coastal markets because there is no demand for manioc

there. West African farmers produce enough manioc and it is

cheaper to buy it locally. An important aspect of movement is

what Ullman (1957, p. 21) called "complementarity." The impor-

tance of complementarity is so great that petroleum moves great

distances to the United States and Japan. The movement of petro-

leum from the Middle East and West Africa (origins) to the United

States and Japan (destinations) is not difficult because there

is no intervening opportunity (alternative destination). The

industrialized nations not only have the demand for petroleum,

but they can also afford to pay the high costs of petroleum ex-

ports. The mutual interdependence of this movement is very
clearly pictured here.

There are other factors that govern the structure, direc-
tion, and consistency of commodity flows apart from demand and
supply. The contemporary ideology of development planners in
deciding from where needed goods should be imported may affect
the direction, structure, or the consistency of commodity move-
ments. This may be in the way of prohibitive tariffs that make
it impossible for traders to make profits because nobody wants
to buy such expensive goods. Governments can ban the sale of
goods from particular countries because of incompatibility in
political ideologies. In most Anglophone countries in Africa,
marxist goods (especially books) are banned. In the twentieth
century Japanese goods were regarded as cheap goods hence Japan
lacked trading interaction with other countries because no coun-
try wanted to trade with it in its cheap goods. Cultural beliefs
or tradition may exclude trade in certain commodities with other
areas or countries. India which belives that cattle are sacred
animals does not trade in beef with other countries. It there-
fore lacks interaction with other countries in this trade even
though there is a demand and it has the supply.

If transfer costs are too great, movements (potential
and actual) between any two places will not occur even though
there is complementarity and no intervening opportunity. If
the cost of overcoming distance is too high, poor local sub-
sistutes will be found, or people will choose to go without the

in demand. If demand cannot be met the people will choose
to do without the goods. This may mean living the live that
their forefathers lived without any change. A typical example
of this is the unsatisfied need for beef in Southern Nigeria.
The cost of overcoming cattle movement from the North to the
South is very high and has resulted in meat costs higher than
most of the poor consumers can afford to pay. As a result of
this situation, the poor people choose to do without beef or
meat in their meals. Protein deficiency and malnutrition are
the end results.

        Movements between any two places (origin and destination)
will increase or decrease according transportation costs separ-
ating them, the number of other possible origins, and the alterna-
tive destinations possible. Movements between places may be
related to the law of Newtonian physics which states that two
objects attract each other with gravitational force that varies
directly with the product of the masses of the object and in-
versely proportional to the square of the distance separating
them. The larger the center, the more attractive the force it
exerts on other places. This is the reason why most travels in
less-developed countries converge on primate (capital) cities.
Rural areas have no or little attractive forces for meat mar-
keting. However, densely settled rural areas would consume beef
had they the purchasing power and the presence of infrastructures
as well as marketing organizations.

How the primate cities (which have the purchasing power in less-developed countries) attract movements into their areas can be mathematically illustrated by the use of gravity model thus:

$$I_{ja} = \frac{P_i P_j}{d_{ij}} \qquad (1)$$

Where:

I_{ija} = Interaction between i and j for commodity "a."

$P_i P_j$ = Measure of sizes i and j.

d_{ij} = Distances separating i from j.

Under normal circumstance (as exemplified by the gravity model) a greater amount of movement takes place between two very large urban centers than two very small villages. This is not always, necessarily so because the great distances which always separate urban centers (primate cities) in less-developed countries have modifying effects on the amount of interaction between such paired centers. This principle of distance decay was empirically tested by Zipf (1946, 1949) when he gathered data on airway, highway, railroad traffics, and telephone calls between cities in the United States. Comparing the data with what would be expected if the traffic between the cities were related to the sizes of the cities and inversely proportional to the distance separating them; it was discovered that the volume of movement decreases as the distance between the cities increases.

A celebrated variation of the gravity model was put
forward by William Reilly in his attempt to delimit trade areas
around centers. In his laws of retail gravitation, Reilly (1929)
states that the trade boundary between towns (A and B) is equal
to the relative retail pull power of the competing towns on an
intervening area. He then developed his 'breaking point' center
between competing towns. His equation reads:

$$D_{jk} = \frac{D_{ij}}{1 + P\sqrt{\dfrac{P_i}{P_j}}} \qquad (2)$$

Where:

D_{jk} = Distance from j to breaking point.

D_{ij} = Distance between i and j.

$P_i P_j$ = Sizes of towns i and j.

k = Breaking point between i and j.

Huff (1963) tried to allow for probabilistic situations
in his formulation. He allows for choice between competing cen-
ters. But he recognizes the constraint of a maximum distance that
a consumer is able or willing to travel for the purchase of his
needs. A derivation of his formulation is put forward here:

$$P(i,j,a,) = \frac{\dfrac{S_j}{T_{ij}}}{\displaystyle\sum_{j=1}^{r}\left(\dfrac{S_j}{T_{ij}}\right)} \qquad (3)$$

$P(i,j,a,)$ = Probability that consumer at i will travel to j
for commodity 'a'

$$S_j = \text{Size of urban center } j.$$

$$T_{ij} = \text{Time distance separating } i \text{ and } j.$$

Perishability Factor

A perishability factor can be introduced into the gravity model. In this case the higher the factor the more perishable the product (i.e., the lesser the interaction the higher the perishability of the product).

This can be mathematically written thus:

$$I = K \frac{P_i P_j}{d_{ij}\phi} \qquad (4)$$

$$\phi = \text{denotes perishability factor.}$$

Let us assume that P_i (100) and P_j (110) and the distance (d_{ij}) between i and j (25 miles) and the perishability factor ϕ (4) gives an Interaction of 110. This is lesser interaction than a perishability factor of 2 which gives an interaction of 200. The problem can be reformulated differently, for example:

$$I = k \frac{P_1 P_2 \phi}{d_{ij}} \qquad (5)$$

Where ϕ is a measure of imperishability; period of time without deterioration. For example, there is trade in beef between Katsina in Northern Nigeria and Benin City in the south. In this case P_1 (Katsina) is 109.4 and P_2 (Benin City) is 121.7 and the imperishability factor (ϕ) is 1 while the distance separating them is 736 miles. The Interaction is 18.09. Or the problem can formulated differently, for example:

$$I = k \frac{P_i P_j}{d_{ij} \phi} \qquad (6)$$

Where 0 is a measure of the cost of preservation without deter-
ioration. This can be illustrated with the trade in beef between
Maiduguri, Northern Nigeria and Enugu, Southern Nigeria. In this
case, P_i (Maiduguri) is 140.0 P_j (Enugu) is 138.5, the distance
between them (d_{ij}) is 747 miles and the cost of preservation with-
out deterioration (ϕ) is 2. The Interaction here is 12.9

The perishability can be expressed otherwise thus:

$$I_{ij} = k \frac{P_i P_j}{d_{ij} \; \infty \; \phi} \qquad (7)$$

∞ = weight, e.g., technological development:

(1) Modern transportment development

(2) Refrigeration

(3) Canning

(4) Freeze-drying

Using the figures for 7 above the interaction between Maiduguri
and Enugu can be calculated with a technological weight (∞) of
+.50 and perishability factor of +1.0. An interaction index of
51.91 is obtained.

Owing to inadequate technology and demand based on the
cultural milieu, most foodstuffs in the less-developed countries
are highly perishable. The foodstuffs here include fresh meats,
fruits and vegetables. The perishability of a product determines

the areal extent of the market for a very short period of time.
If they are held off the market for a long time, losses caused
by spoilage and deterioration in quality and mark-down in prices
will be incurred. A good example of this is the trade in beef
between Northern Nigeria and the Southern Provinces. In order
to supply the southern consumers with fresh beef the cattle are
walked down from the north. The animals suffer from loss of fat
and some fresh during the long walk and the result is a mark-
down in prices. If the butchered meat is not sold on the very
day of slaughter the meat deteriorates in quality and the per-
ishability is irrecoverable.

Implicit in the technique discussed above (which includes
the central place model) is the assumption that the consumer (all
things being equal) purchases his goods from the nearest source
or market. In Christaller's model (central place theory) the
high order center is the nearest one, provided the consumer's
savings in purchasing the needed items, from the higher order
center, exceed the additional transportation costs incurred. In
any case, the purchase of low and high goods from a high order
center makes up for this, if the high order center is more dis-
tant than the low order one. It may here be pointed out that con-
sumers are rational satisficers and not economic men who try to
optimize by minimizing travel effort.

<u>Implication for Removing Food</u>

<u>Deficit in Less-Developed Countries</u>

The protein malnutrition problem which results from in-
efficient transportation-distribution systems of available food-
supplies should not be considered in isolation but in conjunction
with the task of total economic and social development of the less-
developed countries. It is now well known that it is not sufficient
for the regions threatened by the protein malnutrition problems
to work only towards economic development relying on the fact
that given a greater economic growth, the problem of food deficit
and malnutrition will be automatically solved. It should, however,
be noted that one of the important goals of development should be
to guarantee the transportation, distribution, and marketing to
of foods sufficiently high in quality proteins to the people.

