Women and Household Food Security in Rural Uganda

Sarah Nakabo Ssewanyana

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

Department of Agricultural Economics
University of Sydney
NSW 2006
AUSTRALIA

November 2000

Certificate of Originality

I hereby certify that the text of this thesis contains no material which has been accepted as part of the requirements for any degree or diploma in any University nor any material previously published or written unless due reference to this material is made

Abstract

Food security issues are top on the agenda of most African countries. However, the level at which these issues are addressed has varied from country to country. While for countries such as Zambia, Zimbabwe and Malawi the focus is at the household level, in Uganda the emphasis is at the national level, targeting mainly food self-sufficiency. There is compelling evidence in literature that food self-sufficiency does not translate into food security at all levels. On the other hand, one finds that the causes and nature of food insecurity are localised, implying that no blueprint remedies exist on what individual countries could do to improve food security for all.

This study seeks to explore possible explanations for growing food insecurities among rural households in the midst of national food self-sufficiency, fertile soils and strong economic growth in Uganda since 1987. More specifically, the question addressed is how does food security at the household level relate to the status of rural women? To that end, a static Nonseparable agricultural household modelling approach is employed. This approach has the ability to capture the simultaneity that exists between consumption and production decisions that characterise rural households. The data used were from a cross-sectional survey of 300 rural households in three districts.

The study goes beyond the conventional tendency of measuring food security solely in caloric intake. Additionally, protein and iron intakes are considered. The results tend to suggest that household income, food prices and women-specific variables such as education, age, access to productive resources and time allocation influence household food security. Notably, the impact of these variables varied considerably across the household food security measures and district. Raising the incomes of rural households is likely to improve their food security. However, it will take time to move the households at risk of getting food insecure to a higher income level and the subsequent improvements in their overall food security. Additionally, the rural households could no longer be treated as being at the level of subsistence production. They are not 'uncaptured peasants' operating outside the money economy, but appear to respond to changes in food prices despite deriving much of their consumption from own production.

The findings highlight the crucial role that a rural woman plays in ensuring household food security. Increasing time spent on productive activities by women enhances household food production but at the expense of household food security. This reflects a trade-off between time allocated to productive activities and domestic activities that face women. Results confirm the positive impact of health of a rural woman on a household's command over food. Nonseparability of consumption and production decisions shows up in different variables across districts. The policy implications of the findings are also explored. Arguably no single policy can be employed to effectively improve food security of rural households. Instead a mix of policies is suggested explicitly addressing the issues that are central to fostering the productivity of women both in and outside the household.

Keywords: household food security, women, Uganda, Nonseparable agricultural household model

Dedication

To my loving husband Joseph, and
children Andrew, Josephine and Anna Maria

Acknowledgments

I am very grateful to the financial support of AusAID without which this dream would not have been realised. I also extend my gratitude to the African Economic Research Consortium (AERC) and Makerere University for funding my fieldwork.

Special thanks go to Associate Professor Fredoun Z. Ahmadi-Esfahani, my major supervisor, for his untiring supervision for the period of my candidature. His guidance, constructive criticisms and suggestions helped in having my research focused. I also greatly appreciate the useful comments and suggestions of Dr. Euan Fleming.

I extend my gratitude to my field research assistants: Fredrick Mugisha, Robert Muwaazi and Jackson Wamwa. They worked tirelessly in the field for the whole period of my fieldwork.

The forbearance, patience and love of my husband, Joseph and children Andrew and Josephine were crucial to the successful completion of my degree. Very often they needed my attention but I was mostly taken up by my research. To them, I offer all my love and gratitude.

Lastly but not least, I extend my thanks to my in-laws especially Andrew and Peragia Ssekate for taking care of my son, Andrew, during the period of my study. Not forgetting the family of late Erifazi Mutayanjulwa for the good foundation they gave me as a child!

Currency used:

Ug. Shs	Uganda Shilling
US$	United States dollar

Glossary of terms:

- Traditional agricultural export crops are crops that have been known as exports since colonial time. These include coffee, cotton and tea.
- Non-traditional agricultural export crops are crops that were grown mainly for local consumption but have recently emerged as foreign exchange earners. These include beans, maize, simsim and horticultural products.
- Cash crop refers to any crop that can be traded for the purpose of earning income including food.
- Entandikwa is a local terminology equivalent to seed money.
- Women-specific variables. Refers to women's food entitlements (such as access to productive resources and access to social services) and socio-demographic characteristics (such as age).
- Productive activities refer to such activities carried out on the farm, food marketing, and services (such as tailoring, repairs).
- Domestic activities refer to such activities as childcare, collecting fuel wood, fetching water, food preparation and caring for the sick.
- 'Zero-sum game time allocation'. This is a term used to refer to a situation where rural women find themselves increasing time allocated to productive activities by deducting from that they should have spent on domestic activities. The reverse holds true.

Table of Contents

List of Tables

List of Figures

Figures:

List of Appendices

1 Introduction

Household food security is defined as the ability of a household to secure enough food so as to ensure adequate dietary intake for all its members from either food produced directly and stored by the household and/or through sufficient income to purchase the necessary food at all times for an active, healthy life. Additionally, food must be culturally acceptable and derived from non-emergency sources such as food aid. Household food security is an important issue in any country's economic development, despite the complexities surrounding its conceptualisation. Despite overall increases in food production globally, the available literature (see, for example, Pinstrup-Andersen and Pandya-Lorch 1997a 1997b; ACC/SCN 1997) shows that the number of undernourished people in developing countries particularly in sub-Saharan Africa (SSA) and South East Asia is not decreasing at the rates previously predicted. Consequently, the World Food Summit of 1996 called upon individual governments to take action to ensure food security for all. Success stories have been reported in SSA (for example, Botswana) but, unfortunately, strategies followed by such countries cannot be replicated elsewhere given the differences in the causes and nature of food insecurity. This study focuses on Uganda, which has for long been regarded as a food self-sufficient nation but was included on the FAO list of Low-Income Food-Deficit Countries (LIFDCs) in late 1996.

After gaining independence, Uganda had one of the strongest economies andthe best physical infrastructure and social services in Africa. The 1970s and early 1980s were marked by economic collapse, decline in food availability per capita, political instability, and deterioration in the physical infrastructure and social services (FAO 1992; Nabuguzi 1993). When the National Resistance Movement (NRM) government came into power in 1986, remarkable achievements were realised. With the economic reforms adopted after 1986, positive one-digit economic growth rates and a decline in inflation rates from three digits to one were realised but proceeded with slow social progress. Peace and political stability were restored in most parts of the country, attracting massive donor assistance in all sectors of the economy.

In contrast, the exclusive food self-sufficiency-centred, sectoral approach with trickle-down policies neglected the issues of food accessibility at the household level and, more importantly, the crucial role of rural women in ensuring household food security. This study, therefore, tackles the issue of food security at the household level and empirically explores the role of women in ensuring food security and how their role can be enhanced.

1.1 The Need for a Household Food Security Study for Rural Uganda

Uganda appears to lag behind other SSA countries, in particular those in southern Africa, in addressing food security, particularly at the household level. This is evident from the lack of food security assessment at all levels as observed by Riley (1994) and the scanty but descriptive studies[2] on food security such as Ssekiboobo and Kakande (1994) and MoPED (1996b). Inattention to food security, particularly at the household level, is inextricably linked to three important issues. These are: widespread misconception of the food security concept by policymakers; insufficient relevant data; and the low status of rural women.

The concept of food security has evolved, developed, multiplied and diversified since the World Food Conference of 1974 (Maxwell and Smith 1992; Maxwell, S 1996). In part, this explains the apparent misconception of the food security concept by policymakers in Uganda, that ensuring food self-sufficiency at the national level is a necessary and sufficient condition for food security at the lower levels. This is clearly not the case. In fact, the available evidence at the household level indicates that nearly 38 percent of children below 5 years are undernourished and 14 percent of the women deliver babies of low weight (Republic of Uganda 1996, p.1), and as well as anecdotal observation that people are feeding on wild foods in some localities[3]. Such evidence points to growing food insecurity at the household level and a failure on the part of policymakers to address the food accessibility issues. One would not hesitate to question the growing evidence of food insecurity among rural households in the midst of strong economic growth, fertile soils and national food self-sufficiency.

Currently, data pertaining to food security at the household level are insufficient, making it difficult to examine responses of households to policies that affect their food security status. It is very difficult to make headway in food security analysis and

[2] Based on food balance sheets.
[3] Feeding on wild foods has never been a common practice in Uganda.

planning at any level unless proper and accurate data are available. For instance, data played an important role in addressing food security and nutrition issues in Malawi (Quinn 1994). Furthermore, the Uganda National Integrated Household surveys of 1989 and the household budget surveys of 1992 and 1994 carried out by the government's Statistics Department treated women as invisible players. That is, such surveys targeted the head of the household as the main respondent, who in most cases was an adult male despite his peripheral role. More importantly, such data were not disaggregated by gender. This is not peculiar to Uganda. Previous studies such as Strauss (1984, 1986) in Sierra Leone and Kyereme and Thorbecke (1991) in Ghana suffer from the same weakness. Additionally, these studies employed data collected on food expenditures other than actual food consumption; which may fail to provide the relevant data for understanding food security. Clearly, food security policies based on such surveys would have more impact if the key players were targeted as the main respondents in the data collection exercise.

Researchers (for example, Quisumbing *et al.* 1995) and international organisations (notably FAO and the World Bank) concur that women in developing countries play a crucial role in ensuring household food security. Similarly, the Ugandan government has recognised the role played by women. However, the strategies that have been suggested to raise the productivity of rural women, which is seen as crucial for improving household food security, leave a lot to be desired. Firstly, such strategies have focused on women's productive activities while paying little attention to their role in domestic activities. However, time is a scarce resource (Becker 1965), especially for rural women who are trapped in a zero-sum game[4] as argued by McGuire and Popkin (1990). The Ugandan government's campaign to promote income-generating activities among rural women is a prime example of such strategies. This is closely related to the lack of participation of rural women in designing policies and programs where they are targeted as the beneficiaries.

Secondly, the gender disparities in terms of access to productive resources and social services have not been adequately addressed. More importantly, no empirical evidence

[4] That is to say, women found themselves in a closed system in which time devoted to any activity must be diverted from their other activities (see McGuire and Popkin 1990). Some would also argue that women's time trade-off is between different types of work, rather than between work and leisure *per se*. And since the time one may consider as leisure for these women tend to be utilised for making handcraft work for sale, it renders a distinction between productive and/or domestic activities and leisure problematic.

exists to demonstrate how a rural woman's access to productive resources and social services influences a household's command over food. The fully-fledged neo-liberal policies recently embarked on by the government have aggravated the gender disparities (see, for example, UNDP 1997b). It appears that women have disproportionately borne the burden resulting from the continued government budgetary cuts to social services.

Thirdly, there is lack of gender-disaggregated data as previously discussed. The current data fail to make visible the full extent of women's crucial role in ensuring household food security. Fourthly, such strategies assume rural women to belong to a homogeneous group. This explicitly ignores differences in their socio-economic status.

This study focuses on rural Uganda where more than 80 percent of the population of Uganda reside and depend on agriculture for their livelihood, including food security. Rural households grow a variety of food crops partly for their own consumption and partly for sale. In fact, some would argue that consuming a variety of foods helps ensure that the necessary minimum daily dietary requirements of a household are met. In contrast, recent studies on rural Ugandan households, which are mostly based on food balance sheets (such as Jamal 1988; Ssekiboobo and Kakande 1994; MoPED 1996b) report that the diets of these households are centred more on starchy staples that are rich in one nutrient but deficient in others. This necessitates seeking possible explanations for such dietary patterns.

Little research appears to exist that analytically addresses food security at the household level for effective policy making in Uganda. Policymakers lack knowledge on the impact of exogenous factors on food security of rural households. Neither traditional consumer nor producer theoretical frameworks *per se* could be employed to provide insights into rural households' responses to policies that influence their food security. The agricultural household theoretical framework that integrates both consumption and production aspects of the rural households is more plausible.

Previous studies on food demand that have employed the agricultural household theoretical framework in countries of SSA are still scarce. To derive the caloric elasticities with respect to a set of exogenous variables, Strauss (1984, 1986) for

Sierra Leone employed an indirect approach, and Ademola (1994) for Nigeria and Kyereme and Thorbecke (1991) for Ghana employed a direct approach. The indirect approach uses a demand model to identify the determinants of food choice and in turn caloric elasticities. Food choice is central to this method by providing implications concerning caloric intake. Despite these studies providing insights into the impact of exogenous variables on caloric intake, they suffer several weaknesses. Firstly, caloric intake is treated as an overall measure for household food security. There is consensus among researchers that caloric sufficiency does not guarantee sufficiency of other nutrients as initially thought (see, for example, Delisle *et al.* 1991; ACC/SCN 1992). This poses an empirical issue: would there be any significant differences on the impact of the changes in exogenous factors on caloric intakes and other nutrients?

Secondly, there is a failure to capture the nonseparability that exists between production and consumption decisions among rural households. It is too restrictive to employ a separable agricultural household model on rural households in developing countries in general and in particular Uganda. Under a separable model, a household is assumed to make optimal production choices independently of the consumption and labour supply decisions. Clearly, the imperfection in the output and input markets, coupled with the gender division of labour makes the application of a separable agricultural household model inappropriate. Data deficiencies, on the other hand, have been singled out as a major obstacle for estimating a nonseparable agricultural household model (for example, Muller 1994). In addition, the woman's role is invisible in such models.