Food deficit results in undernutrition and malnutrition;
and the impact of malnutrition on economic and social development
are all pervasive. In the less-developed countries 25 to 30 per
cent of the children die before their fifth birthday due to mal-
nutrition (U.N., 1971, p. 7). In Columbia 82 out of every 1,000
children die of malnutrition before they reach 12 months (Givaudan
Flavorist, 1973, p. 4). Mortality rates of Nigerian children
under the age of five years are alarmingly high, and these may
be in the order of 50 per cent in several parts of the country.
In Ilesha village about 12 per cent of the children's deaths are
caused by malnutrition, including undernutrition, and most of
the adults are so grossly underfed that they are poorly motivated
for increased productivity and hope for a better world (Dema,
1965, pp. 36-37). The United Nations has recorded 149 deaths

out of every 1,000 one-year old children in the Federal Terri-
tory of Lagos alone (U.N., 1973, p. 256). It has been concluded
that maldistribution of the available food within social and
economic population groups and among family members is another
explanation for the observed protein malnutrition in the less-
developed countries (U.N., 1975b, p. 601).

The existence of a hungry or malnourished citizen is
an affront to a country that begets him. Perhaps, there is
no single factor as important as hunger in primitive social
strife (May, 1969, p. IX). Food deficit in less-developed
countries can cause national unrest which can endanger terri-
torial security and international stability. Summarizing such
difficulties one author states that:

> The political potency of a food problem depends on the
> perceived need. . . . And those food problems which
> cannot be defined clearly or for which clear support
> from the nutrition is not forthcoming will attract
> varying degrees of attention depending on who reaches
> the ears of decision-makers. . . . For practical
> purposes we deal primarily with grains - an intolerable
> increase in the price of wheat, rice, or corn can cause
> a government to be overthrown. . . . (A recent example
> is the contribution of high meat prices to political
> instability in Poland that forced a change in the govern-
> ment leadership a few years ago) (Altschul, 1974, pp. 5-9).

Anthonio (1966, p. 81) has noted that in recent years tense
political situations in Nigeria have been aggravated by food
shortages and soaring prices. He attributed the alarming rates
of food price increase to past and present neglects and inefficiencies
in transportation, distribution and marketing channels development
by both government and private sector.

In less-developed countries high food prices (causes
by shortages and scarcity) lead to panic situations. This is
necessarily so because a greater part of the income and nearly
all financial transactions (due to low purchasing power) center
around expenditures on food. Anthonio (1966, p. 81) calls this
high-food drain economy. In such an economic region unrest, riots,
mass murder, destruction of property, burglary, and insecurity
of life are frequent.

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FREIGHT COSTS OF SHIPPING CATTLE BY HOOF

PER MILE

No.	From	To 1	2	3	4	5	6	7
1.	Sokoto	.00	2.74	5.42	9.10	10.42	11.08	12.06
2.	Gusau	2.74	.00	5.66	9.28	10.60	11.26	12.24
3.	Kontagora	5.42	5.60	.00	3.68	5.00	5.66	6.64
4.	Ilorin	9.10	9.28	3.68	0.00	1.32	1.98	2.96
5.	Oyo	10.42	10.60	5.00	1.30	.00	0.66	1.64
6.	Ibadan	11.08	11.26	5.66	1.98	0.66	.00	0.98
7.	Abeokuta	12.06	12.24	6.64	2.96	1.64	0.98	0.00
8.	Lagos	12.86	13.04	7.44	3.76	2.44	1.78	1.26
9.	Ijebu-Ode	11.94	12.16	6.52	2.84	0.54	1.24	1.18
10.	Ondo	10.98	11.16	5.56	1.88	1.18	2.84	2.08
11.	Benin City	13.42	13.60	8.00	4.32	3.98	3.76	4.08
12.	Warri	14.68	14.86	9.26	5.58	5.24	5.02	5.34
13.	Katsina	5.32	7.86	6.72	10.40	11.72	12.38	13.36
14.	Kano	6.78	4.40	6.86	10.54	11.86	12.52	13.50
15.	Zaria	5.04	2.30	4.64	8.32	9.64	10.30	11.28
16.	Kaduna	6.04	3.34	3.76	7.44	8.72	9.42	10.40
17.	Minna	7.78	5.56	2.36	5.40	6.72	7.38	8.36
18.	Lokoja	11.64	13.40	7.80	4.12	5.06	4.96	5.94
19.	Enugu	15.58	12.84	11.04	7.62	7.02	6.80	7.12
20.	Onitsha	15.18	13.82	9.76	6.08	5.74	5.52	5.86
21.	Owerri	16.40	14.68	10.98	7.30	6.96	6.74	7.04
22.	Port Har- court	18.98	16.24	12.20	8.52	8.18	7.56	8.28
23.	Calabar	19.20	16.46	13.26	9.84	9.24	9.02	9.34
24.	Makurdi	12.24	9.50	7.86	8.40	9.34	9.24	10.16
25.	Umuahia	19.58	14.76	7.58	7.76	7.42	7.20	7.52
26.	Bauchi	9.68	6.94	8.72	12.40	12.64	16.38	15.36
27.	Gombe	11.62	8.88	10.66	14.34	15.66	14.62	17.30
28.	Maiduguri	13.38	11.92	14.26	17.14	18.46	19.12	20.10
29.	Ikot Ekpene	17.68	15.50	12.26	8.84	8.24	8.02	8.34
30.	Uyo	18.58	15.84	12.64	8.96	8.62	8.40	8.72
31.	Aba	17.20	15.44	11.78	8.38	7.76	7.54	7.86
32.	Jos	8.04	5.30	7.08	9.68	12.08	11.66	7.92
33.	Yola	14.78	12.16	13.82	15.86	17.30	16.70	17.64
34.	Kabba	12.14	13.66	6.72	3.04	4.06	4.00	4.98

APPENDIX A (Continued)

No.	From	To	8	9	10	11	12	13	14
1.	Sokoto		12.86	11.94	10.98	13.42	14.68	5.32	6.78
2.	Gusau		13.04	12.12	11.16	13.60	14.86	7.86	4.04
3.	Kontagora		7.44	6.52	5.56	8.00	9.26	6.72	6.86
4.	Ilorin		3.76	2.84	1.88	4.32	5.58	10.40	10.54
5.	Oyo		2.44	0.54	1.18	3.98	5.24	11.72	11.86
6.	Ibadan		1.78	1.24	2.84	3.76	5.02	13.38	12.52
7.	Abeokuta		1.26	1.18	2.08	4.08	5.34	13.36	13.50
8.	Lagos		0.00	1.24	2.86	4.14	5.40	14.16	14.24
9.	Ijebu-Ode		1.24	0.00	1.96	2.90	7.54	13.24	13.38
10.	Ondo		2.86	1.96	.00	2.80	4.06	12.28	12.42
11.	Benin City		4.14	2.90	2.80	0.00	1.26	14.72	14.80
12.	Warri		5.40	7.54	4.06	1.26	0.00	15.98	16.06
13.	Kastina		14.16	13.24	12.28	14.72	15.98	0.00	2.16
14.	Kano		14.24	13.38	12.42	14.80	16.06	2.16	.00
15.	Zaria		12.08	11.16	10.36	12.46	14.02	3.42	2.22
16.	Kaduna		11.18	10.28	9.32	11.76	13.02	4.46	3.20
17.	Minna		9.16	8.24	7.28	7.46	8.72	6.68	5.82
18.	Lokoja		6.84	5.86	3.88	3.60	5.80	14.52	14.60
19.	Enugu		7.18	5.94	5.84	3.04	3.78	13.96	12.76
20.	Onitsha		5.90	4.66	4.56	1.76	2.50	14.98	13.74
21.	Owerri		7.12	5.88	5.78	2.98	3.78	15.80	14.60
22.	Port Harcourt		8.34	7.10	7.00	4.20	4.49	17.36	16.38
23.	Calabar		9.40	9.16	8.04	5.30	6.00	17.58	16.38
24.	Makurdi		10.22	9.98	8.16	6.08	6.82	10.62	9.42
25.	Umuahia		7.58	5.34	6.24	3.44	4.18	15.88	14.68
26.	Bauchi		16.16	14.82	13.20	11.92	12.66	5.92	3.76
27.	Gombe		18.10	16.76	14.22	13.86	14.60	7.86	5.70
28.	Maiduguri		20.88	19.98	19.02	17.68	18.42	9.56	6.60
29.	Ikot Ekpene		8.40	7.16	6.98	4.26	5.00	16.58	15.38
30.	Uoy		8.78	7.54	7.44	4.64	5.38	16.96	15.76
31.	Aba		7.92	6.68	6.58	2.80	4.52	16.56	15.36
32.	Jos		13.44	12.52	11.56	10.28	11.02	6.42	5.22
33.	Yola		17.70	16.46	15.62	13.54	14.30	11.14	8.98
34.	Kabba		5.76	4.86	2.88	2.76	4.14	15.74	13.58

APPENDIX A (Continued)