In light of the issues posed above, the current study seeks to address the following research questions:

- Given its strong economic growth since 1988, fertile soils, diversity of food crops grown and consumed, and self-sufficiency at the national level, what could possibly explain the increasing incidence of food insecurity among rural households in Uganda?

- What is the nature and extent of the food insecurity problem among rural households? Could some households be at a higher risk of being food insecure than others? If so, why?

- To what extent is increasing food insecurity at the household level related to the status of rural women? More specifically, how do women-specific variables influence the household's command over food?

- What alternative strategies could be implemented to help raise rural women's productivity, both in domestic and productive activities, and thereby improve food security of the household members?

Seeking answers to these questions is not possible without robust data. Thus, a sample of 300 households was selected from three purposively chosen districts: Kiboga, Mbarara and Pallisa. Kiboga was chosen as a moderately food surplus district, Mbarara as a food surplus district and Pallisa as a district prone to food deficits, a categorisation based on MoPED (1996b) and Ssekiboobo and Kakande (1994). These districts were also different in terms of the proportion of cultivated area, diversity of crops grown and consumed and population growth. This study employs data that offer unique opportunities to study household food security in rural Uganda. Firstly, data on consumption and production were collected from the same households. This is a very important issue in the estimation of a complete agricultural household model. Food consumption data were collected contrary to previous studies that have employed such data from household budget surveys. Secondly, data were collected directly from the women who are the key players in ensuring food security. Thirdly, some data variables such as time allocation and asset ownership were disaggregated by gender. Fourthly, the coverage of the survey ensured price variability across households to circumvent the conventional demand analysis using cross-sectional data where prices are excluded.

1.2 Organisation of the Study

In Chapter 2 background information on agriculture, food and the status of women in Uganda that will be useful in investigating and understanding the food security situation in rural Uganda and how it relates to women is presented. Factors affecting food availability at the household are also discussed since no discussion of food security in Uganda will be considered completed without such knowledge. The existing gaps in food security research in Uganda are highlighted. In this chapter it is revealed that little research has been carried out in the area of food security in Uganda, and points to the failure on the part of the government to adequately identify, understand and address women's constraints and the subsequent neglect of household food security.

A review of literature is presented in Chapter 3. First, the evolution of the food security concept and integrating women in the development process are discussed. This is followed by a review of the relationship between household food security and women in developing countries in general and SSA in particular. It is observed that despite the governments' recognition of the role of women in ensuring food security, effective strategies to assist them in improving food security have not been forthcoming. The different modelling procedures and estimation techniques employed by previous studies on food demand are also reviewed prior to data issues. Their strengths and weaknesses are highlighted.

Theoretical considerations to assist in understanding the complexities of rural households are discussed in Chapter 4. This chapter begins with a short review of traditional consumption and production theories and demonstrates their inability to fully capture the behaviour of rural households. This study, instead, appeals to new household economics and Chayanovian household theories that are postulated to be able to capture such behaviours. The fundamental assumptions of these theories are discussed, highlighting those with relevance to rural Uganda.

This study employs cross-sectional data to seek answers to the research questions posed. The methodology used to collect data and the limitations of the data is the subject of Chapter 5. A descriptive statistical analysis of the data is also provided. This analysis is important in that it provides further insights into model selection and building for rural households. The prevalence of household food insecurity in rural areas is empirically revealed by the findings.

In Chapter 6 an empirical nonseparable agricultural household model and estimation procedure are presented. The model captures the simultaneity that exists between production and consumption decisions among the rural households in Uganda while appealing to the theory presented in Chapter 4. The model takes into account the gender division of labour in the household. Thus, the suggested model differs from the conventional recursive agricultural household model that dominates earlier studies conducted elsewhere in the developing world.

In Chapter 7, the empirical results derived from the model as described in Chapter 6 are presented and interpreted. The explanations for the behaviour of the signs and magnitude of the coefficients on the explanatory variables are discussed where possible. Undoubtedly, the status of a rural woman affects her household's command over food. The impact of the exogenous variables, including women-specific variables, varies considerably across the different measures of food security used and from district to district. The application of a nonseparable agricultural household model is overwhelmingly supported. The factors affecting household consumption also affect household production.

Policy implications and recommendations drawn from the findings of the study are the subject of Chapter 8. The social, economic, cultural and ecological environment in the country was central in this chapter to avoid recommending untimely policies. Short-term and long-term policies are suggested with a central emphasis on raising the status of women.

Finally, Chapter 9 summarises the major findings of the study. Caveats are made about the data used and modelling procedures, and suggestions are offered for further research.

In summary, the study provides useful insights for effective household food security planning and decision-making processes. It demonstrates empirically how food security in rural households responds to changes in exogenous factors, including women-specific variables. This is a step forward in the 'still fresh' food security research in Uganda. Raising productivity of rural women both on the farm and within the household is central to improving household food security. There is no single policy that can be adopted; instead, a mix of policies is suggested. Furthermore, the study demonstrates that a nonseparable agricultural household model could effectively be employed to explain the behaviour of rural households.

2 Agriculture, Food and Status of Rural Women

The background information to the study and identification of the research problems are the subject of this chapter. In section one the geographical and socio-economic factors on Uganda, and in particular on the districts from which sample data was collected are presented. A brief review of the agricultural sector is presented in section two. This is followed in section three by a review of the food sub-sector and the constraints which the sub-sector faces. Section four analyses the current food security situation paying particular attention to the household level. In Uganda, like other SSA countries, women play a crucial role in the three pillars of household food security: adequate food production; economic access to food; and nutritional security. Therefore, in section five the situation of women in Uganda and how they relate to these three pillars is presented.

2.1 Geographical and Socio-economic Features

Uganda is a landlocked country and occupies an area of 241,038 square kilometres. It is blessed with fertile soils and good climate. Uganda lies along the equator and hence has equatorial type of climate. The districts south of the equator receive two rainy seasons which supports two growing seasons annually. Unlike the districts in the south, the districts north of the equator have only one rainy season. The reliability of rainfall is also generally less in the north. On average, most areas receive between 900 - 1300 mm per annum; some locations receive as low as 500 mm per annum; and areas around Lake Victoria receive over 2,000 mm per annum (MoPED 1996b). With such a favourable climate, cultivation of a variety of tropical and sub-tropical crops is possible all year round.

Of the total land area in Uganda, 11.1 percent is water and swamps; 13.7 percent forest/reserves; 20.7 percent cultivated land and 54.5 percent pasture/arable land (World Bank 1993b, p.14). Paradoxically, only 34.75 percent of the cultivable land is under use and 16 percent of the population were landless as reported in the 1991 Population Census. The picture is quite different at lower levels. For instance, some districts within cultivable land abundant region face cultivable land scarcity. Efforts to resettle people from cultivable land scarcity to cultivable land abundant areas have between impeded on several fronts: the complex land tenure system; and non-availability of social services, ethnicity differences, and presence of tsetse flies in the new areas (World Bank 1993b).

While for the period 1970-1995 Uganda had a lower annual population growth than Kenya or Tanzania, the reverse is expected for the period 1995-2015 (see Table 2.1). This is partly due to its high fertility rate and early age at first marriage (17.7 years). The population density based on the 1991 Population Census was 85 persons per square kilometre which is much higher than for all the East African countries (31) and Africa as a whole (21) (MoPED 1996a). Population densities are highest in areas with the best soils and rainfall. Additionally, 47.3 percent of the total population were below 15 years of age, which is indicative of a high dependency ratio or a high consumer-worker ratio according to the Chayanovian household theory (see section 4.3.2). The life cycle of Uganda's population today cannot lead to development as postulated by some economic development theories, as it has instead more mouths to feed than productive hands.

Most social indicators in Table 2.1 suggest that Uganda lags behind Kenya and Tanzania. This explains its low human development index value. However, this should not overshadow the fact that improvements in some social indicators have been realised over time. In terms of human development profile, more than 50 percent of its population had no access to safe water and health services, despite improvements over time.

While gender disparities are common to all countries in Table 2.1 some observations do emerge: Uganda recorded the lowest gender disparity in terms of life expectancy but the highest disparity in terms of adult literacy. Further, only 50 percent of the female adult in Uganda are literate compared to the other two countries. Wide gender disparity in terms of HDI does exist in Uganda. For instance, in 1995 the HDI for female was 0.372 compared to 0.405 (UNDP 1997b). UNDP (1997b) attributes this to the unequal access to income and social services.

Table 2.1 Selected Socio-economic Indicators for East African Countries

Indicator	Uganda	Kenya	Tanzania
I. Human Development Index (HDI)			
a) Life expectancy at birth - 1960	43.0	44.7	40.5
- 1995	40.5	53.8	50.6
b) Adult Literacy (%) - 1970	37.0	43.0	37.0
- 1995	61.8	78.1	67.8
c) Life expectancy index 1995	0.26	0.48	0.43
d) Education index 1995	0.54	0.69	0.56
e) GPD index 1995	0.22	0.22	0.09
f) HDI value 1995	0.34	0.46	0.36
II. Gender Related Index (1995)			
a) Gender related index	146	122	137
b) Life expectancy at birth - Female	41.4	55.1	52.0
- Male	39.6	52.5	49.2
c) Adult literacy (%) - Female	50.2	70.0	56.8
- Male	73.7	86.3	79.4
d) Gender Development Index value	0.33	0.46	0.35
III. Human Poverty Profile			
a) Human poverty index value (%) 1995	42.1	27.1	39.8
b) Population without access to:			
- Safe water (%) - 1990-1996	54	47	62
- 1975-1980	65	83	61
- Health services (5) – 1990-1995	51	23	58
- Sanitation	43	23	14
c) Population below income poverty line			
- $1 a day (1985 PPP$) 1989-1994	50.0	16.4	50.0
- National poverty line 1989-1994	55.0	50.0	37.0
IV. Others			
a) Infant mortality rate (per 1,000 live births) - 1996	88	61	93
- 1960	133	124	147
b) Underweight children under 5 years 1990-97	26	23	27
c) Under-five mortality rate (per 1,000 live births) 1996	141	90	144
d) Maternal mortality rates per 100,000 live births 1990	1,200	650	770
e) Total fertility rates 1995	7.1	5.1	5.7
f) Annual population growth 1995 estimate 1995-2015	2.9	2.4	2.6
1970-1995	2.8	3.5	3.2
g) Population 1995	19.7	27.1	30.0

Source: UNDP (1998).

While Uganda is continuing to record strong economic growth wide disparities do exist between rural and urban areas. For instance, in 1995 the HDI for rural areas was 0.36 compared to 0.58 for urban areas (UNDP 1997b). This has led some to argue that the increasing incidence of poverty is a rural phenomenon.

With the above national picture in mind, a brief background presentation of the three sampled districts, Mbarara, Kiboga and Pallisa (see Appendices 1-4), follows. These districts are quite different in some aspects: food consumption behaviour, farming systems, area under cultivation, population growth and level of food self-sufficiency. Mbarara district occupies an area of 10,020.8 square kilometres of which 97.1 percent is arable land. Based on the 1991 Population Census, 28.2 percent of arable land was under small-scale subsistence farmland; 94.2 percent of the population lived in the rural areas; and the average annual population growth was 2.74 percent. Pallisa district occupies an area of 1,991.7 square kilometres, of which 79.7 percent is arable land. Based on the 1991 population census, 73.3 percent of arable land was under small-scale subsistence farmland; 99.2 percent of the population lived in the rural areas; and the average annual population growth was 2.86 percent. Kiboga district occupies an area of 4,045.5 square kilometres of which 96.5 percent is arable land. Based on the 1991 Population Census, 30.1 percent of arable land was under small-scale subsistence farmland; 96.3 percent of the population lived in the rural areas; and the average annual population growth was 0.19 percent.

The percentage of arable land under small-scale farming in Pallisa was very much above the national percentage of 34.75; that of Kiboga was just slightly above and that of Mbarara well below. The area under large-scale farming is negligible, with only 0.28 percent nationally, 0.03 percent for Kiboga, 0.11 percent for Pallisa, and 0.03 percent for Mbarara. Pallisa recorded 229 persons per square kilometre, well above that of Mbarara (80) and Kiboga (37). The population density of Pallisa was more than double the national average and that of Mbarara and Kiboga were below the national figure (85). The average persons per rural household for Mbarara, Kiboga and Pallisa were 5.5, 4.3 and 5.4, respectively. The national rural figure is 4.9 percent. The rate of urbanisation for all the three districts is well below the national figure (11.3 percent), with 0.8 percent for Pallisa, 3.7 percent for Kiboga and 5.5 percent for Mbarara as per the 1991 Population Census (MoPED 1996b).

The human development index value for the sampled districts is presented in Table 2.2. The income index was the smallest of all, confirming the extent of income poverty in rural areas. Education index was the highest. There is no systematic pattern in the indices across districts. Mbarara district had the highest HDI. While Pallisa is classified as a food deficit district (MoPED 1996a), it does not necessarily imply that all households are food insecure or that they are the only food insecure households in the country. Some households in the other two districts regarded as food surplus districts may also be at risk of becoming food insecure.

Table 2.2 Human Development Index (1995) Disaggregated for the Sample Districts

	Kiboga	Mbarara	Pallisa
Income index	0.189	0.188	0.191
Education index	0.530	0.501	0.451
Life expectancy index	0.353	0.410	0.425
HDI estimate 1995	0.358	0.366	0.355

Source: UNDP (1997b).

2.2 The Economy and Agricultural Sector

Before 1971, Uganda had one of the strongest economies in SSA. The health and transportation systems and the quality of education were among the best in Africa. However, the Amin regime marked the beginning of 15 years of political instability, civil strife, and economic and social regression (FAO 1992; Nabuguzi 1993). A once prosperous and promising country was reduced to one of the poorest in the world. All sectors of the economy were adversely affected. The per capita Gross Domestic Product (GDP) fell by 40 percent between 1970 and 1986; export crop producer prices declined; and the processing, marketing and transport infrastructure collapsed. Agricultural research, in particular on food, halted between 1970 and 1980. Exports of the agricultural produce[5] declined as production of the major export crops drastically declined. The food sub-sector also experienced a decline in production, although at a lesser rate than the export sub-sector. The collapse of the processing and transportation infrastructure led to a shift of resources from production of export

[5] These exports included mainly coffee, tea and cotton.

crops to food production. Unlike the export crops, price controls[6] did not exist for the food crops making the latter more lucrative than the former. The rural population as noted by Bibangambah (1983), did not shift their resources to subsistence production as perceived by some western economists. During this period the economy became more monetised, and food crops ceased being subsistence crops and became cash crops (Bibangambah 1983; Nabuguzi 1993).

Even after Amin's regime, the economic, social and political situation continued to worsen due to civil wars until early 1986. In 1986, the NRM government inherited an economy with shattered infrastructure, rampant inflation (260 percent) and acute foreign exchange shortages. At the end of 1985 official exchange reserves were down to only US$ 24 million and net foreign reserves were negative US$ 254 million (Museveni 1997, p.180). To improve the economic situation, the government has implemented several macroeconomic policies since mid-1987. There are policies with major implications for the agricultural sector in general and the food sub-sector in particular, including liberalisation of the marketing and removal of government monopoly in the export sector; export diversification; privatisation; rehabilitation of the physical infrastructure; reviving agricultural extension and research; and, in general, placing agricultural and food production at the top of government development priorities. The policies were skewed toward improving efficiency in production and marketing.

Since the implementation of economic reforms, the country has recorded 6.7 percent economic growth over the financial years 1987/88 to 1995/96 (MoPED 1996b) and inflation was down to only 2.8 percent by 1997/98 (MoPED 1998). This has been happening in the face of increasing income inequality and poverty (see Riley 1994; UNDP 1997b). The benefits of economic growth have not trickled down to the rural population in general and women in particular. On the other hand, Uganda is among the poorest countries with the heaviest debt service burden, despite the positive developments since 1987. The external debt to exports increased from US$ 525.1 million in 1987 to US$ 1,298.3 million in 1991 (World Bank 1993b). The ratio of external debt to Gross National Product (GNP) was 88 percent and exports to imports

[6] This also liberates the nation from food riots that have taken place in other countries in SSA, such as Zimbabwe and Zambia.

37 percent, in 1994 (UNDP 1997a). The debt service ratio as a percentage of exports of goods and services increased from 17 percent in 1980 to 46 percent in 1994. On a positive note, Uganda benefited from the heavily indebted poorest countries debt initiatives, with a reduction of the debt by US$ 338 million in net present value terms (World Bank News 1997).

Uganda's agricultural sector provides employment to over 80 percent of the rural population. Agricultural output comes almost exclusively from about 2.5 million small-scale farmers, mostly women. At the same time agriculture is the main source of foreign exchange earnings, with traditional export crops accounting for the largest share. For the period 1990 to 1995, traditional export crops contributed on average 76.6 percent annually to the total exports compared with only 23.4 percent by non-traditional exports. Coffee is still the highest foreign exchange earner, contributing over 67.3 percent over the same period (MoPED 1996b). From Table 2.3, between 1987/88 and 1995/1996, on average, the agricultural sector accounted for 51 percent of GDP of which the food sub-sector contributed 68.1 percent and the livestock sub-sector only 16.7 percent. A further decline in the contribution of agriculture to GDP was realised from 45.4 percent in 1995/96 to 42.4 percent in 1996/97 mainly due the prolonged drought which was followed by *El Nino* (MoPED 1998).

Table 2.3 Contribution and Growth Rates by Sector, 1987/88 - 1995/96

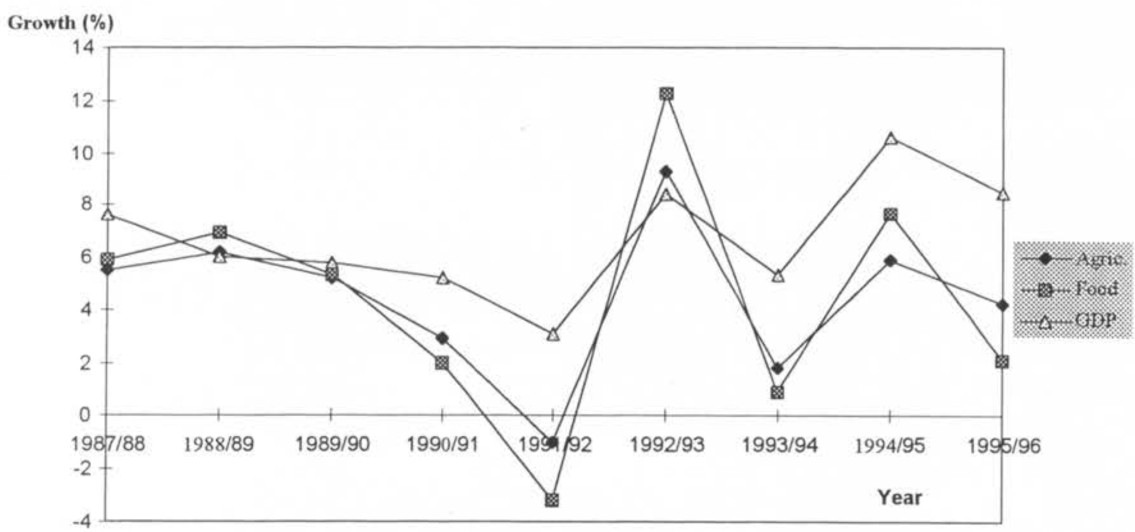
	Agricultural Sector		Food sub-sector		Livestock sub-sector		GDP at factor cost	
Year	Contribution to GDP	Growth	Contribution to Agriculture	Growth	Contribution to Agriculture	Growth	Growth	Per capita growth
	%	%	%	%	%	%	%	%
1987/88	54.1	5.5	68.1	5.9	17.2	6.0	7.6	4.8
1988/89	54.2	6.2	68.6	6.9	17.1	5.6	6.0	3.1
1989/90	53.9	5.2	68.6	5.3	16.8	3.7	5.8	2.8
1990/91	52.8	2.9	68.0	2.0	17.0	3.9	5.2	2.2
1991/92	50.7	-1.0	66.5	-3.2	17.5	2.2	3.1	0.2
1992/93	51.1	9.3	68.3	12.3	16.6	3.7	8.4	4.5
1993/94	49.4	1.8	67.7	0.9	16.9	3.2	5.3	2.1
1994/95	47.3	5.9	68.8	7.7	15.5	-2.6	10.6	7.3
1995/96	45.4	4.2	67.5	2.1	16.0	7.7	8.5	5.4
Average	51.0	4.4	68.1	4.4	16.7	3.7	6.7	3.6

Source: Computed from MoPED (1996b).
*Gross domestic product computed at 1991 constant prices.

Agriculture's percentage contribution to GDP growth was subject to significant annual fluctuations over the period specified in Table 2.3 and Figure 2.1, with a negative growth during the 1991/92 financial year. The agricultural sector experienced a very big recovery from a growth rate of only 0.1 percent in 1986/87 to the rates as presented in Table 2.3 and Figure 2.1. The food sub-sector was behind this recovery with high growth rates averaging 4.4 percent per annum over the period 1987/88 to 1995/96. The growth rate was higher than the population growth rate of 2.8 percent (see Table 2.1) for seven out of nine years.

Growth in the food sub-sector was attributed to the restoration of peace and improved political security; the restoration of the rural marketing system; improvements in the transportation system; a more liberalised marketing system; growth in real income of the urban population; and expansions in cultivated area. A decline in agricultural growth for 1991/92 was mainly attributed to a reduction in food production which was mainly due to poor rains (MoPED 1996b). Despite some negative growth rates in the agricultural sector and food sub-sector, the livestock sub-sector's per capita growth and growth in real GDP maintained positive rates (see also Figure 2.1).

Figure 2.1 Growth Rates by Sector, 1987/88 - 1995/96



Paradoxically, agriculture has remained the least developed sector despite its importance in the country's economic development. It has continued to receive very little in the form of government assistance. Agriculture-related government services received about 4 percent of budgetary expenditure in 1990/91 excluding grants (World Bank 1993b) and 4 percent of the national budget for the period 1983 - 1986. The share of the agricultural sector in the sectoral allocations of recurrent expenditure was

3.7 percent, 3.8 percent and 3.1 percent for the financial years 1990/91, 1991/92 and 1992/93, respectively (UNICEF 1994, p.169). The share of loans that went to agricultural production was only 4.5 percent compared to manufacturing of 15 percent and trade and services of 65 percent (MAAIF 1996). For the period 1986 to 1991, the sector received only 9.0 percent of the total sectoral allocation of disbursement on long-term debt (World Bank 1993b). Intuitively, discrimination against agriculture does more injustice to the welfare of the rural population.

Worth noting are the still weak linkages from the agricultural sector to other sectors especially the industrial and service sectors. The role the agricultural sector played in the economic development of countries such as Japan is yet to be replicated in Uganda. Surplus labour from the agricultural sector played a greater role in Japan's development than the flow of capital from the same sector (Norton and Alwang 1992). There is no empirical evidence to suggest whether surplus labour exists in rural Uganda. Additionally, the domestic savings level is too low to provide capital for development. For instance, in 1994 domestic savings was only 4 percent of GNP (UNDP 1997a) with negligible contribution from voluntary rural savings. Instead the Ugandan government since 1987 is increasingly depending on foreign aid or foreign investment to finance most developments in the agricultural sector.

2.3 Food Sub-Sector

With the above broader picture, this section narrows down to give an overview of the food sub-sector. Uganda has had a long history of being among the few SSA countries which are self-sufficient in food supply. This is evident from its ability to have gone through 15 years of political upheaval without its population suffering from famine and starvation except for the Karamoja region[7]. With its long history of fertile soil, plentiful rainfall and good climate, policymakers and politicians never anticipated a food insecurity problem. This could partly explain the lack of well-stated food policies by the government. Instead these policies are embodied in the agricultural development policy (see MoPED 1996b) and include:

- increasing agricultural productivity to ensure food security and self-sufficiency in raw materials for agro-processing industries as well as cash crops for export;

[7]Karamoja region includes Kotido and Moroto districts.

- diversifying the country's exports through promotion of non-traditional export crops, such as beans, maize and sesame; and
- increasing peoples' income and reducing poverty at a faster pace through increased sales of their surplus.

2.3.1 Food Production

Unlike in most Asian countries where mono-cropping is common, most farmers in Africa in general and Uganda in particular, practice mixed and/or inter-cropping. Thus growing a variety of food crops is common. However, Ugandan food crops are of a more diverse nature than those of Kenya, Tanzania, Rwanda or Burundi. Food crop specialisation among households does not exist, hence reducing the prospects of exchange among themselves. This is perceived by Museveni (1997, p.197) as a hindrance to the modernisation of agriculture.

More than 70 percent of the farms in Uganda are primarily crop production oriented (World Bank 1993b, p.30), of which 90 percent is food crops. Small-scale farmers produce virtually all food produced domestically. The average household farm size ranges from 1.3 ha (DANIDA 1993) to 2 ha (World Bank 1993b). The medium- and large-scale farmers are mainly involved in traditional export crops such as coffee. It is evident from Figure 2.2 that food production per capita declined during the 1970s. The drastic decline between 1971 and 1980 was mainly due to the political turmoil the country experienced at the time. The food crops' yields have not been able to retain their early 1970's levels, even in the presence of high population growth.

The major food crops grown include matooke[8]; cereals (finger millet, maize, sorghum, rice and wheat[9]); root crops (sweet potatoes, Irish potatoes, and cassava); pulses (beans, field peas, cowpeas and pigeon peas); and oil seeds (groundnuts/peanuts, soybeans and sesame). The food crop yields are very much below those attainable at the research stations. For instance, the current matooke yield is only 17 percent of the yield attainable at a research station, beans is 33 percent, finger millet is 32 percent, cassava is 18 percent, maize is 22 percent, Irish potatoes is 20 percent, and sweet potatoes is 13 percent (MAAIF 1996). On average, the total area under food crops

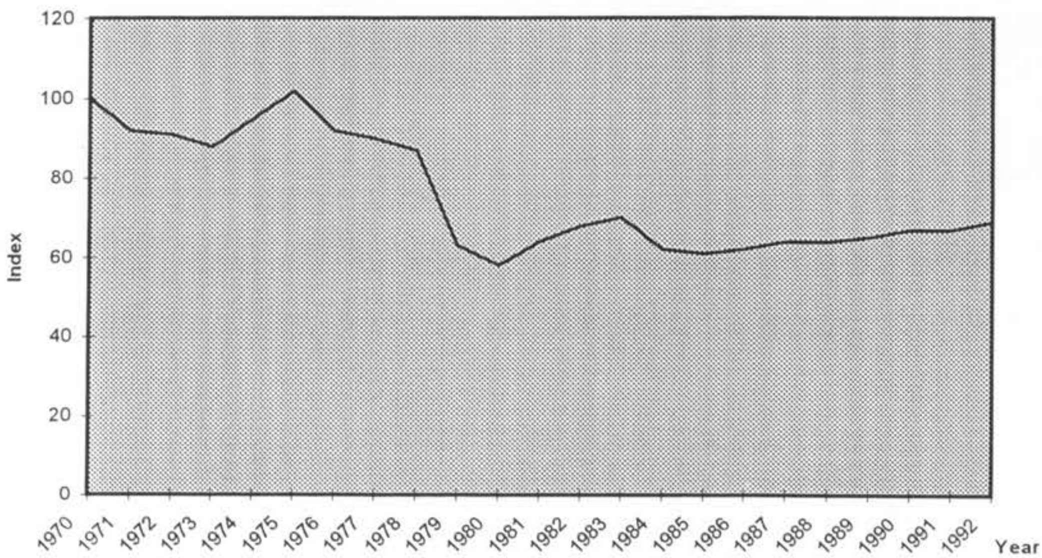
---

[8]Matooke is a local name for green plantains.