No.	From To	15	16	17	18	19	20	21
1.	Sokoto	5.04	6.04	7.78	11.64	15.58	15.18	16.40
2.	Gusau	2.30	3.34	5.56	13.40	12.84	13.82	14.68
3.	Kontagora	4.64	4.76	2.36	7.80	11.04	9.76	10.98
4.	Ilorin	8.32	7.44	5.40	4.12	7.62	6.08	7.30
5.	Oyo	9.64	8.72	6.72	5.06	7.02	5.74	6.96
6.	Ibadan	10.30	9.42	7.38	4.96	6.80	5.52	6.74
7.	Abeokuta	11.28	10.40	8.36	5.94	7.12	5.86	7.06
8.	Lagos	12.08	11.18	9.16	6.84	7.18	5.90	7.12
9.	Ijebu-Ode	11.16	10.28	8.24	5.86	5.94	4.66	5.88
10.	Ondo	10.36	9.32	7.28	3.88	5.84	4.56	5.78
11.	Benin City	12.46	11.76	7.46	3.60	3.04	1.76	2.98
12.	Warri	14.02	13.02	8.72	5.80	3.78	2.50	3.78
13.	Katsina	3.42	4.46	6.68	14.52	13.96	13.74	14.60
14.	Kano	2.22	3.20	5.82	14.60	12.72	13.74	14.60
15.	Zaria	0.00	1.04	4.60	11.48	10.54	11.52	12.38
16.	Kaduna	1.04	0.00	3.72	11.56	9.58	10.56	11.42
17.	Minna	4.60	3.72	0.00	3.86	8.84	8.16	10.98
18.	Lokoja	11.48	11.56	3.86	0.00	3.54	4.30	5.52
19.	Enugu	10.54	9.58	8.84	3.54	0.00	1.28	2.20
20.	Onitsha	11.52	10.56	8.16	4.30	1.28	0.00	1.22
21.	Owerri	12.38	11.42	10.98	5.52	2.20	1.22	0.00
22.	Port Harcourt	13.94	12.98	12.24	6.74	3.40	2.44	1.22
23.	Calabar	14.08	13.20	12.46	7.16	3.62	3.50	2.28
24.	Makurdi	7.20	6.24	5.50	4.28	3.34	4.32	5.18
25.	Umuahia	12.46	11.50	10.76	5.46	1.92	1.68	0.72
26.	Bauchi	4.46	5.12	7.34	10.12	7.56	10.16	11.02
27.	Gombe	6.58	4.64	5.12	7.34	10.12	7.56	10.16
28.	Maiduguri	9.62	10.88	13.10	15.88	14.94	15.92	16.78
29.	Ikot Ekpene	13.16	12.20	11.46	6.16	2.62	2.50	1.28
30.	Uyo	13.54	15.76	11.04	6.54	3.00	2.88	1.66
31.	Aba	13.16	12.18	11.44	6.14	2.60	2.02	0.80
32.	Jos	3.00	3.48	5.70	8.48	7.14	8.52	9.38
33.	Yola	9.14	10.22	12.44	11.74	10.80	10.80	12.80
34.	Kabba	11.36	10.48	4.94	3.86	5.40	4.12	5.34

APPENDIX A (Continued)

No.	From To	22	23	24	25	26	27	28
1.	Sokoto	18.98	19.20	12.24	19.58	9.68	11.62	13.38
2.	Gusau	16.24	16.46	9.50	14.76	6.94	8.88	11.92
3.	Kontagora	12.20	13.26	7.86	7.58	8.72	10.66	14.26
4.	Ilorin	8.52	9.84	5.40	7.76	12.40	14.34	17.14
5.	Oyo	8.18	9.24	9.34	7.42	12.64	15.66	18.46
6.	Ibadan	7.96	9.02	9.24	7.20	14.38	14.62	19.12
7.	Abeokuta	8.28	9.34	10.16	7.52	15.36	17.30	20.10
8.	Lagos	8.34	9.40	10.22	7.58	16.16	18.10	20.88
9.	Ijebu-Ode	7.10	9.16	9.98	5.34	14.82	16.76	19.98
10.	Ondo	7.00	8.06	8.16	6.24	13.20	14.22	19.02
11.	Benin City	4.20	5.30	6.08	3.44	11.92	13.86	17.68
12.	Warri	4.94	6.00	6.82	4.18	12.66	14.60	18.02
13.	Katsina	17.36	17.58	10.62	15.88	5.92	7.86	9.56
14.	Kano	16.16	16.38	9.42	14.68	3.76	5.70	6.60
15.	Zaria	13.94	14.08	7.20	12.46	4.64	6.58	9.62
16.	Kaduna	12.98	13.20	6.74	11.50	5.12	7.06	10.88
17.	Minna	12.24	12.46	5.50	10.76	7.34	9.38	13.10
18.	Lokoja	6.74	7.16	4.28	5.46	10.12	12.06	15.88
19.	Enugu	3.40	3.62	3.34	1.92	7.56	11.14	14.96
20.	Onitsha	2.44	3.50	4.32	1.68	10.16	12.10	15.92
21.	Owerri	1.22	2.28	5.18	0.72	11.02	12.96	16.78
22.	Port Harcourt	0.00	2.28	6.74	1.48	12.58	14.52	18.34
23.	Calabar	2.28	0.00	6.96	1.70	12.80	14.74	18.56
24.	Makurdi	6.74	6.96	0.00	5.34	5.84	7.78	11.60
25.	Umuahia	1.48	1.70	5.34	0.00	11.10	13.04	16.86
26.	Bauchi	12.58	12.80	5.74	11.10	0.00	1.94	5.84
27.	Gombe	11.02	12.55	12.80	13.04	1.94	0.00	4.98
28.	Maiduguri	18.34	18.56	11.60	16.86	5.84	4.98	0.00
29.	Ikot Ekpene	1.28	1.00	5.96	0.70	11.80	13.74	17.56
30.	Uyo	1.66	0.62	6.34	1.08	12.18	14.12	17.94
31.	Aba	0.80	1.48	5.94	0.68	11.78	13.72	17.54
32.	Jos	10.94	11.16	4.20	9.46	1.64	3.58	7.40
33.	Yola	14.20	14.42	8.40	12.72	5.16	3.28	5.46
34.	Kabba	6.56	7.62	5.36	5.80	11.20	13.14	16.96

APPENDIX A (Continued)

No.	From To	29	30	31	32	33	34
1.	Sokoto	17.68	18.58	17.20	8.04	14.78	12.14
2.	Gusau	15.50	15.84	15.44	5.30	12.16	13.66
3.	Kontagora	12.26	12.64	11.18	7.08	13.82	6.72
4.	Ilorin	8.84	8.96	8.38	9.68	15.86	3.04
5.	Oyo	8.24	8.62	7.76	12.08	17.30	4.06
6.	Ibadan	8.02	8.40	7.54	11.66	16.70	4.00
7.	Abeokuta	8.34	8.72	7.86	7.92	17.64	4.98
8.	Lagos	8.40	8.78	7.92	13.44	17.70	5.76
9.	Ijebu-Ode	7.16	7.54	6.68	12.52	16.46	4.86
10.	Ondo	6.98	7.44	6.58	11.56	15.62	2.88
11.	Benin City	4.62	4.64	2.80	10.28	13.54	2.76
12.	Warri	5.00	5.38	4.52	11.02	14.30	4.14
13.	Katsina	16.58	16.96	16.56	6.42	11.14	15.74
14.	Kano	15.38	15.76	15.36	5.22	8.98	13.58
15.	Zaria	13.16	13.54	13.14	3.00	9.14	11.36
16.	Kaduna	12.20	15.76	12.18	3.48	10.22	10.48
17.	Minna	11.46	11.04	11.44	5.70	12.44	4.94
18.	Lokoja	6.16	6.54	6.14	8.48	11.74	3.86
19.	Enugu	2.62	3.00	2.60	7.14	10.80	5.40
20.	Onitsha	2.50	2.88	2.02	8.52	11.80	4.12
21.	Owerri	1.28	1.66	0.80	9.38	12.80	5.34
22.	Port Harcourt	1.28	1.66	0.80	10.94	14.20	6.56
23.	Calabar	1.00	0.62	1.48	11.16	14.42	7.62
24.	Makurdi	5.96	6.34	5.94	4.20	8.40	5.36
25.	Umuahia	0.70	1.08	0.68	9.46	12.72	5.80
26.	Bauchi	11.80	12.18	11.78	1.64	5.16	11.20
27.	Gombe	13.74	14.12	13.72	3.58	3.28	13.14
28.	Maiduguri	11.56	17.94	17.54	7.40	5.46	16.96
29.	Ikot Ekpene	0.00	0.38	0.48	10.16	13.16	6.62
30.	Uyo	0.38	0.00	0.86	10.57	13.80	7.00
31.	Aba	0.48	0.86	0.00	10.14	13.40	0.86
32.	Jos	10.16	10.57	10.14	0.00	6.74	9.56
33.	Yola	13.42	13.80	13.40	6.74	0.00	12.52
34.	Kabba	6.62	7.00	0.86	9.56	12.82	0.00