[9]Rice and wheat are only grown on a very small-scale

grew by 3.6 percent annually for the period 1980 to 1994 with 2.9 percent for the period 1980 to 1985 and 4.0 percent for the period 1986 to 1994. Table 2.4 shows the percentage distribution of area planted of some selected crop groups. It indicates that, of the total area under food crops, matooke occupy the largest area, followed by cereals and pulses. The area under oil seeds is still very low, below 10 percent of total area. Finger millet and maize dominate cereal production.

Figure 2.2 Index of Food Production per Capita, Uganda (1970=100)



Source: MoPED (1996a, 1996b).

The production of rice and wheat are very low but with increasing growth rates over the years. Cassava dominates roots crops followed by sweet potatoes. Cassava mosaic disease has drastically reduced cassava yields and some districts are reported to have given up growing cassava. This may reduce its dominance in the root crops group. Beans dominate the pulses group whereas groundnuts dominate oil seeds (MoPED 1996b). The diversity of crops grown is observed at lower levels. The eastern region ranks first in beans, maize, millet, cassava and sweet potatoes, and second in groundnuts. The northern region ranks first in supply of groundnuts, second in beans, maize, millet, cassava and sweet potatoes and third in milk. The western region ranks first in banana and milk, second in beef and third in beans, maize, finger millet, cassava and groundnuts. The central region ranks last in almost all the above crops (MoPED 1995).

Table 2.4 Distribution of Area Planted of Selected Food Crops, 1980-1994

Year	Plantains	Cereals	Root crops	Pulses	Oil seeds	Total
	%	%	%	%	%	'000 ha
1980	39.8	24.5	18.9	11.2	5.6	2,946
1981	36.8	23.2	21.3	12.9	5.8	3,209
1982	34.7	24.1	21.1	14.1	6.0	3,460
1983	32.8	23.5	23.3	14.3	6.1	3,687
1984	32.8	24.6	21.8	14.2	6.6	3,687
1985	35.9	23.7	20.3	13.5	6.6	3,369
1986	32.8	24.2	21.3	14.4	7.3	3,693
1987	35.1	23.6	21.2	13.7	6.4	3,624
1988	33.1	24.7	20.5	14.7	7.0	3,934
1989	31.9	26.0	20.1	14.8	7.2	4,148
1990	32.5	24.7	20.0	14.7	8.1	4,277
1991	32.6	25.1	19.4	14.7	8.3	4,385
1992	32.4	25.3	18.7	15.0	8.6	4,498
1993	31.8	26.1	18.6	14.9	8.6	4,673
1994	31.5	27.2	17.6	15.1	8.7	4,769

Source: Computed from Uganda MoPED (1996b).

2.3.2 Food Exports

Between 1990 and 1994, MoPED (1995) reports that exports of beans, maize and sesame amounted to 13,654 metric tons, 57,710 metric tons and 10,461 metric tons per annum, respectively. Although the country recorded a domestic deficit in beans (MoPED 1995) some exports were realised. Exports of non-traditional export crops including horticultural crops contributed 15 percent of the total exports. Table 2.5 shows that food and animal exports contributed the largest percentage share toward the agricultural exports. The table further depicts a declining percentage share of agricultural products in total merchandise exports. The share of agricultural products to total exports declined from 96.7 percent over the period 1979 to 1985 to 89.1 percent over the period 1986 to 1993. For the same periods, the share of food and animal exports declined from 94.8 percent to 81.8 percent, respectively. As the world markets for traditional export crops continue to soar, the government's strategies focus on enhancing exports of the non-traditional crops, such as beans and maize.

While Uganda enjoys a comparative advantage in food production in the Greater Horn of African region[10] (USAID 1996), its food exports to the neighbouring countries are negligible. Nor is the urban food market big and likely to expand to the extent of requiring the full utilisation of the country's agricultural potential. This has led

[10]Greater Horn of Africa includes Uganda, Tanzania, Kenya, Rwanda, Burundi, Ethiopia, Eritrea, Sudan and Djibouti.

policymakers to argue that prospects for increasing demand for rural produce and hence incomes of the rural population lie in the export sector. As much as this may sound very appealing it raises some concerns. The impact of the export sector is assumed by MoPED (1996b) to be uniform on all of the rural population, ignoring the issue of a household as either a net buyer or net producer of food. Household type, as argued by Phillips and Taylor (1990), plays a crucial role in household food security. If a food crop competes favourably in both the domestic and export market, the income of the net producers may rise. However, the real income of the buyer will fall hence reducing his/her ability to acquire food. On the other hand, the impact of the increases in the incomes of the net buyers depends on the efficiency of food markets in the rural areas. It is important to determine under what circumstances an increase in real income of the net producer translates into improved household food security.

Table 2.5 Distribution of Imports and Exports of the Agricultural Products and Food and Animal, 1979-1993

	Imports		Exports	
Year	Agriculture products	Food and animal	Agricultural products	Food and animal
	%	%	%	%
1979	10.8	10.5	99.8	98.1
1980	10.4	10.3	99.7	98.4
1981	12.6	12.5	99.7	98.8
1982	8.7	7.9	97.8	96.9
1983	5.6	5.5	87.9	84.9
1984	5.9	5.6	99.4	96.5
1985	6.7	5.4	92.3	89.9
1986	5.1	3.4	92.9	91.6
1987	5.8	5.2	99.9	98.0
1988	5.1	3.2	94.5	89.7
1989	5.0	3.3	93.9	89.4
1990	4.5	2.7	92.1	80.4
1991	5.1	2.5	85.8	68.9
1992	6.0	2.6	79.2	64.8
1993	7.6	4.2	80.9	71.4

Source: Computed from the FAO Trade Yearbook (several issues).

Studies conducted elsewhere in Africa have come up with different conclusions regarding the impact of export production on household food security. Studies such as Dione (1987) and D'Agostiono (1988) in Mali and Loveridge (1988) in Rwanda found cash crop production to enhance household food security. Conversely, in Uganda and Tanzania, Madeley (1985) observes that rural households eat best when the economy is depressed because, in these conditions, the market for produce may not exist leading households to eat all the food they produce. The authenticity of these findings may not hold in the long run as households' production may decline during recessions, consequently affecting food availability.

2.3.3 Food Imports

Table 2.5 above indicates that agricultural products are only a small proportion of total imports, of which food and animal imports have contributed the highest percentage. It is evident from Table 2.5 that imports of agricultural products and food and animal experienced fluctuations over the period 1979 to 1993. Uganda is a net importer of rice and wheat for both industrial use and human consumption, especially in urban areas. On average, the annual imports of maize, beans, rice, wheat and Irish potatoes by the World Food Program and other Non-Government Organisations (NGOs) amounted to 8,591 tons, 18,438 tons, 2,266 tons, 9,871 tons and 480 tons respectively, over the period 1990 to 1994 (MAAIF 1996). These imports were mainly meant for refugees and the people displaced by war within the country.

2.3.4 Food Aid

Table 2.6 depicts food aid to Uganda over the period 1981 to 1993, mainly from the European Community. The figures are comparatively low with the aid received by other SSA countries.

Table 2.6 Food Aid to Uganda (tons), 1981-1993

Year	Cereals	Wheat	Rice	Coarse grain	Skimmed milk	Vegetable oil
1981	48,500	10,300	2,700	35,500	-	-
1982	14,300	10,000	4,200	100	-	-
1983	10,400	700	6,200	3,500	3,407	353
1984	31,200	18,000	5,800	7,400	3,002	318
1985	6,700	na	na	6,700	856	5
1986	15,000	11,700	na	3,300	1,210	691
1987	29,300	26,200	na	3,100	1,258	6,291
1988	16,900	9,700	300	6,900	722	4,077
1989	34,600	13,900	na	20,700	1,583	4,279
1990	61,400	14,300	100	46,900	1,307	9,269
1991	27,600	20,400	na	7,200	395	3,926
1992	58,600	3,900	300	54,400	1,283	4,856
1993	43,700	5,500	6,700	31,400	1,190	8,580

Source: FAO Food Aid in Figures, 1993 and 1994.

Cereals dominated food aid followed by coarse grains. Significant fluctuations in food aid are observed. Much of the aid goes to assist refugees and some areas in Uganda hit by drought and famine, especially in the Karamoja region. The low food imports and aid figures may not necessarily reflect a level of self-sufficiency in food

2.3.5 Factors Affecting Food Availability

Given the fact that the majority of households in rural areas derive food from their own production, some would argue that food availability is still a necessary condition for food security. Hence the discussion that follows examines, in brief, the major factors affecting food availability in rural Uganda.

Peace

Peace is a precondition in ensuring household food security (Maxwell 1990; FAO 1996b), especially for countries where most rural farmers depend on own production for their survival and livelihood. The recovery of the food sub-sector in Uganda would not have been possible without the prevailing peace and political stability in the country since 1986. Pockets of insecurity, however, still prevail in some parts. In Karamoja, cattle raiding disrupted agricultural activities in the 1980s and early 1990s. In the north and northwestern districts, farmers' activities have been affected by the Kony rebel[11] activities for the last twelve years. Even in the presence of well-distributed rain and low pest infestation, farmers have been unable to work on their land due to such insecurities (FAO/WFP 1997). Escalating food prices aggravate inaccessibility to adequate food by the rebel-displaced households.

Low Incomes

Despite its strong economic growth, Uganda is one of the world's poorest countries. Its ranking based on HDI worsened from 159th of 175 (UNDP 1997a) to 160th (UNDP 1998). Approximately 55 percent of the households, nationally, lived below the estimated poverty line of US$ 110 per capita per year (see Table 2.1) and were regarded to be poor. Further, Table 2.1 suggests that Uganda recorded a higher percentage of its population living under income poverty line compared to Kenya and Tanzania. Although poverty is widespread throughout in Uganda some areas are more

[11] This is a group of rebels, which has been fighting the government for the last 12 years.

affected than others. As previously discussed poverty is more pronounced in rural areas than in urban. Low incomes of the rural farmers not only affect their food accessibility but also their food availability from own production. This also has implications for the overall food security in the country.

Drought

Agriculture in Uganda is entirely rain-fed unlike in some other countries in SSA where irrigation is being practiced. Despite this, regular occurrence of drought has become a common phenomenon in some parts of the country, including Pallisa district. The major famine during the early 1980s due to drought struck the Karamoja region[12] leaving approximately 50,000 starved to death, half of them children (Dodge and Alnwick 1986). The great drought of 1991 - 1992 that hit the Greater Horn of Africa left 16 districts mainly in the north and northeast[13] of Uganda with food shortages. While massive starvation resulted, it is not clear whether it claimed any lives. From September 1997 through to March 1998 some districts in the eastern and northern regions experienced another drought leading to food shortages.

Unlike countries like Botswana, Uganda appears to be ill-prepared for drought despite its regularity. This is true of the recent drought of 1997/98. Politicians and policymakers blamed farmers for the food shortages, arguing that they were ill-prepared for such natural calamities. Similarly, farmers blamed the government's National Early Warning Systems for failure to predict the drought. The issue should not be who to bear the blame. Should not the government work together with farmers to identify and possibly tackle the root causes of drought, especially those mainly man-made? UNICEF (1994) cites some research that found a positive relationship between drought and environmental degradation in the affected districts. They further linked the environmental degradation to lack of environmental policy and low literacy levels among the farmers especially women.

---

[12]Karamoja is one area which has had a long history of food shortages.

[13]UNICEF (1994) cites Lubwama (1991) that the districts that have suffered with periodic droughts and famine are also some of the districts where deforestation and burning of vegetation cover have been most extensive.

Post-harvest Technologies

Post-harvest technologies including harvesting, preservation, storage and processing are still underdeveloped in Uganda. This may lead to enormous crop losses that may be physical, or in terms of quality or nutritional value. Quality and nutritional losses have not received attention from researchers and policymakers. If farmers are growing food crops for sale or decide to sell food to meet other pressing needs, its quality determines its worth. Therefore, deterioration in food quality due to poor harvesting technologies attaches a discount to the price the farmer receives. Loss of nutritional value, especially during cooking, can also have adverse effects on members' health status and hence productivity.

Table 2.7 summarises, in general, the post-harvest technologies in the rural areas of Uganda. Generally speaking, these technologies vary from one locality to another and across crops and require considerable skills, effort and time of farmers. The harvesting, preservation, storage and processing stages are closely linked in that what happens at the lower stage influences the extent of food losses at the higher levels.

Table 2.8 shows the physical percentage of crop output lost from the time of maturity to marketing. Although the on-farm level crop losses are not documented, they are generally high. Nationally, the estimates are from 15 percent to 40 percent (MoPED 1995); and for some selected crops (see Table 2.8) from 8 percent to 25 percent. Maize alone is at 23 percent and beans at 25 percent. Regional crop losses range from 6 percent to 35 percent. The northern region recorded the highest losses for almost all crops. Finger millet recorded the lowest loss. Perishable crop losses are not known but occur at all levels of the food system. Despite such big crop losses, some districts recorded surpluses in such food. The implication of such loses for household food security and future non-traditional exports may be enormous.

Table 2.7 Summary of Some of the Post-Harvest Technologies at the Household Level

Stage	Method currently used	Problems	Remarks
Harvesting	- vary across crops, - Millet and sorghum are harvested during the dry period. Therefore farmers leave such crops after reaching maturity standing in the fields to partly dry before being harvested, and	- early harvesting	- due to inadequate access to food, and - to earn money to meet other pressing needs, such as education and health
	- continuous harvesting in the cases of cassava, yams, sweet potatoes and matooke.	- late harvesting	- due to inadequate labour, - sickness and death, - inadequate markets for perishables and - inadequate and poor storage facilities.
Preservation	- sun drying is common	- Poor drying methods. Food crops placed on bare ground, - Lack of knowledge on optimum moisture content, and - foreign particles, especially stones are inevitable.	- preservation methods have implications for storage and processing stage, and - food preservation still limited to a small group of food items. Most food items are eaten when still fresh.
Storage	- in-ground storage in the cases of sweet potatoes, cassava and yams.	- gets spongy when kept for a long time, and - may occupy land area, which would have been used by other crops.	- left in ground for a long time leads to losses in terms of nutrients.
	- Granaries[14], baskets, jute sacks mainly used at the household level, and - maize either stored on cob or shelled, groundnuts shelled or unshelled, sorghum and millet threshed or unthreshed.	- facilities are in poor state and inadequate. Granaries are infested by termites.	- poor storage facilities discourage farmers to produce beyond subsistence level, and - lack of government's involvement in buying excess production from farmers.
		- storage of perishable has proved to be difficult.	- discourages growing of vegetables.
	- parastatal/NGO storage infrastructure	- Poor state especially those of PMB.	
	- national silos	- not sure if these silos are full all time.	
Processing	- grinding of millet and sorghum, - pounding groundnuts and dried cassava, and - milling of maize not at household level.	- inefficient and wasteful methods, - labour intensive.	- processing of foods usually at household level. Uganda has very few agro-based industries.

[14]Granaries are common in the eastern, western and some parts of the northern region.

Table 2.8 Distribution of Regional Crop Losses for Selected Crops (as % of output)

Crop	Eastern	Northern	Western	Central	Uganda
	%	%	%	%	%
Beans	25	30	20	22	25
Maize	25	25	22	20	23
Finger Millet	7	12	6	6	8
Cassava	25	35	20	20	25
Groundnuts	12	12	10	10	10

Source: MoPED (1996b, p.182).

Rural Road Infrastructure

Food trade and distribution is contingent on good rural road infrastructure. Since 1986 there have been improvements in the main road infrastructure but not all districts have benefited. In contrast, the rural feeder roads are in a bad state in almost every district. They become less accessible during the rainy seasons. The poor infrastructure and distribution networks have hindered the movement of food crops from surplus areas to the deficit ones. The private sector, which is said to be the key player in food trade and distribution, has concentrated only in the most accessible areas. This leaves farmers in more remote areas at a higher risk of receiving lower prices for their produce, and at times not getting buyers at all. Additionally, poor flow of market information (price movements and consumer preferences) leads buyers to offer very low prices to the farmers.

Land Tenure System

Land is a complex and very sensitive issue in Uganda. Uganda has had a long history of land tenure systems: a period before colonial era, colonial and post colonial era, the Land Reform Decree of 1975 and Land Act 1998 (see, for example, Mamdani 1992; Nabuguzi 1993; MoPED 1996b). Four land tenure systems were in place before the promulgation of the Land Reform Decree of 1975 by the government of Amin: customary tenure, freehold rights, mailo tenure and leasehold estate. These systems hindered agricultural development by hampering effective access to land by all people and promoted land fragmentation. This perpetuated land degradation, poor utilisation of land and low crop yields. The Land Reform Decree of 1975 was meant to address these issues. It abolished absolute ownership of land and also the power of the customary tenant to stand in the way of development. It saw the creation of the Uganda Land Commission to be in charge of land. Land Commissions at the district level were also created and empowered to terminate lease on underdeveloped land and grant it to potential developers. The Decree had sought to make all land public to facilitate development. Unfortunately, implementation of this Decree of 1975 never succeeded. The previous land tenure systems continued to exist.

In contrast, the new Land Act enacted in July 1998 reversed the Land Reform Decree of 1975 in terms of land ownership. It re-instated the old land tenure systems; formed Land Boards and Committees at lower levels; and management of communal land. It also established the rights of women, children and disabled persons. Further, tenants are now more protected than before. However, it is too early to tell whether this newly enacted act will lead to agricultural development, and consequently to increased food production.

Rural Labour Market

Household members, especially women and children, are the main source of labour. Household utilisation of hired labour varies across crops, with a higher response in the case of crops such as coffee and tea than food crops. Labour demands vary across farming activities and crops. Generally, the most labour-demanding farming operations are weeding and harvesting. Labour shortages are more pronounced during these operations and have been reported to lead to high pre-harvest and post-harvest losses.

Historically, the responses to labour shortages have varied across regions, districts and localities over time (World Bank 1993b, pp.30-34). Farmers in some areas in Buganda region used to hire immigrants of Zaire and Rwanda origin. Labour-sharing arrangements in the north and east were, and to some extent still are, practised and communal labour participation in northern Uganda is no longer common in most areas due partly to increasing population. In the rice-growing areas in Busoga, for instance, Nabuguzi (1993) reports communal labour arrangements at harvesting period, with remuneration made in the form of rice. Hiring out labour by poorer farmer migrants[15],

---

[15]Hired on contractual basis and are not necessarily landless labourers.

mostly men, from the land-scarce southwest into the western and central areas is now a common occurrence.

The market for labour among small-scale farmers is small, fragmented and constrained by limited mobility and imperfect information. In some rural areas, relationships are localised and personalised transactions[16] are preferred. For instance, relatively better off peasants in Amwona village, in Lira district, hire labour of their poorer neighbours and relatives (Mamdani 1992). An open rural market for labour does not exist in itself. Payment is negotiable either in cash, kind or both. Increased rural-urban migration among the youth is rampant, leaving agriculture mainly to the elderly, who are less energetic and lack ability to hire labour. Inaccessibility to hired labour by most households has, in some instances, led to temporary withdrawal of children from school, especially during the peak periods. This affects their performance at school and increases chances of dropping out, in turn contributing to the vicious cycle of human resource underdevelopment.

Rural Financing

Agricultural credit increases farmers' command over agricultural inputs for production. It is an important tool for promoting the adoption of improved technologies, and indirectly helps the farmers to alleviate long-term chronic food shortages.

Informal and formal credit facilities, although limited in numbers, are available to the rural areas in Uganda. Farmers may borrow money from their friends and/or relatives; in some other instances, farmers form groups and pool funds that rotate among the members. Because of their inability to satisfy the requirements for formal credit, farmers have resorted to informal ones. For instance, Nabuguzi (1993) reports rural moneylenders in the rice-growing areas in Busoga region[17] extending loans to the farmers in return for a commitment to sell them rice at a lower price at the time of harvest. Informal credit is less costly to farmers in terms of time, transaction costs and accessibility, and lenders are most likely to recover much of their money. However, it

[16]That is, to be hired as a labourer one requires to be known to the farm holder or recommended by a friend to the holder.

[17]Busoga region includes Jinja, Iganga and Kamuli districts.

has some shortcomings. For instance, in the case of rice growing in Busoga, Nabuguzi observes that lenders take advantage of farmers by paying a lower price for their rice than they would have earned if sold to the open market.

On the other hand, accessibility to formal credit in the agricultural sector in general and to small-scale farmers in particular has been hindered by high credit costs estimated to range from 17 to 25 percent (MoPED 1996b). Lack of collateral, bias towards medium- and large-scale farmers and high investment risks in agriculture compared to trade and business have also hindered such access. For a detailed account of some of the credit and lending institutions in rural areas, see MoPED (1996b) and the World Bank (1993a 1993b).

Rural financing is not all about credit but also savings by rural farmers. The role of savings is twofold in this case. Firstly, they may help in the alleviation of transitory food shortages. Secondly, in the long run investments in agricultural inputs can be carried out using such savings. However, savings among the rural population in Uganda are still very low (see section 2.2). In part, this led to closure of government-owned commercial bank branches and has also discouraged opening rural-based branches by private banks.

Agricultural Implements

Uganda depends mainly on the foreign market for the supply of agricultural implements, which in turn, depends on foreign exchange availability. The traditional hand hoe is still the main implement used to till the land by most farmers, which obviously limits the expansion of cultivated land. Traditional as it may sound, not every household can afford to own one due to high prices. UNICEF (1994) cites a study on self-sufficiency in the west Nile region by Natukunda *et al.* (1991) where 25 percent of the households had no hoe and 33 percent had only one hoe. Borrowing a hoe from a friend or relative is a common practice in some areas.

Utilisation of draught animals is common in SSA. The main advantages of such technology include increasing the productivity of labour, expanding the area under cultivation, increasing the intensity of land use, improving the quality and timeliness of performing key farming operations and reducing manual labour (Mrema and Mrema

1993). In Uganda, use of oxen for basic land preparation grew rapidly in some parts of eastern region from the early 1970s. The availability of suitable cattle, the nature of the soil and vegetation and land conformation all combined to make the use of oxen a profitable venture (World Bank 1993b). In Uganda, ox power is used only for ploughing, unlike in other parts of Africa where use is extended to weeding, transportation and threshing of grains.

The late 1980s and early 1990s marked a shift from ox-ploughing to hand hoe agriculture in some districts including Pallisa. This was due to cattle rustling that led to a reduction in the number of cattle and in turn to a reduction in the amount of cultivated land per family. It has also had a gender effect; the greater physical burden of cultivation that used to be carried out by men is now falling on women (UNICEF 1994). Lack of spare parts for ox-ploughs has also exacerbated the situation.

Agricultural Inputs

Besides land, capital and labour inputs, agricultural inputs may be used to increase agricultural production. The agricultural development process can be accelerated through the provision of new and improved inputs and technologies, especially improved seeds, fertilisers, agrochemical inputs and irrigation (Norton and Alwang 1992). The use of high pay-off inputs leads to a shift in the agricultural production function. However, adoption of new technologies in Uganda has not been smooth due to supply and demand constraints. Much of the production is obtained with limited application of agricultural inputs. Exploitative means of production (also known as extensification), where increased production derives from increasing cultivated area and labour inputs, have been and still are prevalent in most rural areas. The question that might arise: would use of high-pay-off inputs in Uganda with big chunk of uncultivated arable land be a cost-effective option?

Uganda depends on the foreign market for supply of agricultural inputs. Since 1991 the government has gradually reduced its involvement in the importation and marketing of agricultural inputs, leaving it to the private sector. This was in response to the distortions in the market brought about by the government. Unfortunately, the market for these inputs is fragmented, characterised by seasonality in demand, small rural market size, low returns in relation to other investments, and low household incomes. All these combine to make involvement in the agricultural inputs market a financially risky investment for the private sector. Hence, availability of these inputs is not guaranteed and farmers in most cases cannot afford the inputs due to their high prices.

While Larson and Frisvold (1996) note that improvements and management of soil fertility are a prerequisite for achieving sustainable yields, it appears farmers in Uganda have not taken it seriously. The exploitative means of agricultural production appears not to have been utilised in an ecologically and sustainable manner. After independence soil conservation was perceived in terms of profits. Enforcement of conservation practices by the local chiefs ceased, resulting in soil degradation (Zake 1992). Lack of security of land tenure by the stakeholder in agriculture and lack of agricultural intensification aggravate the situation.

Little has been done to reverse the increasing soil degradation. Application of chemical fertilisers is, in general, very small and largely confined to high-value export crops (World Bank 1993b). Fertiliser application, on average, is less than 2 kg of nutrients per hectare per annum (MoPED 1996b). This rate is very much lower than 10 kg/ha for SSA in the late 1980s and of 48 kg/ha in Kenya (Larson and Frisvold, 1996), 21 kg/ha for SSA as a region and 11 kg/ha in the inter-tropical areas (FAO 1996b). Larson and Frisvold (1996) suggest an increase in the fertiliser application in SSA from 10 kg/ha to 50 kg/ha. Widespread use of agrochemicals in some districts, such as Pallisa, accompanied with chemical misuse resulted in more soil toxicity and reduced soil fertility. In part, inadequate knowledge and awareness by the farmers was a major contributory factor (MoPED 1996b, p.213). This is inextricably linked to inadequate extension services.

Most farmers depend on their own local seed supply. With their traditional knowledge on seed selection, they select and store the seed from the previous crop harvest. Use of improved/hybrid seeds is very small, and these include maize, groundnuts, beans and soybeans, with maize dominating the list. Although improved maize variety is available from the research centres domestically, 20 percent of the total supply is imported from Kenya. The new cassava variety resistant to African cassava mosaic has been distributed to some farmers and MAAIF has so far reported successful results. There is no control or any regulations in place on choice of variety, suitability and adaptability (MoPED 1996b).