APPENDIX B

FRIGHT COSTS OF SHIPPING CATTLE BY TRUCK,

PER MILE

No.	From	To 1	2	3	4	5	6
1.	Abakaliki	0.00	20.29	33.54	8.94	28.58	12.30
2.	Abeokuta	20.29	0.00	53.22	25.02	46.08	12.24
3.	Adamawa	33.54	52.92	0.00	40.26	15.48	40.62
4.	Annang	8.94	25.02	40.26	0.00	35.40	17.88
5.	Bauchi	28.68	46.08	15.48	35.04	0.00	35.76
6.	Benin	12.30	12.24	40.62	35.40	35.76	0.00
7.	Benue	11.16	30.48	25.20	17.88	17.52	18.24
8.	Bornu	45.96	60.30	16.38	52.68	17.28	53.04
9.	Calabar	11.94	28.02	43.26	3.00	38.40	15.90
10.	Degema	27.60	26.40	43.20	9.72	39.48	15.30
11.	Delta	14.34	16.02	42.90	15.00	37.98	3.78
12.	Enugu	3.00	21.36	32.40	7.86	22.68	8.12
13.	Fed. Territory	24.54	3.78	53.10	25.20	48.48	12.42
14.	Ibadan	23.40	2.94	51.30	24.06	43.14	11.28
15.	Ijebu	20.84	3.54	49.38	21.48	44.46	8.70
16.	Ilorin	25.44	8.88	47.58	26.52	37.20	12.96
17.	Kabba	16.98	14.94	38.46	19.86	33.60	8.28
18.	Kano	39.42	40.50	26.94	46.13	11.28	44.40
19.	Katsina	43.02	40.08	33.42	49.74	17.76	44.16
20.	Niger	36.12	19.92	41.46	52.68	26.16	40.62
21.	Ogoja	3.60	27.96	37.14	12.54	38.92	14.40
22.	Ondo	18.24	8.46	45.78	18.90	6.12	23.40
23.	Onitsha	6.94	17.92	35.40	7.50	30.48	5.28
24.	Owerri	7.08	21.18	38.40	3.84	33.06	8.94
25.	Oyo	24.06	4.92	51.90	2.52	37.92	11.94
26.	Plateau	24.76	37.92	20.22	30.12	4.92	30.84
27.	Port Harcourt	11.28	24.84	42.60	3.84	37.74	12.60
28.	Sardauna	33.54	247.20	7.20	52.86	19.08	49.62
29.	Sokoto	47.88	36.18	44.34	53.04	40.26	36.72
30.	Umuahia	6.94	22.56	37.56	2.10	33.30	10.32
31.	Uyo	10.08	26.16	41.40	1.14	36.54	13.92
32.	Yenogoa	13.08	27.60	43.14	9.72	39.48	15.30
33.	Zaria	32.76	33.84	28.92	39.48	13.92	37.38

APPENDIX B (Continued)

No.	From to	7	8	9	10	11	12
1.	Abakaliki	11.16	45.96	11.94	27.60	14.34	23.40
2.	Abeokuta	30.48	60.30	28.02	26.40	16.02	2.94
3.	Adamawa	25.20	16.38	43.26	43.20	42.90	51.30
4.	Annang	17.88	52.68	3.00	9.72	15.00	24.06
5.	Bauchi	17.52	17.28	38.40	39.48	37.98	43.14
6.	Benin	18.24	53.04	15.90	15.30	3.78	11.28
7.	Benue	0.00	34.80	20.88	21.96	20.46	27.72
8.	Bornu	34.80	0.00	55.68	57.76	55.26	57.36
9.	Calabar	20.88	55.68	0.00	13.26	18.00	27.06
10.	Degema	21.96	56.76	13.26	0.00	17.58	26.58
11.	Delta	20.46	55.26	18.00	17.58	0.00	15.06
12.	Enugu	10.02	44.82	10.86	13.02	11.34	20.40
13.	Fed. Territory	30.66	62.64	28.20	22.50	16.20	5.34
14.	Ibadan	27.72	57.36	27.06	26.58	15.06	0.00
15.	Ijebu	26.90	59.94	24.48	24.06	12.48	2.58
16.	Ilorin	25.20	51.42	29.52	29.10	16.74	5.94
17.	Kabba	16.08	50.88	22.86	22.44	12.06	12.00
18.	Kano	28.26	19.80	49.14	50.22	48.19	37.56
19.	Katsina	31.86	28.68	52.74	53.82	47.94	37.02
20.	Niger	23.58	54.78	39.78	39.48	27.78	16.98
21.	Ogoja	14.76	55.02	8.04	16.02	17.16	26.22
22.	Ondo	23.40	58.20	21.90	21.48	9.90	5.52
23.	Onitsha	12.96	47.76	10.50	10.08	7.50	16.55
24.	Owerri	15.54	50.34	6.84	6.42	11.16	20.22
25.	Oyo	28.02	55.38	27.72	27.30	15.72	1.98
26.	Plateau	12.60	22.20	33.48	33.96	33.06	34.98
27.	Port Harcourt	20.22	55.02	6.84	5.88	14.82	23.88
28.	Sardauna	32.40	23.58	50.46	47.94	50.10	57.30
29.	Sokoto	36.72	40.14	57.60	55.62	44.04	33.24
30.	Umuahia	15.98	50.58	5.10	8.58	12.54	21.60
31.	Uyo	19.02	53.82	1.86	10.86	16.14	25.20
32.	Yenogoa	21.96	56.76	13.26	3.60	17.58	26.64
33.	Zaria	21.60	28.86	42.48	43.56	42.06	30.06

APPENDIX B (Continued)

No.	From	to	13	14	15	16	17	18
1.	Abakaliki		3.00	24.54	20.82	25.44	16.98	39.42
2.	Abeokuta		21.36	3.78	3.54	8.88	14.94	40.50
3.	Adamawa		32.40	53.10	49.38	47.58	38.46	26.84
4.	Annang		7.86	25.20	21.48	26.52	19.86	46.13
5.	Bauchi		22.68	48.48	44.46	37.20	33.60	11.28
6.	Benin		9.12	12.42	8.70	12.96	8.28	44.40
7.	Benue		14.02	30.66	26.94	25.20	16.08	28.26
8.	Bornu		44.82	62.64	59.94	51.42	50.88	19.80
9.	Calabar		10.86	28.20	24.48	29.52	22.86	49.14
10.	Degema		13.02	22.50	24.06	29.10	22.44	50.22
11.	Delta		11.34	16.20	12.48	16.74	12.06	48.19
12.	Enugu		0.00	21.54	17.82	22.86	16.20	38.28
13.	Fed. Territory		21.54	0.00	3.72	11.28	17.28	42.72
14.	Ibadan		20.40	5.34	2.58	5.94	12.00	37.56
15.	Ijebu		17.82	3.72	0.00	8.52	14.58	40.14
16.	Ilorin		22.86	11.28	8.52	0.00	9.12	31.62
17.	Kabba		16.20	17.28	14.58	9.12	0.00	40.74
18.	Kano		38.28	42.72	40.14	31.62	40.74	0.00
19.	Katsina		41.88	42.48	39.72	31.20	47.22	6.48
20.	Niger		32.12	22.32	19.56	11.04	20.16	20.58
21.	Ogoja		6.60	28.14	24.42	29.04	18.18	43.02
22.	Ondo		15.24	9.54	5.82	7.92	7.50	39.54
23.	Onitsha		3.84	17.70	13.98	18.24	12.35	41.22
24.	Owerri		6.60	21.36	17.64	21.90	16.02	43.80
25.	Oyo		21.06	7.32	4.62	3.96	12.18	35.58
26.	Plateau		21.42	40.42	37.56	29.04	28.68	15.66
27.	Port Harcourt		10.20	25.02	21.30	25.56	19.68	48.48
28.	Sardauna		39.60	60.30	56.40	54.78	38.46	34.14
29.	Sokoto		46.74	38.58	35.82	27.30	36.42	20.34
30.	Umuahia		5.76	22.74	19.02	23.28	17.40	44.04
31.	Uyo		9.00	26.34	22.62	26.88	21.00	47.28
32.	Yenogoa		13.02	22.50	24.06	29.10	22.44	50.22
33.	Zaria		31.52	36.24	33.48	24.95	34.08	6.66

APPENDIX B (Continued)