Agricultural Extension Services and Research

Revitalisation of the extension services was among the components of the economic reform after mid-1987. An agricultural extension project (1993 - 1996) funded by the World Bank (IDA) was aimed at supporting the government's strategy of agricultural development and diversification. Delivery of extension services was effective in increasing production of field crops from 10 percent to 60 percent. However, the coverage was limited to food surplus or food transitory deficit districts ignoring chronic food deficit and marginally serious food deficit districts (MoPED 1996b).

Research on African staple foods, where women dominate, has received very little attention resulting in Africa lagging behind most developing regions in generating improved seed varieties that are locally adaptable (FAO 1996c). This applies to Uganda where much of the limited research has concentrated on the traditional agricultural export crops; and food research has not received its due attention (World Bank 1993b). While Uganda has well-established research institutes, inadequate funding has impeded these institutes from achieving their set goals.

2.4 Informing Food Security in Uganda

Uganda appears to lag behind all the other African countries in addressing food security at all levels. Lack of data at lower levels, especially the household level, has partly contributed to this situation. Scanty studies exist on addressing food security in Uganda. A brief review of these studies is presented below. "Uganda has the potential to provide enough food both quantitatively and qualitatively to maintain adequate food security and meet the nutritional requirements of its populace" (Kikafunda *et al.* 1994, p.2). Kikafunda *et al.* (1994) note, however, that the country's potential is not fully utilised. In part, this is attributed to the supply constraints faced by the agricultural sector (see section 2.3.5).

MoPED (1996b) employs two methods descriptively to assess the food security situation in the country. These include: the food balance sheet and per capita terms. The appropriateness of each method depends on the level of analysis and data availability. Food balance sheets are used to provide data on food availability for the whole population. They are the best tools that most developing countries have employed to assess food security situation and are not very demanding in terms of data. However, its application at household level is inappropriate as it ignores, firstly, differences in the means of acquiring food by different households; secondly, age and sex composition; thirdly, internal food distribution within the country and lastly, seasonal variations.

With the help of a food balance sheet[18,19] MoPED (1995 1996b) reports the country to have a positive balance in maize, peas, finger millet, sorghum, cassava, banana, fish, goat meat and mutton; and a negative balance in beans, milk, beef and poultry products. The northern, eastern and western regions were reported to have a positive balance except for the central region. At district level, some districts recorded a food deficit including Pallisa, one of the sampled districts in this study. MoPED (1995) reports a threat of transitory food insecurity in some districts and chronic food insecurity in others. Kiboga and Mbarara are grouped among the food surplus districts. It is worth noting that even in those regions or districts with food surpluses, unequal access to productive assets may lead to a significant proportion of households failing to meet their food requirements.

Using the household budget survey data, MoPED (1995, 1996b) reports an average caloric intake of about 2,400 kcal, protein intake of 50 gm and fats intake of 19 gm on a daily basis at the national level. These figures are marginally lower than the 2,419 kcal caloric intake suggested by UNDP (1994) and 57.7 gm and 20.3 gm for proteins and fats, respectively, as recommended by FAO (1973) for all SSA countries. However, the daily caloric intake is higher than the critical minimum of 2,200 kcal suggested by WHO.

At the regional level, the eastern, northern, central and western regions recorded 2,608, 2,495, 2,353 and 2,178 caloric intake, respectively; in terms of protein intake,

[18]Computations of the Uganda food balance sheet excluded carryover stocks, did not account for errors in the production figures and uses crude methods to estimate non-consumption uses of food and of loss and wastage (Riley 1994).

[19]Results based on the Uganda National Integrated Survey 1992/1993.

51.37 gm, 45.66 gm, 49.95 gm, 52.80 gm, respectively; and in terms of fats, 15.95 gm, 16.57 gm, 22.51 gm, 21.26 gm, respectively. The eastern region recorded a nutritional intake higher than the figures suggested by either UNDP or WHO in terms of caloric intake and protein intake and the northern region figures are lower than the recommended figures except for caloric intake. The central region figures are below the recommended levels for all SSA countries except for fats and the western region intake is above recommended levels for both protein and fats. Despite its low caloric intake, Mbarara district recorded a high protein and fat intake, above those levels recommended by FAO. Details of Kiboga and Pallisa were not provided; however, the fat intake is reported to be low in most districts.

Households derive most of their daily caloric requirements from starchy foods (Ssekiboobo and Kakande 1994). This finding is consistent with the FAO 1980-1982 and 1983 Uganda Food Balance Sheet, that the starchy foods, roots and tubers provided twice as many calories as cereals. Because starchy foods are less nutritious, the diets of the populace are generally deficient of other nutrients. Matooke, sweet potatoes and beans contributed a large share to daily caloric intakes nationally (Ssekiboobo and Kakande 1994; MoPED 1996b). Most rural households depend on their own production for survival, yet the supplies are generally inadequate to meet the daily nutritional requirements for an active, healthy life. The situation is exacerbated by traditional food consumption habits entrenched by people's culture. For instance, in the central region, a meal cannot be appreciated as one without matooke. While millet is more nutritious than matooke, it is hard to influence households in this region to add millet into their diets.

Previous studies on food security in Uganda are silent on vegetables and fruits, which are very rich in micronutrients. This does not suggest that the rural households do not engage in production of vegetables and fruits. Nor does it suggest that they do not consume vegetables and fruits. They grow vegetables but on a very small scale. Some households grow fruits but an unknown proportion is sold leaving little, if any for their own consumption.

It is inescapable to think of increasing incidences of food insecurity in rural Uganda. Households have responded differently to failures in their entitlements. In response to the drought of 1984, the Karamojongs resorted to selling off their cattle to neighbouring districts (Dodge and Alnwick 1986). Some households in Kumi were reported feeding on thorny tree leaves to survive starvation. Additionally, some households in drought hit areas responded by selling their labour to rich peasants in exchange for food, selling their assets at give away prices, stealing food and reducing the number of meals taken everyday. Response to increasing rural poverty has led some households to sell part of their subsistence food to meet other pressing needs, such as education and health (Riley 1994, pp.28-29).

Clearly, food security at a higher level conceals a lot of information on what is happening at lower levels. It is also clear from the above discussion that food security at a higher level does not guarantee food security at a lower level. For instance, the eastern region is a food surplus region but some districts were found to be suffering from food shortages. It, therefore, follows that security (insecurity) at the district does not translate into security (insecurity) at household or individual levels. Little emphasis, if any, is placed on household food security. Food security at the household level is both a desired output of successful development and a necessary input for development on a healthy human capital basis, which permits accelerated technological change and specialisation. Despite giving insights into the growing food insecurity at the national, regional and district levels, the previous studies have some shortcomings. The analysis is too descriptive for any meaningful improved food security planning and intervention. Additionally, the analysis is based on data such as from household budget surveys, which do not necessarily reflect the actual food consumption. There is a need to investigate how changes in the exogenous factors affect food security, especially at the household level. There is also a need to have a better understanding of what goes on within the rural households and specifically the role of women at this level of analysis.

The discussion so far has concentrated on the agricultural sector in general and the food sub-sector in particular. It has also analysed the current situation of food security in Uganda in general. Rural women, who make up the largest portion of small-scale farmers, are the main players in the sector and ensure their households' food security. As the UNDP (1996) points out, the low status of women in developing countries has worked to the detriment of the sector and consequently food security. Therefore, to internalise food security in Uganda an examination of the status of women is paramount. This is what the subsequent sections are all about.

2.5 Situation of the Rural Women

Research on women's issues in Uganda dates back some years. Several researchers have generalised the problems of rural women in their efforts to provide food. Some of these studies (for example, Mwaka 1990) are not based on empirical evidence. Where empirical evidence has been carried out (for example, ACFODE 1989) the analysis is of an illustrative (descriptive) nature, without giving insights into the relationships between these problems. Much of the available research carried out on women is in the fields of demography, health and education. Inspite of their shortcomings, these studies have rendered the visible facts about the reality of women's issues. This has led the Ugandan government to recognise the role of rural women in ensuring food security for all and overall development process but recognition without appropriate action is inefficacious. Below are some highlights on government's efforts to recognise women:

- Recognition of women dates back to 1984 when 8 March was first declared National Women's Day in Uganda. In 1991, this day was officially declared a public holiday to recognise and honour women.

- The NRM government initiative brought women into the mainstream of the governance of the country. For a long time women were relegated to the periphery of political activities. However, they are now represented at all levels of government from local resistance councils to parliament. They participate in the decision-making process.

- Ministry of Women in Development was established. In 1993 to June 1998 its name changed to the Ministry of Gender and Community Development. After June 1998, it changed from being a ministry to a department[20]. It organises women's activities and promotes their rights and opportunities. However, no evaluation of its performance has been carried out since inception.

---

[20] This was done during the restructuring of the ministry as requested by the World Bank.

- A Women Studies Department was established at Makerere University under the Faculty of Social Sciences in 1990.

- To increase the access of women to tertiary education, a policy of gender weighting of examination score was adopted in 1990. This system involves adding an extra 1.5 points to girls' marks. However, like all other government policies its success has not been evaluated.

- The new constitution provides a special quota for women in Article 180 2(b) by which a minimum of one-third of all seats on local councils must be reserved for women. Article 33 provides that women shall have a right to equal treatment with men, and to affirmative action for the purpose of redressing the imbalances created by history, tradition or custom (Museveni 1997, p.191). Uganda has a higher percent of women in government (10 percent) than Kenya (5 percent) or Tanzania (9 percent) (UNDP 1998).

- To increase their access to credit, the government has set up schemes such as Entandikwa[21] Credit Scheme. Unfortunately, poor loan recovery led to suspension of the scheme since early 1999.

- NGOs addressing women's issues are on the increase. These include FIDA, Action for Development (ACFODE), Safe Motherhood and Women's credit schemes.

The World Bank (1993b) places the rural women in Uganda at the centre of agriculture. They provide 68 percent of the labour for food cultivation and 53 percent of the labour needed for cash crop cultivation (World Bank 1993b, p.34). They are responsible for 70 percent to 80 percent of food crop production (MAAIF 1996), a sub-sector behind the growth the country is enjoying today. While activities of women in support for their families usually determine the amount of food available for family consumption and hence nutritional status of household members (FAO 1987), the society continues to inhibit them from access to social services, status and other means of realising their full potential. In the light of this, how does the government expect to achieve sustainable food security with the existing biases against rural women?

[21] Entandikwa is a localised terminology equivalent to seed money.

2.5.1 Access and Control over Productive Resources

Notwithstanding their crucial role in food production, women still face a number of gender-specific constraints that limit their effective access to productive resources. Despite their contribution to the household welfare, their control over the use of the resources generated is minimal (World Bank 1993b cites Jarawan 1991). Insecurity of land tenure is amongst the most serious constraints to increasing agricultural productivity and incomes of rural women (FAO 1996d). For instance, while 97 percent of rural women were reported to have access to farming land, only 7 percent owned land (UNICEF 1994). Like UNICEF (1994), DANIDA (1993) reported that less than 10 percent of rural women owned land. It is usually through marriage that most women acquire access, but not ownership to their husbands' property.

Despite the Uganda Succession Act entitling a widow to 15 percent share in her deceased husband's estate, denial in most societies is a common practice. Additionally, most societies are patrilineal, a further evidence of discrimination against females. Unfortunately, the new Land Act of 1998 does little to address this issue. Surprisingly, neither ownership nor control is guaranteed even in cases where women purchase land with their own monies. For instance, women in Kisoro district cannot own or sell livestock or own land in their names. Land bought by a woman is titled in her husband's name (Oxfam 1996). El Ghonemy (1990) and Lipton (1983) argue that land is still overwhelmingly the main productive asset by value for security of caloric intake. They assert that land ownership plays a decisive role in determining the degree of rural poverty and in turn food security. To use land more efficiently and thereby make a greater contribution to household food security, women need security of land tenure (FAO 1996c; MOPED 1996b), which provides them with sufficient incentive and security to invest in rather than exploit land (Toulmin 1991). This is perceived as an avenue to ensure that land management decisions are made in a sustainable manner for long-term productivity.

Marriage obliges a woman to work for the husband and the kin group members into which she is married. She cannot exercise rights over the use of labour of her in-laws living with her, but a man does on his in-laws. Apart from lacking control over the use of labour of her in-laws, some women lack control over their own labour. For instance, in Mukono district, labour of women and children is drawn from food production to work on vanilla production. Rice-growing farmers in Busoga responded to labour scarcity by intensification entailing the utilisation labour of women and children. This was achieved by working longer hours (Nabuguzi 1993), having a negative impact on food production. On the other hand, most rural women lack access to hired labour. Either the labour to hire is scarce or they lack the ability to hire. Lack of access to hired labour, coupled with a time constraint on their own labour during peak periods, has implications for pre- and post-harvest losses. The current traditional hoe farming and inadequate labour limit expansions in the area planted, leading to low food availability at the household level.

The low levels of literacy among rural women and the requirement for a male co-signer impede access to formal credit by women (MoPED 1996b). Moreover, their time constraints and lack of collateral for loan limits their accessibility to formal loans. The inter-sectoral allocation of credit leaves a lot to be desired. Much of the agricultural credit is biased towards traditional agricultural export crops that are not much in the women's production line. Even the Entandikwa credit scheme, which was supposed to ease the credit problems faced by rural women has only 30 percent of the total credit grant earmarked for women and youth. On the other hand, organisations have sprung up offering credit to poor women without any collateral. Such organisations include Uganda Women's Finance and Credit Trust, ACFODE and Rural Development and Training to name a few organisations. Despite their good intention of empowering women, these credit organisations have left out the rural women who most need such credit (Kwesiga and Muhereza 1997).