No.	From	to	19	20	21	22	23	24
1.	Abakaliki		43.02	36.12	3.60	18.24	6.94	7.08
2.	Abeokuta		40.08	19.92	27.96	8.46	17.92	21.18
3.	Adamawa		33.42	41.46	37.14	45.78	35.40	38.40
4.	Annang		49.74	52.68	12.54	18.90	7.50	3.84
5.	Bauchi		17.76	26.16	38.94	40.92	30.48	33.06
6.	Benin		44.16	40.62	14.40	6.12	5.28	8.94
7.	Benue		31.86	23.58	14.76	23.40	12.96	15.54
8.	Bornu		28.68	54.78	55.02	58.20	47.76	50.34
9.	Calabar		52.74	39.78	8.04	21.90	10.50	6.84
10.	Degema		53.82	39.48	16.02	21.48	10.08	6.42
11.	Delta		47.94	27.78	17.16	9.90	7.50	11.16
12.	Enugu		41.88	33.12	6.60	15.24	3.84	6.60
13.	Fed. Territory		42.48	22.32	28.14	9.54	17.70	21.36
14.	Ibadan		37.02	16.98	26.22	5.52	16.55	20.22
15.	Ijebu		39.72	19.56	24.42	5.82	13.98	17.64
16.	Ilorin		31.20	11.04	29.04	7.92	18.24	21.90
17.	Kabba		47.22	20.16	18.18	7.50	12.35	16.02
18.	Kano		6.48	20.58	43.02	39.54	41.22	43.80
19.	Katsina		0.00	20.16	46.62	39.12	44.82	47.40
20.	Niger		20.16	0.00	39.72	18.95	29.28	32.94
21.	Ogoja		46.62	39.72	0.00	21.84	10.44	10.68
22.	Ondo		39.12	18.95	21.84	0.00	11.40	15.06
23.	Onitsha		44.82	29.28	10.44	11.40	0.00	3.66
24.	Owerri		47.40	32.94	10.68	15.06	3.66	0.00
25.	Oyo		35.16	15.00	37.66	5 82	17.22	20.88
26.	Plateau		19.26	21.24	27.36	36.00	25.56	28.14
27.	Port Harcourt		52.08	36.60	14.88	18.72	7.32	3.66
28.	Sardauna		40.62	48.66	45.54	52.98	42.60	45.60
29.	Sokoto		15.96	16.26	51.48	32.22	45.54	49.20
30.	Umuahia		47.64	34.32	10.44	16.44	5.10	2.16
31.	Uyo		50.88	37.92	13.68	20.04	8.64	4.98
32.	Yenogoa		53.82	39.48	14.16	21.48	10.08	6.42
33.	Zaria		10.25	20.88	36.36	32.88	34.56	37.14

No.	From to	25	26	27	28	29	30
1.	Abakaliki	24.06	23.76	11.28	33.54	47.88	6.94
2.	Abeokuta	4.92	37.92	24.84	247.20	36.18	22.56
3.	Adamawa	51.90	20.22	42.60	7.20	44.34	37.56
4.	Annang	2.52	30.12	3.84	52.86	53.04	2.10
5.	Bauchi	37.92	4.92	37.74	19.08	29.04	33.30
6.	Benin	11.94	30.84	12.60	49.62	40.26	10.32
7.	Benue	28.42	12.60	20.22	32.40	36.72	15.78
8.	Bornu	55.38	22.20	55.02	23.58	40.14	50.58
9.	Calabar	27.72	33.48	6.84	50.46	57.60	5.10
10.	Degema	27.30	33.96	5.88	47.94	55.62	8.58
11.	Delta	15.72	33.06	14.82	50.10	44.04	12.54
12.	Enugu	21.06	21.42	10.20	39.66	46.74	5.76
13.	Fed. Territory	7.32	40.32	25.02	60.30	38.58	22.74
14.	Ibadan	1.98	34.98	23.88	57.30	33.24	21.60
15.	Ijebu	4.62	37.56	21.30	56.40	35.82	19.02
16.	Ilorin	3.96	29.04	25.56	54.78	27.30	23.28
17.	Kabba	12.18	28.68	19.68	38.46	36.42	17.40
18.	Kano	35.58	15.66	48.48	34.14	20.24	44.04
19.	Katsina	35.16	19.26	52.08	40.62	15.96	47.64
20.	Niger	15.00	21.24	36.60	48.66	16.26	34.32
21.	Ogoja	27.66	27.36	14.88	45.54	51.48	10.44
22.	Ondo	5.82	36.00	18.72	52.98	32.22	16.44
23.	Onitsha	17.22	25.56	7.32	42.60	45.54	5.10
24.	Owerri	20.88	28.14	3.66	45.60	49.20	2.16
25.	Oyo	0.00	36.24	24.54	59.10	31.26	22.26
26.	Plateau	36.24	0.00	32.82	27.42	24.12	28.38
27.	Port Harcourt	24.54	32.80	0.00	49.80	56.94	4.44
28.	Sardauna	59.10	27.42	49.80	0.00	51.54	45.36
29.	Sokoto	31.26	24.12	56.94	51.54	0.00	52.74
30.	Umuahia	22.26	28.38	4.44	45.36	52.74	0.00
31.	Uyo	28.86	31.62	4.98	48.60	55.74	3.24
32.	Yenogoa	30.90	34.56	5.88	47.10	55.62	8.58
33.	Zaria	28.92	9.00	41.82	36.42	15.12	37.38

APPENDIX B (Continued)

No.	From	to	31	32	33
1.	Abakaliki		10.08	13.80	32.76
2.	Abeokuta		26.16	27.60	33.84
3.	Adamawa		41.40	43.14	28.92
4.	Annang		1.14	9.72	39.48
5.	Bauchi		36.54	39.48	13.92
6.	Benin		13.92	15.30	37.38
7.	Benue		19.02	21.96	21.60
8.	Bornu		53.82	56.76	28.86
9.	Calabar		1.86	13.26	42.48
10.	Degema		10.86	3.60	43.56
11.	Delta		16.14	17.58	42.06
12.	Enugu		9.00	13.02	31.52
13.	Fed. Territory		26.34	22.50	36.24
14.	Ibadan		25.20	26.64	30.06
15.	Ijebu		22.62	24.06	33.48
16.	Ilorin		26.88	29.10	24.95
17.	Kabba		21.00	22.44	34.08
18.	Kano		47.28	50.22	6.66
19.	Katsina		50.88	53.82	10.25
20.	Niger		37.92	39.48	20.88
21.	Ogoja		13.68	14.16	36.36
22.	Ondo		20.04	21.48	32.88
23.	Onitsha		8.64	10.08	34.56
24.	Owerri		4.98	6.42	37.14
25.	Oyo		25.86	30.90	28.92
26.	Plateau		31.62	34.56	9.00
27.	Port Harcourt		4.98	5.88	41.82
28.	Sardauna		48.60	47.16	36.42
29.	Sokoto		55.74	55.62	15.12
30.	Umuahia		3.24	8.58	37.38
31.	Uyo		0.00	10.86	40.62
32.	Yenogoa		10.86	0.00	43.56
33.	Zaria		40.62	43.56	0.00

All costs are in Naira (₦ 1.00 = $1.60)

APPENDIX C

FREIGHT COSTS OF SHIPPING CATTLE BY

RAIL PER MILE

No.	From	To	1	2	3	4	5	6
1.	Kaura Namoda		0.00	0.20	0.80	1.30	1.80	2.70
2.	Gusau		0.20	0.00	0.60	0.90	1.50	2.40
3.	Funtua		0.80	0.60	0.00	0.30	0.80	1.80
4.	Zaria		1.30	0.80	0.30	0.0	0.40	1.40
5.	Kaduna		1.80	1.50	0.80	0.40	0.00	0.90
6.	Minna		2.70	2.40	1.80	1.40	0.90	0.00
7.	Baro		3.80	3.50	2.80	2.50	2.00	1.10
8.	Zungeru		3.20	2.80	2.10	1.80	1.30	2.20
9.	Jebba		4.20	4.00	3.40	2.90	2.40	1.50
10.	Ilorin		4.80	4.50	3.90	3.50	2.40	2.10
11.	Oshogbo		5.00	5.40	4.50	4.10	3.60	2.60
12.	Ibadan		6.00	5.80	5.10	4.70	4.20	3.20
13.	Abeokuta		6.60	6.30	5.70	5.30	4.70	3.80
14.	Lagos		7.20	6.90	6.30	5.90	5.40	4.10
15.	Idogo		7.20	6.90	6.30	5.90	5.40	4.10
16.	Nguru		3.50	3.20	3.50	2.20	2.60	3.60
17.	Kano		2.10	1.80	1.20	0.90	1.30	2.20
18.	Maiduguri		7.10	6.80	6.20	5.80	5.30	6.20
19.	Gombe		3.50	1.50	4.30	3.90	3.50	4.40
20.	Bauchi		4.30	4.00	2.40	2.90	2.40	3.40
21.	Jos		3.50	3.20	2.50	2.10	1.60	2.60
22.	Bukuru		3.40	3.10	2.40	2.00	1.60	2.50
23.	Zonkwa		2.50	2.40	1.80	1.40	0.80	1.80
24.	Kafanchan		2.80	2.50	1.90	1.50	1.10	2.00
25.	Lafia		3.90	3.60	2.90	2.50	2.00	3.10
26.	Makurdi		4.50	4.20	3.60	3.20	2.60	3.60
27.	Oturkpo		4.90	4.70	4.10	3.70	3.20	4.10
28.	Enugu		5.80	5.50	4.80	4.50	4.00	4.90
29.	Umuahia		6.60	6.30	5.70	5.30	4.70	5.70
30.	Aba		6.80	6.60	6.00	5.60	0.50	6.00
31.	Port Harcourt		7.30	6.90	6.30	5.90	5.50	6.40

APPENDIX c (Continued)