2.5.2 Gender Division of Labour

A distinguishing feature of rural areas in developing countries is the prevalence of home production with the use of family labour and capital. Home production is characterised by a remarkable division of labour based on gender and age. Gender division of labour in most societies in Africa reflects social customs, norms and beliefs, which govern individual behaviour. It has had a long history and varies across countries, societies, communities, tribes and households. However, general characteristics will suffice to explain the situation in Uganda.

Before the colonial period division of labour was between heavy and light work. Heavy work such as land clearing, building shelter and herding was customarily defined as the male's role. Fetching water and collection of fuel wood, weeding, drying and threshing and processing were customarily defined as the female's role. During the colonial era, the introduction of export cash crops by the colonialist disrupted the division of labour, which changed along the lines of export cash crops and food crops. Females were responsible for food crops and males for export crops. Many of the heavy tasks that used to be men's were taken over by women. The land use pattern changed and more land was allocated to export crops. Women were left with no choice other than working harder to replace the lost men's labour. These women had to feed not only their households but also the urban areas. However, the post-colonial era led to a further shift in the division of labour. These shifts were mainly due to economic, social and political circumstances. In some localities, women were left totally responsible for all the agricultural activities when men migrated in search for employment. Some may argue that male out-migration is indicative of the entitlement failure, which in turn puts pressure on women's labour.

The division of labour in the Amwona village of Lira district is contingent on the household's status in the society (Mamdani 1992). Migration of men in Kumi district in search for employment left women in Agule and Komodo villages to take on bush clearing and ploughing tasks that were traditionally done by men (Oxfam 1996). In Pallisa district men and women share equally in planting; however, weeding, harvesting and transportation are mainly women's role. Men are responsible for land clearing and preparation. The reduction in the number of oxen in the district has led women to take on the land clearing, formerly a man's task. While oxen technology raises the productivity of male tasks and permits them to cultivate more land, it disproportionately increases women's workload in weeding and harvesting. At the national level, women provide 60 percent of labour required in planting, 70 percent in weeding and 60 percent in harvesting (MIWID 1996).

Apart from division of labour in the productive activities, men and women to some extent divide their labour in the domestic activities. However, the rate of substitution between women and men in domestic chores is lower than that in the productive activities (Ellis 1992). They are responsible for food preparation and ensuring that every member of the household eats. Food processing is entirely a woman's responsibility. Women provide 90 percent of the labour required in food preparation and processing (MIWID 1996). The underdeveloped food processing technologies put pressure on women's time, especially in grain processing. Children, in particular girls, do assist their mothers in the domestic work. Some researchers cite girls' involvement in domestic work as a major contributing factor to high school dropout rates. Undoubtedly, gender division of labour in the Ugandan context is not static. It has the capacity to change and adapt the prevailing social and economic conditions.

2.5.3 Income Generating-Activities

Women are not only responsible for producing food but also bear the burden to earn income to cater for other household needs. The increase in male migration to search for employment has left some women with the full responsibility of caring for household needs. Some male migrants never remit money to their wives. This leaves the women with no alternative than seeking a source of income to sustain their households on a daily basis. The main sources of income are informal activities including food sales, handicraft making, tailoring and brewing to name a few activities.

A common feature of rural women's income-generating activities is that there is a tendency of getting involved in the same activities. This implies the market for the products does not exist locally and women have to look for other market outlets. As much as the markets for products of their activities may exist in urban areas, transportation impedes their efforts. Even in circumstances where the activities are different, the purchasing power in the rural areas is very low. Women in Adogarao village in Apac district work harder to earn cash to meet other pressing needs including paying graduated tax for their husbands (Oxfam 1996). Oxfam (1996) further reports family conflicts do arise when women in Kapchorwa district fail to find extra income to support the household. Women in Bushenyi and Mbarara districts plan the income and men plan the expenditure (UNICEF 1994). It further reports some husbands give up household responsibilities once women earn some income.

While the Ugandan government's campaign to promote income-generating activities for rural women is appealing, it fails to take into account and address the time constraints faced by these women. The rural women's participation in such activities is contingent on breaking the 'zero-sum game' in their time allocation between productive and domestic activities.

2.5.4 Education

The proportion of girls at all levels of the education system is lower than the proportion of boys (UNDP 1994). Several factors have been advanced to explain such a situation. These include a culture which favours boys; girls being assigned more domestic work than boys; and increasing poverty has exacerbated the situation. Of the female population aged 10 years and above, only 45 percent are literate. The World Bank (1993b, p.36) reports that 43 percent of the rural women are functionally illiterate compared with only 28 percent of men; and 51 percent had finished primary education, compared with 60 percent of men.

The high female illiteracy rates limit their participation in the development process. Gender imbalance in the education system leaves women worse off as better-educated farmers are more likely to adopt new technologies faster than their non-educated counterparts. And as mothers, the educated ones are more likely to adopt nutritional information than their uneducated counterparts. If women's education is that important in effective agricultural strategy, population control policy and nutrition policy, why does it not get all the attention it needs? To increase their enrolment in tertiary education, the government introduced a 1.5 point system for female student as noted previously, which has been criticised by Kwesiga and Muhereza (1997) for favouring girls mainly from urban schools where children of the rich dominate. It affirmatively leaves out the girls in rural areas who most need it. The government in 1997 introduced Universal Primary Education (UPE) but it is limited to four children per family.

2.5.5 Time Allocation

Rural women in Uganda, like other women in developing countries, allocate their time across productive and domestic activities. A rural woman's working day in Uganda is estimated between 15 to 18 hours (UNICEF 1994). It is their responsibility to fetch water and collect fuel wood, which are both time-consuming. The availability of water and fuel wood has implications for production and consumption in terms of a household's time expenditure (Charlton 1984). Scarcity in fuel wood is now widespread resulting in women spending more time on collection and also making adjustments in their household consumption patterns. In some localities women have started using fuel-saving stoves. The drought and increasing encroachment on wetlands have led to a lowering of water tables, at times rendering water collection spots dry.

Time is a constraint to rural women in Uganda like any other women in developing countries, in particular Africa. The World Bank (1993b, p.35) cites Evans (1992) that female labour supply is limited by their multiple demands of domestic food production, processing and other related domestic activities. Constraints on women's ability to allocate time and resources optimally lead to their restricted bargaining power and contractual inferiority in the labour market.

Given their responsibility to feed the members of their households, especially children, women postpone taking care of their pains by continuing to work as planting, weeding or harvesting cannot be suspended (Obbo 1995). Pregnant women perform agricultural work until the eleventh hour and most of them resume work shortly after delivery.

Obbo (1995) reports that the AIDS scourge has exacerbated women's workload. Cultivating, caring and nursing the sick is strenuous on women. The cost of caring for AIDS victims is being borne disproportionately by women. Household assets are lost to raise the medical bills. Traditionally, if death occurs in the village no agricultural work takes place until after burial has taken place. However, this culture is gradually changing.

2.6 Concluding Remarks

The agricultural sector is the mainstay of the economy of Uganda. It is a source of employment, survival and livelihood for over 80 percent of the rural population. While the agricultural sector has been discriminated against, discrimination within the sector is prevalent. The food sub-sector *per se* has received little consideration in the policy making process. This is evident from the lack of well-stated food policies by the government. Additionally, research and allocation of credit to name a few are skewed toward the nonfood sub-sector. The major constraints facing the food sub-sector have been discussed in detail. And since women are the key players in this sub-sector, constraints facing the sub-sector are constraints to the women. These constraints threaten women's command over food and that of their households, in general.

Most African governments during the early 1980s adopted policies geared toward achieving self-sufficiency in food supply. However, most governments came to recognise that self-sufficiency in food supply is not sufficient to ensure food security of the population. Issues of food accessibility and entitlements are at the top of some countries' planning and policy agenda. In contrast policymakers in Uganda have continued to perceive food security to imply food self-sufficiency. Additionally, little emphasis is put to addressing food security at the household level. The inadequacies in the available data have partly slowed down informing food security at this level. Despite national food self-sufficiency and strong economic growth, the persistence of child malnutrition and recent famine problems are all evidence of growing household food insecurity in rural areas. This suggests that a household level analysis is a good place to start understanding and informing food security.

Little research has been carried out to address the food security situation in Uganda, and where it exists it has suffered from being descriptive. The government has continued to employ *ad hoc* measures to address consumption and production, which directly affect household food security. With such measures, realisation of effective food policy planning may not be forthcoming. There is a need to go beyond the descriptive approach and examine the impacts of the changes in exogenous factors on household food security. Earlier studies carried out elsewhere in Africa have employed either an indirect approach (for example, Strauss 1984, 1986) or a direct approach (for example, Njoku and Nweke 1994) to derive the impact of mainly monetary entitlements on household dietary intake. These studies display some shortcomings. They ignored the nonseparability that exists between production and consumption decisions, and concentrated only on caloric intake as an overall measure of food security. Lack of micronutrients has been found to have serious consequences on human productivity, in particular of women and children. Considering such findings, renewed emphasis has been placed on household food security in the 1990s and the concept has been broadened to include also micronutrients.

The few studies on women in Uganda can be systematically categorised in three broad groups. The first group consists of studies that have continued to generalise problems of rural women by ignoring their cultural, social and economic differences. The second group comprises those studies that are purely theoretical. Third, there are empirical studies but of a descriptive nature. While these studies give insights into the status of women, they offer limited input in the policy making and decision-making processes. The few studies carried out elsewhere have gone a step further by categorising women into those from female-headed households and male-headed households. In consideration of this categorisation, these studies have suggested preferential treatment of women in the former based on the perception that they have more problems than the latter. This has led donor agencies and NGOs to ignore women in male-headed households. In rural Uganda, how does headship affect household food security? Could one be justified to assume male-headed households are more food secure than female-headed ones? Are women within each categorisation homogeneous? Should women's problems related to food security be identified and tackled according to their socio-economic status?

Indubitably, time is a scarce resource to rural women. Unfortunately some researchers have continued to ignore it. The remedies to remove the constraints faced by women as suggested by the studies cited above fail to explicitly take into account their backbreaking workload. This is also true with the current government's efforts to encourage women to get involved in income-generating activities. How does the government expect rural women to get involved in income-generating activities without breaking their 'zero-sum game' trap? If the 'zero-sum game' trap remains, how does increasing women's involvement in income-generating activities affect their household food security?

The issue of increasing income of the rural population through export diversification raises questions on its implications on household food security. MoPED (1996b) assumes all rural households to be net producers of food. Could this be the case in the sampled districts? If so, how does it affect household food security? Lack of knowledge on household type may have serious consequences for food security.

While rural households consume a variety of food items, these foods are rich in one type of nutrient but severely deficient in others. Traditional food consumption patterns (cultural preferences) play a major role in what to be consumed, although researchers are ignoring this role. Additionally, consumption of fruits, livestock and poultry products from own production is very small; much is said to be traded depriving members of a richer nutritional intake. The questions that arise include, do the farmers sell off the fruits, livestock and poultry because of the economic squeeze? Do they sell them because of women's ignorance about the nutritional needs of their household members? Could it be that women have the nutritional knowledge but do not make a decision about what should be retained and sold to earn income? Could it be that food is available but because of the women's workload, they do not have time to prepare it? Could the cultural taboos be playing a part in what should not be eaten? How much does illiteracy influence food consumption?

In its efforts to promote food production and improve the food security of its population, the Ugandan government may not succeed without identifying, understanding and addressing the problems of women. How does the status of rural women affect their household food security? If women are poor and lack access to productive resources, there is a need to investigate which of these factors has the most significant impact on their efforts to increase food production and hence improve the food security of their household members. What about their time allocation? How much does it influence household food security? Many of the forces working against women's agricultural production and thus food production are not being directly tackled, and these forces may vary across women of all categories. What about the forces working against their efforts in food consumption? This kind of analysis is necessary if the responses of most rural women to food policy interventions are to be more accurately predicted. Without such empirical knowledge, the government's efforts to increase food production and improve the food security of its population will be inefficacious.

3 A Review of Literature

In the preceding chapter background information on rural women and food security in Uganda were presented. A review of literature on food security and women in developing countries in general and in particular Africa, and agricultural household modelling is the subject of this chapter. In section one the evolution of the food security concept is discussed. The evolution of integrating women in the development process is discussed in section two. The role of women in ensuring food security in developing countries, in particular Africa, is reviewed in section three. The modelling and estimation procedures employed by the previous studies are reviewed in section four prior to concluding remarks.

3.1 Evolution of Food Security Concept

Maxwell and Smith (1992) present a critical review of the developments of the concepts and re-definitions of food security. Like Maxwell and Smith, FAO (1996a) presents a review of the evolution of food security concept since the World Food Conference of 1974. Initially the concept emphasised food security at the international and national levels. It was assumed that ensuring larger grain stocks globally and maintaining the fluctuations in grain prices within a reasonable range would ensure security at the individual country level. Maintaining stability of food supplies to ensure physical availability in the event of widespread crop failure was recommended by the conference. This led policymakers and donor agencies to push for policies for ensuring food self-sufficiency. It was assumed that countries experiencing food shortages could easily gain access to food through importation, ignoring the foreign exchange constraints of most developing countries. Researchers and scholars by then assumed that ensuring national food security was a necessary and sufficient condition for ensuring security at lower levels.