No.	From	To	7	8	9	10	11	12
1.	Kauna Namoda		3.80	3.10	4.20	4.80	5.50	6.00
2.	Gusau		3.50	2.80	4.00	4.50	5.00	5.80
3.	Funtua		2.80	2.10	3.40	2.90	4.40	5.10
4.	Zaria		2.50	1.80	2.90	3.50	4.00	4.70
5.	Kaduna		2.00	1.40	2.40	3.10	3.60	4.20
6.	Minna		1.10	0.30	1.50	2.10	2.50	3.30
7.	Baro		0.00	2.80	1.50	2.10	3.80	4.30
8.	Zungeru		1.40	0.00	1.20	1.70	4.80	2.90
9.	Jebba		2.50	3.40	0.00	0.50	0.90	1.70
10.	Ilorin		3.20	2.40	0.50	0.00	0.40	1.20
11.	Oshogbo		3.70	2.30	1.20	0.50	0.00	0.50
12.	Ibadan		5.10	3.60	1.70	1.20	1.20	0.00
13.	Abeokuta		4.90	4.20	2.30	1.70	1.20	0.50
14.	Lagos		5.50	4.40	2.80	2.30	2.00	1.20
15.	Idogo		5.50	4.40	2.80	2.30	2.00	1.20
16.	Nguru		4.70	4.10	5.10	5.80	6.20	6.90
17.	Kano		3.30	2.60	3.80	4.30	4.40	5.60
18.	Maiduguri		7.30	6.50	7.80	8.30	8.80	9.50
19.	Gombe		5.50	4.70	5.90	6.50	7.10	7.70
20.	Bauchi		4.40	3.70	4.90	5.50	6.00	6.70
21.	Jos		3.80	2.90	4.10	4.70	5.10	5.90
22.	Bukuru		3.60	2.80	4.00	4.60	5.10	5.80
23.	Zonkwa		2.80	2.10	2.70	3.40	3.90	4.50
24.	Kafanchan		3.10	2.30	3.50	4.10	4.60	5.30
25.	Lafia		4.10	3.40	4.50	5.10	5.60	6.30
26.	Makurdi		4.70	4.10	5.10	5.70	6.20	6.90
27.	Oturkpo		5.30	4.50	5.70	6.30	6.50	7.40
28.	Enugu		6.00	5.00	6.40	7.10	0.70	8.20
29.	Umuahia		6.70	6.10	7.30	7.80	8.30	9.00
30.	Aba		1.10	6.40	7.60	8.10	8.60	9.30
31.	Port Harcourt		7.50	6.70	7.90	8.50	9.00	9.70

APPENDIX C (Continued)

No.	From	To	13	14	15	16	17	18
1.	Kauna Namoda		6.50	7.50	7.40	3.50	2.10	7.10
2.	Gusau		6.30	6.90	6.90	3.20	1.80	6.80
3.	Funtua		5.70	6.30	6.30	2.50	1.20	6.20
4.	Zaria		5.30	5.90	5.60	2.20	0.70	5.80
5.	Kaduna		4.70	5.40	5.40	2.60	1.30	5.30
6.	Minna		3.80	4.10	4.20	3.60	2.20	3.20
7.	Baro		4.90	5.50	5.50	4.70	3.30	7.30
8.	Zungeru		3.50	4.10	4.10	5.00	2.60	6.50
9.	Jebba		2.30	2.80	2.80	5.10	3.80	7.80
10.	Ilorin		1.70	2.30	2.30	5.80	4.30	8.30
11.	Oshogbo		1.20	1.70	1.70	6.30	4.00	8.90
12.	Ibadan		0.50	1.20	1.20	6.90	5.60	9.50
13.	Abeokuta		0.00	0.50	0.50	7.50	6.10	10.10
14.	Lagos		0.50	0.00	0.40	8.10	6.70	6.60
15.	Idogo		0.50	0.40	0.00	8.10	6.70	6.60
16.	Nguru		7.50	8.10	8.10	0.00	1.40	8.00
17.	Kano		5.90	6.70	6.70	1.40	0.00	6.60
18.	Maiduguri		10.10	10.60	10.60	8.00	6.60	0.00
19.	Gombe		8.80	8.80	8.80	6.20	4.70	1.80
20.	Bauchi		7.30	7.90	7.90	5.10	3.80	2.70
21.	Jos		6.40	7.10	6.80	4.30	2.90	4.00
22.	Bukuru		6.30	6.90	6.90	4.20	2.80	3.90
23.	Zonkwa		5.10	5.70	5.70	3.10	1.60	4.30
24.	Kafanchan		5.90	6.40	6.40	3.80	2.30	4.20
25.	Lafia		6.90	6.80	7.50	7.50	4.50	3.40
26.	Makurdi		7.50	8.10	8.10	8.40	5.40	4.00
27.	Oturkpo		8.00	8.60	8.60	6.60	6.70	6.30
28.	Enugu		8.80	9.30	9.30	6.70	5.40	7.20
29.	Umuahia		9.60	10.20	10.20	7.50	6.10	7.90
30.	Aba		9.90	10.50	10.50	7.80	6.40	8.20
31.	Port Harcourt		10.30	10.80	10.80	8.20	6.70	8.60

APPENDIX C (Continued)

No.	From	To	19	20	21	22	23	24
1.	Kauna Namoda		5.30	4.30	3.50	3.40	2.60	3.20
2.	Gusau		4.90	4.00	3.20	3.10	2.40	2.50
3.	Funtua		4.30	3.40	2.50	2.40	1.80	1.90
4.	Zaria		3.90	2.90	2.10	2.00	1.40	1.50
5.	Kaduna		3.50	2.40	1.60	1.60	0.80	1.10
6.	Minna		4.40	3.40	2.60	2.50	1.80	2.00
7.	Baro		5.50	4.40	3.70	3.60	2.80	3.10
8.	Zungeru		4.70	3.80	2.90	2.80	1.90	2.30
9.	Jebba		5.90	4.90	4.10	4.00	3.40	3.50
10.	Ilorin		6.50	5.50	4.70	4.60	3.40	4.10
11.	Oshogbo		7.40	6.10	5.30	5.10	4.50	4.70
12.	Ibadan		7.70	6.70	5.90	5.80	5.00	5.30
13.	Abeokuta		8.30	7.30	6.40	6.30	5.70	5.90
14.	Lagos		8.80	7.90	7.10	6.90	6.20	6.40
15.	Idogo		8.80	7.90	7.10	6.90	6.20	6.40
16.	Nguru		7.50	5.10	4.30	4.20	3.60	3.70
17.	Kano		4.70	3.80	2.90	2.80	2.20	2.30
18.	Maiduguri		1.80	2.70	4.00	3.90	4.30	4.20
19.	Gombe		0.00	0.90	2.20	2.10	4.30	2.40
20.	Bauchi		0.90	0.00	1.20	1.10	6.20	1.40
21.	Jos		2.20	1.20	0.00	0.10	0.70	0.50
22.	Bukuru		2.10	1.10	0.10	0.00	0.60	0.40
23.	Zonkwa		2.50	1.60	0.70	0.60	0.00	0.10
24.	Kafanchan		2.40	1.40	0.50	0.40	0.10	0.00
25.	Lafia		5.30	3.40	4.10	1.60	1.50	1.20
26.	Makurdi		5.80	4.00	3.10	2.20	2.10	1.90
27.	Oturkpo		6.70	6.70	5.70	2.60	2.60	2.30
28.	Enugu		5.40	4.30	3.50	3.50	0.70	2.90
29.	Umuahia		6.10	5.10	4.30	4.20	3.90	3.70
30.	Aba		6.40	5.40	4.60	4.50	4.20	4.00
31.	Port Harcourt		6.70	5.80	4.90	4.80	4.50	4.30

APPENDIX C (Continued)

No.	From	To	25	26	27	28	29	30	31
1.	Kaura Namoda		3.90	4.50	4.90	5.80	6.60	6.80	7.20
2.	Gusau		3.60	4.20	4.70	5.50	6.30	6.60	6.90
3.	Funtua		2.90	3.60	4.00	4.80	5.70	6.00	6.30
4.	Zaria		2.50	3.20	3.70	4.50	5.30	5.60	5.90
5.	Kaduna		2.00	2.60	3.20	4.00	4.70	5.00	5.50
6.	Minna		3.10	3.60	4.10	4.90	5.70	6.00	6.40
7.	Baro		4.10	4.70	5.10	6.00	6.70	7.10	7.50
8.	Zungeru		3.50	4.00	4.40	5.30	6.10	6.30	6.70
9.	Jebba		4.50	5.10	5.60	6.40	7.30	7.60	7.90
10.	Ilorin		5.10	5.70	6.20	7.10	7.80	8.10	8.50
11.	Oshogbo		5.70	6.30	6.80	7.70	8.40	8.70	9.10
12.	Ibadan		6.30	6.90	7.40	8.20	9.00	9.30	9.70
13.	Abeokuta		6.80	7.50	8.00	8.80	9.60	9.90	10.30
14.	Lagos		7.50	8.10	8.60	9.30	10.20	10.50	10.80
15.	Idogo		7.50	8.14	8.60	9.30	10.20	10.50	10.80
16.	Nguru		4.70	5.40	5.90	6.70	7.50	7.80	8.20
17.	Kano		3.40	4.00	4.50	5.40	6.10	6.40	6.70
18.	Maiduguri		5.30	5.80	6.30	7.30	7.90	8.20	8.60
19.	Gombe		3.40	4.00	4.50	5.30	6.10	6.40	6.70
20.	Bauchi		2.40	3.10	3.30	4.30	5.10	5.40	5.80
21.	Jos		1.60	2.60	2.60	3.50	4.30	4.60	4.90
22.	Bukuru		1.50	2.10	2.60	3.50	4.20	4.50	4.80
23.	Zonkwa		1.20	1.80	2.20	3.20	3.40	3.90	4.00
24.	Kafanchan		0.90	1.60	2.10	2.90	3.70	4.00	4.30
25.	Lafia		0.00	0.50	1.10	1.90	2.60	2.90	3.40
26.	Makurdi		1.60	0.00	0.40	1.30	2.00	2.30	2.70
27.	Oturkpo		2.10	1.10	0.00	0.70	1.60	1.90	2.20
28.	Enugu		1.90	1.30	0.70	0.00	0.70	1.11	1.40
29.	Umuahia		2.60	2.00	1.50	0.70	0.00	0.20	0.60
30.	Aba		2.90	2.30	1.80	1.10	0.20	0.00	0.30
31.	Port Harcourt		3.40	2.70	2.20	1.40	0.60	0.30	0.00

Source: Nigerian Railway Corporation, <u>Tariff No. 7</u>., 1971.

All costs are in Naira (₦)., 1974.

Optimum Movement of Cattle By Hoof

No.	From To	1	2	3	4	5	6
1.	Sokoto						80,030
2.	Gusau						
3.	Kontagora						
4.	Ilorin						
5.	Oyo						
6.	Ibadan						
7.	Abeokuta						
8.	Lagos						
9.	Ijebu-Ode						
10.	Ondo						
11.	Benin City						
12.	Warri						
13.	Katsina						
14.	Kano						
15.	Zaria						
16.	Kaduna						
17.	Minna						
18.	Lokoja						
19.	Enugu						
20.	Onitsha						
21.	Owerri						
22.	Port Harcourt						
23.	Calabar						
24.	Makurdi						
25.	Umuahia						
26.	Bauchi						
27.	Gombe					36,902	
28.	Maiduguri						
29.	Ikot Ekpene						
30.	Uyo						
31.	Aba						
32.	Jos			62,613			
33.	Yola						
34.	Kabba						

		1	2	3	4	5	6
Total				62,613		36,902	80,030
Delivered Value N				32.10		33.40	12.50

APPENDIX D (Continued)

No.	From To	7	8	9	10	11	12
1.	Sokoto						
2.	Gusau						
3.	Kontagora				108,849		52,841
4.	Ilorin						
5.	Oyo						
6.	Ibadan						
7.	Abeoketa						
8.	Lagos						
9.	Ijebu-Ode						
10.	Ondo						
11.	Benin City						
12.	Warri						
13.	Katsina			21,242			
14.	Kano						
15.	Zaria						
16.	Kaduna						
17.	Minna						
18.	Lokoja						
19.	Enugu						
20.	Onitsha						
21.	Owerri						
22.	Port Harcourt						
23.	Calabar						
24.	Makurdi						
25.	Umuahia						
26.	Bauchi						
27.	Gombe 30,457						
28.	Maiduguri						
29.	Ikot Ekpene						
30.	Uyo						
31.	Aba						
32.	Jos						
33.	Yola						4,432
34.	Kabba						
	Total	30,457		21,242	108,849		57,273

APPENDIX **D** (Continued)

No.	From To	13	14	15	16	17		18
1.	Sokoto							
2.	Gusau							
3.	Kontagora							
4.	Ilorin							
5.	Oyo							
6.	Ibadan							
7.	Abeokuta							
8.	Lagos							
9.	Ijebu-Ode							
10.	Ondo							
11.	Benin City							
12.	Warri							
13.	Katsina							
14.	Kano							
15.	Zaria							
16.	Kaduna							
17.	Minna							
18.	Lokoja							
19.	Enugu							
20.	Onitsha							
21.	Owerri							
22.	Port Harcourt							
23.	Calabar							
24.	Makurdi							
25.	Umuahia							
26.	Bauchi							
27.	Gombe							
28.	Maiduguri							
29.	Ikot Ekpene							
30.	Uyo							
31.	Aba							
32.	Jos							
33.	Yola							
34.	Kabba							
	TOTAL	−	−	−	−	−	−	−
	Delivered Value ₦							

APPENDIX D (Continued)

No.	From	To	19	20	21	22	23	24
1.	Sokoto							
2.	Gusau							
3.	Kontagora							
4.	Ilorin		15,591	33,169				
5.	Oyo							
6.	Ibadan							
7.	Abeokuta							
8.	Lagos							
9.	Ijebu-Ode							
10.	Ondo							
11.	Benin City							
12.	Warri							
13.	Katsina							20,142
14.	Kano		18,754			23,805		
15.	Zaria						3,531	
16.	Kaduna							
17.	Minna							
18.	Lokoja							
19.	Enugu							
20.	Onitsha							
21.	Owerri							
22.	Port Harcourt							
23.	Calabar							
24.	Makurdi			3,553	19,000			
25.	Umuahia							
26.	Bauchi			58				
27.	Gombe						12,235	4,858
28.	Maiduguri							
29.	Ikot Ekpene							
30.	Uyo							
31.	Aba							
32.	Jos							
33.	Yola							
34.	Kabba			1,292				
	TOTAL		34,472	30,072	19,000	23,805	15,766	25,000

APPENDIX D (Continued)

No.	From	To	25	26	27	28	29	30
1.	Sokoto							
2	Gusau							
3.	Kontagora							
4.	Ilorin							
5.	Oyo							
6.	Ibadan							
7.	Abeokuta							
8.	Lagos							
9.	Ijebu-Ode							
10.	Ondo							
11.	Benin City							
12.	Warri							
13.	Katsina							21,082	
14.	Kano		51,921					
15.	Zaria							
16.	Kaduna							
17.	Minna							
18.	Lokoja							
19.	Enugu							
20.	Onitasha							
21.	Owerri							
22.	Port Harcourt							
23.	Calabar							
24.	Makurdi							
25.	Umuahia							
26.	Bauchi							11,626
27.	Gombe							
28.	Maiduguri							
29.	Ikot Ekpene							
30.	Uyo							
31.	Aba							
32.	Jos							13,374
33.	Yola							
34.	Kabba							
			51,921				21,082	25,000

APPENDIX D. (Continued)

No.	From	To	31	32	33	34
1.	Sokoto		13,894			
2.	Gusau					
3.	Kontagora					
4.	Ilorin					
5.	Oyo					
6.	Ibadan					
7.	Abeokuta					
8.	Lagos					
9.	Ijebu-Ode					
10.	Ondo					
11.	Benin City					
12.	Warri					
13.	Katsina					
14.	Kano		9,597			
15.	Zaria					
16.	Kaduna					
17.	Minna					
18.	Lokoja					
19.	Enugu					
20.	Onitsha					
21.	Owerri					
22.	Port Harcourt					
23.	Calabar					
24.	Makurdi					
25.	Umuahia					
26.	Bauchi					
27.	Gombe					
28.	Maiduguri					
29.	Ikot Ekpene					
30.	Uyo					
31.	Aba					
32.	Jos					
33.	Yola					
34.	Kabba		8,364			

TOTAL   31,855

Optimum Shipment of Cattle by Truck

From	To	1	2	3	4	5	6	7
1.	Abakaliki							
2.	Abeokuta							
3.	Adamawa							
4.	Annang							
5.	Bauchi.							
6.	Benin							
7.	Benue						4,931	
8.	Bornu							
9.	Calabar							
10.	Degema							
11.	Delta							
12.	Enugu							
13.	Federal Territory							
14.	Ibadan							
15.	Ijebu							
16.	Ilorin		18,708					
17.	Kabba							
18.	Kano							
19.	Katsina							
20.	Niger							
21.	Ogoja							
22.	Ondo							
23.	Onitsha							
24.	Owerri							
25.	Oyo							
26.	Plateau							
27.	Port Harcourt							
28.	Sardauna							
29.	Sokoto							
30.	Umuahia							
31.	Uyo							
32.	Yenogoa							
33.	Zaria							
	TOTAL	---	18,708	---	---	---	66,197	---

Appendix E (Continued)

		8	9	10	11	12	13	14
1.	Abakaliki							
2.	Abeokuta					33,678		
3.	Adamawa							
4.	Annang							
5.	Bauchi							
6.	Benin							
7.	Benue		4,613					6,756
8.	Bornu							20,892
9.	Calabar							
10.	Degema							
11.	Delta							
12.	Enugu							
13.	Federal Territory							
14.	Ibadan							
15.	Ijebu							
16.	Ilorin							
17.	Kabba							
18.	Kano							
19.	Katsina							
20.	Niger							43,991
21.	Ogoja							
22.	Ondo							
23.	Onitsha							
24.	Owerri							
25.	Oyo							
26.	Plateau					12,179		
27.	Port Harcourt							
28.	Sardauna				6,147		18,525	
29.	Sokoto							
30.	Umuahia							
31.	Uyo							
32.	Yenogoa							
33.	Zaria				34,272			
	TOTAL	---	4,613	---	40,419	45,857	18,525	

Appendix E (continued)

		15	16	17	18	19	20	21	
1.	Abakaliki								
2.	Abeokuta								
3.	Adamawa								
4.	Annang								
5.	Bauchi								
6.	Benin								
7.	Benue	2,114							
8.	Bornu								
9.	Calabar								
10.	Degema								
11.	Delta								
12.	Enugu								
13.	Federal Territory								
14.	Ibadan								
15.	Ijebu								
16.	Ilorin								
17.	Kabba								
18.	Kano								
19.	Katsina								
20.	Niger								
21.	Ogoja								
22.	Ondo								
23.	Onitsha								
24.	Owerri								
25.	Oyo								
26.	Plateau								
27.	Port Harcourt								
28.	Sardauna	5,776							
29.	Sokoto								
30.	Umuahia								
31.	Uyo								
32.	Yenogoa								
33.	Zaria								3,939
	TOTAL	7,890	---	---	---	---	---	3,939	

Appendix E (continued)

		22	23	24	25	26	27	
1.	Abakaliki							
2.	Abeokuta							
3.	Adamawa							
4.	Annang							
5.	Bauchi							
6.	Benin							
7.	Benue				13,642			
8.	Bornu							
9.	Calabar							
10.	Degema							
11.	Delta							
12.	Enugu							
13.	Federal Territory							
14.	Ibadan							
15.	Ijebu							
16.	Ilorin				14,930			
17.	Kabba	33,157						
18.	Kano			112,835				
19.	Katsina							
20.	Niger							
21.	Ogoja							
22.	Ondo							
23.	Onitsha							
24.	Owerri							
25.	Oyo							
26.	Plateau				22,586			
27.	Port Harcourt							
28.	Sardauna						3,650	
29.	Sokoto		23,456					
30.	Umuahia							
31.	Uyo							
32.	Yenogoa							
33.	Zaria							
	TOTAL	33,157	23,456	112,835	51,158	----	3,656	

Appendix E (continued)

		28	29	30	31	32	33
1.	Abakaliki						
2.	Abeokuta						
3.	Adamawa						
4.	Annang						
5.	Bauchi						
6.	Benin						
7.	Benue			1,635			
8.	Bornu				90,675		
9.	Calabar						
10.	Degema						
11.	Delta						
12.	Enugu						
13.	Federal Territory						
14.	Ibadan						
15.	Ijebu						
16.	Ilorin						
17.	Kabba						
18.	Kano						
19.	Katsina						
20.	Niger						
21.	Ogoja						
22.	Ondo						
23.	Onitsha						
24.	Owerri						
25.	Oyo						
26.	Plateau						
27.	Port Harcourt						
28.	Sardauna			21,067			
29.	Sokoto						
30.	Umuahia						
31.	Uyo						
32.	Yenogoa						
33.	Zaria						
	TOTAL	----	----	23,103	100,412	---	----

APPENDIX F

Optimal Cattle Flow by Train

No.	From To	1	2	3	4	5	6	7
1.	Kaura Namoda							
2.	Gusau							
3.	Funtua							
4.	Zaria							
5.	Kaduna							
6.	Minna							
7.	Baro							
8.	Zungeru							
9.	Jebba							
10.	Ilorin							
11.	Oshogbo							
12.	Igadan							
13.	Abeokuta							
14.	Lagos							
15.	Idogo							
16.	Ngurn							
17.	Kano							
18.	Maiduguri							
19.	Gombe							
20.	Bauchi							
21.	Jos							
22.	Bukuru							
23.	Zonkwa							
24.	Kafanchan							
25.	Lafia							
26.	Makurdi							
27.	Oturkpo							
28.	Enugu							
29.	Umuahia							
30.	Aba							
31.	Port Harcourt							

APPENDIX F (Continued)

No.	From To	8	9	10	11	12	13	14
1.	Kaura Namoda							
2.	Gusau							
3.	Funtua			75				
4.	Zaria							
5.	Kaduna							
6.	Minna			11				
7.	Baro							
8.	Zungeru							
9.	Jebba							
10.	Ilorin							
11.	Oshogbo							
12.	Ibadan							
13.	Abeokuta							
14.	Lagos							
15.	Idogo							
16.	Ngurn					2,075		
17.	Kano					2,035		
18.	Maiduguri					6,674		32,173
19.	Bombe							
20.	Bauchi						5,472	
21.	Jos							
22.	Bukuru					9,898		
23.	Zonkwa			2,949				
24.	Kafanchan							
25.	Lafia							
26.	Makurdi							
27.	Oturkpo							
28.	Enugu							
29.	Umuahia							
30.	Aba							
31.	Port Harcourt							
	TOTAL			3,035 8.30		20,682 9.50	5,472	32,173 10.60

No.	From	To	15	16	17	18	19	20	21
1.	Kaura Namoda								
2.	Gusau								
3.	Funtua								
4.	Zaria								
5.	Kaduna								
6.	Minna								
7.	Baro								
8.	Zungeru								
9.	Jebba								
10.	Ilorin								
11.	Oshogbo								
12.	Ibadan								
13.	Abeokuta								
14.	Lagos								
15.	Idogo								
16.	Ngurn								
17.	Kano								
18.	Maiduguri								
19.	Gombe								
20.	Bauchi								
21.	Jos								
22.	Bukuru								
23.	Zonkwa								
24.	Kafanchan								
25.	Lafia								
26.	Makurdi								
27.	Oturkpo								
28.	Enugu								
29.	Umuahia								
30.	Aba								
31.	Port Harcourt								

APPENDIX F (Continued)

No.	From	To	22	23	24	25	26	27	28
1.	Kaura Namoda								
2.	Gusau						3,116		
3.	Funtua								
4.	Zaria								
5.	Kaduna								
6.	Minna								
7.	Baro								
8.	Zungeru								
9.	Jebba								
10.	Ilorin								
11.	Oshogbo								
12.	Ibadan								
13.	Abeokuta								
14.	Lagos								
15.	Idogo								
16.	Ngurn								
17.	Kano								
18.	Maiduguri								
19.	Gombe								8,692
20.	Bauchi						236		426
21.	Jos								
22.	Bukuru								
23.	Zonkwa								
24.	Kafanchan								
25.	Lafia								
26.	Makurdi								4,020
27.	Oturkpo								
28.	Enugu								
29.	Umuahia								
30.	Aba								
31.	Port Harcourt								
	TOTAL						3,352		13,138
	Delivered Value ₦						8.10		9.30

APPENDIX **F** (Continued)

No.	From To	29	30	31
1.	Kaura Namoda			
2.	Gusau			
3.	Funtua			988
4.	Zaria			2,934
5.	Kaduna			
6.	Minna			
7.	Baro			
8.	Zungeru			
9.	Jebba			
10.	Ilorin			
11.	Oshogbo			
12.	Ibadan			
13.	Abeokuta			
14.	Lagos			
15.	Idogo			
16.	Ngurn	21,113		
17.	Kano		1,041	
18.	Maiduguri			
19.	Gombe			
20.	Bauchi			
21.	Jos			
22.	Bukuru			
23.	Zonkwa			
24.	Kafanchan			1,455
25.	Lafia			
26.	Makurdi		1,377	5,469
27.	Oturkpo			
28.	Enugu			
29.	Umuahia			
30.	Abe			
31.	Port Harcourt			
	TOTAL Delivered	21,113	2,418	10,846
	Value ₦	10.10	10.30	10.70

Source:

APPENDIX G

The relationship that exist in the Fulani Cattle
trade between northern and southern Nigeria is an example of a
flow-movement of goods from one place to another. The rates of
changes of the levels of flow are simply the sum of or the differ-
ence of the rates of various flows. The rates can either be added
or subtracted according as if the goods are flowing from outside
source or flowing into an outside sink. The rates of change ean
be written:

$$AIRK = AIRJ + ETRDJK - ETSRJK \quad (1)$$

which means - the acutal number of goods (cattle) at the present
time (K) is equal to the number at earlier time (J) plus the num-
ber received during the elapsed time (ET) multiplied by the rate
at which shipments were received (RD) over the time J-K minus the
number delivered during the elapsed time (ET) multipled by the rate
of shipment (SR) at the time J-K.

$$UORK = UORJ + ETNORJK - ETSRJK \quad (2)$$

unfilled orders at retail at the present time (K) is equal to un-
filled orders at earlier time (J) plus new orders at the elapsed
time (ET) over the time J-K minus the rate of shipments received
at the time J-K.

$$SRKL = \frac{UORK}{DOR} \sqrt{\frac{AIRK}{DFRK}} \quad (3)$$

Shipments recieved at the time KL is equal to unfilled order at
the time K divided by the delay in ordering and the square root
of actual number of stock at the present time (K) over the delay
in filling order at time K[1].

[1] For Source on this see: (1) Jay W. Forrester, Industrial
Dynamics, Cambridge, Massachussetts: MIT Press, 1961. (2)_____
Principles of Systems, Cambridge, Mass: Wright-Allen Press. 1968.