Despite increases in global per capita food availability, widening gaps between national food availability and requirements, an increasing number of malnourished persons and hunger particularly in SSA (Pinstrup-Andersen and Pandya-Lorch 1997b) led to a reappraisal of the food security concept in the 1980s. At its Eighth Session in 1983 the Committee on World Food Security adopted a broadened concept of food security. The objective of the committee was to ensure that all people at all times have both physical and economic access to the basic food they need. The three components needed to fulfil this objective were to ensure stability of supply, access to food at the household level, and availability of food. This session marked a shift in the level of analysis to household and individual levels and a shift in emphasis from food availability to accessibility. Several researchers have partly attributed this shift to Sen's (1981) work on food entitlements, where it is argued that an individual or household may lack sufficient command over food even if it is available. The reappraisal of the concept continued in 1992 by the International Conference on Nutrition (ICN), adding a nutritional dimension to the concept that '... all people at all times have access to safe and nutritious food to maintain a healthy and active life' (FAO 1996a).

There are a number of variations of the definition of food security. However, as Maxwell and Smith (1992) point out some definitions have been more influential. For instance, World Bank (1986) defines it as '...access by all people at all times to enough food for an active, healthy life[22]'; FAO (1983) as '... ensuring that all people at all times have both physical and economic access to basic food they need[23]'; for Maxwell (1990), '...people are food secure when their food system operates efficiently in such a way as to remove fear that there will not be enough to eat. In particular, food security will be achieved when the poor and vulnerable, particularly women, children and those living in marginal areas, have secure access to the food they want ...'; and the Committee on World Food Summit of 1996 considers it to exist when '...food is available at all times, that all persons have means to access to it, that is nutritionally adequate in terms of quantity, quality and variety, and that is acceptable within a given culture'.

Secure access to adequate food at all time characterises all the above definitions. However, Maxwell's definition focuses on the poor and vulnerable people, who are the high-risk groups. Like the Committee on World Food Summit, Maxwell and Smith (1992, p.39) cite some researchers who argue for an extension of the definition to include the proposition that food must be culturally acceptable. These definitions

[22]See Smith *et al.* (1992, p.188)
[23]See Smith *et al.* (1992, p.152)

jointly are silent on the issue of securing access through emergency relief programs. The definition of food security should explicitly point out that people should be able to gain access to food through non-emergency means.

If a household fails to gain secure access to food, it is said to be faced with either transitory or chronic food insecurity. Transitory food insecurity occurs when a household experiences a decline in its access to enough food. If a household faces continuous inadequacies in its diet resulting from lack of resources to produce or acquire food, then it is said to be chronically food insecure.

3.2 Measuring Household Food Security

Apart from definitional aspects, measuring household food security has also merged as another issue. There has been a shift from objective measures to subjective measures (Maxwell, S. 1996). This is to some extent reflected in the definitions of food security discussed in section 3.1. The objective measures include among other things comparing the actual daily dietary intake against recommended daily intake. Development economists have continued to use calories as a proxy for overall measurement of food intake. It has been used to characterise the widespread malnutrition, especially in developing countries. Little attention, if any, is given to other macronutrients, such as protein and fats, and micronutrients especially iron, vitamins and iodine for which high deficiencies are continuing to be reported for SSA and South Asia (ACC/SCN 1997). Such emphasis is prompted by the perceived assumption that caloric adequacy ensures adequacy of other nutrients.

Ellis (1992, p.309) contends that as long as the household has adequate caloric intake, other nutritional requirements will be automatically met. Some studies by nutritionists cited by Millman (1990, p.284) concur with Ellis that most diets that meet caloric needs also provide adequate amounts of protein. Other development economists have argued that protein deficiency tends to be accompanied by caloric deficiency and protein sufficiency by caloric sufficiency. However, Delisle *et al.* (1991) and ACC/SCN (1992) suggest that the household food security definition (of sufficiency in terms of caloric intake) be broadened to dietary adequacy with respect to other nutrients, which has been supported by IFPRI studies such as Behrman (1995). Micronutrient deficiencies lead to increased morbidity, long-term impairment and sometimes death (Behrman 1995). Therefore, for a household to be food secure the food must be adequate not only in terms of quantity but also quality.

The major problem that has surrounded objective measures is that of the establishment of the minimum requirements. For instance, FAO/WHO have recommended minimum caloric requirements taking into account age, sex, physical activity and environment, which has received criticisms from researchers such as Poleman (1981) and Srinivisan (1985) and are subject to constant revision (Payne 1990). It assumes constant caloric requirements based on studies of Caucasian population of industrialised countries (Srinivisan 1985). Estimates based on these assumptions, some researchers have argued, may lead to underestimation of caloric intakes in developing countries. Subsequently, some have argued that such estimates be treated as value judgements.

On the other hand, Maxwell's (1990) food security definition stresses the subjective dimension of food security. Maxwell, D. (1996), Kabra (1996) and Ramider *et al.*'s (1990) approach emphasise this subjective dimension. Such subjective measures include coping strategies that are mainly used to investigate vulnerability to food insecurity. In order to understand the extent of food insecurity and subsequently develop effective food security policies, both objective and subjective measures need to be used.

3.3 Evolution of Integrating Women in the Development Process

Debates about the possible causes of and remedies for the food crisis in SSA coincided with the rise of the 'Women in Development' (WID) lobby. This lobby group pointed out the important role played by women of SSA in food production, and linked their low status to the food crisis. A short summary is presented of the different policy approaches suggested for integrating women in the development process. The summary is based on Moser (1989).

3.3.1 Welfare Approach

This approach appeared before the rise of the WID lobby. It predominated in the period from 1950 to the early 1970s, and is still widely used. It is based on three assumptions. Firstly, it assumes women to be passive recipients of development, rather than participants in the development process. Secondly, it assumes motherhood to be the most important role for women in society. Lastly, it assumes child rearing to be the most effective role for women in all aspects of economic development. In other words, this approach focuses on the women's reproductive role and neglects their active and productive role in the development process. It emphasises bringing women into the development process as better mothers through better access to water, health and education. This approach also extends to tackle the world's population problem by identifying women as primarily responsible for limiting the size of the family. Food aid provision and nutritional education programs were among the welfare programs for targeting the most vulnerable groups of the societies that predominated with this approach. Although it is still popular among governments and international organisations, it does not promote women's economic independence due to the top-down handout nature of the welfare programs.

3.3.2 Equity Approach

This approach marked the beginning of the WID lobby and predominated from the late 1970s until early 1985. It originated from the failure of the modernisation development theory, Boserup's (1970) influential and pioneering work that recognised the crucial role of Third World women in food production, and the declaration of UN Decade for Women. The failure of the modernisation theory was detected from the increasingly negative impacts that new technologies had on women's time and in diminishing their status in the society. The Declaration of UN Decade for Women 1976 - 1985 played a role in emphasising and publicising the important role of women in the social and economic development of their countries. This approach recognises women as active participants in the development process, through not only their reproductive role but also through their productive role. It also identifies the origins of women's subordination as lying not only in the context of the family but also in relationships between men and women in the market place. It focuses on reducing the inequality between women and men in the sexual division of labour.

3.3.3 Anti-Poverty Approach

This approach marked the second series of policy approaches of the WID lobby. Like the equity approach, it focuses on women's productive role in the development process. It emphasises a shift from reducing inequality in the division of labour to reducing income inequality. The main objective of this approach is to ensure that poor women increase their productivity. This is perceived as a necessary condition for poverty alleviation and promotion of economic growth. Women's poverty is perceived as a problem of underdevelopment rather than of subordination. Women's poverty and inequality with men is to be attributable to their lack of access to productive resources and sexual discrimination in the labour markets. Therefore, the approach aims at increasing the employment and income generating options through better access to productive resources. The approach is silent on the reproductive role.

3.3.4 Efficiency Approach

This marked the third series on policy approach in WID. It emphasises a shift away from women and toward development on the assumption that increased economic participation for developing countries' women is automatically linked to equity. This shift from equity to efficiency was marked by deterioration of the world economies, especially in Latin American and African countries. To restore the situation, economic stabilisation policies of economic recovery and Structural Adjustment Programs (SAP) were designed by the International Monetary Fund (IMF). This approach focuses on the utilisation of women's non-remunerated labour. This results in increased reliance on women's unpaid labour to deliver services. The major critics of SAP point out that it defines economies only in terms of marketed goods and services. It excludes women's reproductive work. Critics have called for stabilisation programs which are human centred.

3.3.5 Gender Approach

Donor agencies (notably FAO and the World Bank) and researchers have recognised that treatment of women in isolation from men may have little impact on the women. Hence a shift from WID to Gender and Development (GAD). WID was meant to ensure that women benefited from the development efforts. It focused on how women could better be integrated into the development process and overlooked the heterogeneous nature of women. Gender relations were assumed to change automatically as women become full economic partners in development. GAD emerged in the 1980s and takes into account the causes and consequences of gender differences for economic and human resource development. It argues that women's success and problems are closely related to how they relate with men. GAD discerns women as agents of change rather than as passive recipients of development assistance. Unlike WID, it puts emphasis on the participation of governments in promoting women's emancipation (Rathgeber 1990). Contradictory to the neo-liberal policies, GAD sees it as the responsibility of the government to provide social services such as education and health to women. GAD goes further to question the underlying assumptions of current social, economic and political structures. It demands a degree of commitment to structural changes. While the GAD approach is more appealing than WID, most of the intervention strategies to integrate women in the development process find their roots in the WID perspective (Rathgeber 1990). Undoubtedly little on the part of most governments has been done to reform gender biases. Similarly, despite donor agencies showing concern to adopt GAD, the practical implementation of the same leaves a lot to be desired.

Like the concept of food security, there are confusions among policymakers and researchers on the differences between WID and GAD. Some have tended to use both synonymously. Developing countries in general and SSA countries in particular have adopted one or a combination of approaches for integrating women in the development process. However, their successes/failures have not been evaluated due to lack of statistics on the women they are attempting to address. In Uganda, a combination of these approaches seem to be prevalent; however, the anti-poverty approach is more pronounced.

3.4 Household Food Security and Women

Despite the growing focus on household food security in the 1990s, the transition from addressing national food security to household food security has been slow for some countries. In part, definition, measurement and inadequate data have hindered informing food security at the household level (von Braun *et al.* 1992). More importantly, the cost of collecting data at the household level has overshadowed the benefits that might accrue from such data.

Some countries (such as Kenya and SADC countries) have recognised the contribution of improved household food security to the general wellbeing of the people and have placed these issues at the top of their planning and policy agenda. These countries have gone a step ahead to design food security and nutrition monitoring systems at the household level (see, for example, Quinn and Kennedy 1994) unlike countries such as Uganda, where the early warning system is at the national level. Such systems at the national level pay little attention to the household level or even issues of food accessibility (Maxwell and Smith 1992). They further fail to explicitly incorporate women.

It is now well established in the literature that a majority of the poor people in developing countries live in rural areas and depend on agriculture for survival and livelihood, including food security. In the rural African context, some would argue that food availability is still a necessary condition for ensuring food security, given the majority of people gain access to food through own production. However, factors affecting food availability have varied across nations (see, for example, Aziz 1986; von Braun *et al.* 1992) and these factors have been the focus for many governments. Not much attention has been given to accessibility issues. Food accessibility is perceived as a necessary and sufficient condition for ensuring household food security. Mwadime and Baldwin (1994) partly ascribe inadequate access to food to lack of physical access to food or lack of financial access or both. The World Bank and some researchers link inadequate access to food to poverty. They argue that poverty is the main determinant of chronic food insecurity, with the rural poor being at a higher risk. Other studies, such as UNDP (1996), have partly ascribed inadequate access to food to the low status of rural women. Wandel (1989) observes that women's issues in relation to household food security have not been given the due attention.

Economic policy reforms have failed partly due to the lack of attention paid to the rural women's role in food production and ensuring household food security. These reforms have been and still are gender-blind. Despite the emergence of GAD, policymakers and politicians have inadvertently failed to fully recognise that women and men have different roles in food production and household food security, and that their needs and constraints are different.

3.4.1 Women and Time Allocation

Despite the differences in focus and emphasis of policy approaches for integrating women in the development process discussed in section 3.3, each policy confronts the issue of women's time. Unfortunately, they all fail to recognise time as a scarce resource to rural women.

The available evidence (such as FAO 1987) shows that activities of women in support of their households usually determine how much food is available for household consumption and in turn the nutritional status of the members. This suggests that household food security cannot be discussed without paying attention to a woman's time allocation. Women allocate their time not only to home production activities but also to domestic chores. Paradoxically, time allocated to domestic chores is ignored by the WID approaches. Clearly, domestic chores and productive activities compete for a woman's time. Studies such as Senauer *et al.* (1986) have demonstrated the impact women's time could have on both the children's nutritional intake and on the nutrition of the household as a whole.

Most researchers have come to the same conclusion that a woman's day in most developing countries is longer than a man's day; however, this tends to vary across countries and societies. A rural woman spends from 10 to 15 hours on farming, marketing, cooking and other domestic chores (Henn 1983). In Uganda, a woman's day is estimated to be between 15 to 18 hours (UNICEF 1994). Ellis (1993, p.178) cites some case studies that found women's time allocated to domestic activities to vary from 5 to 7 hours compared to only 15 minutes to 1.5 hours per day by men. However, men's contribution to income-generating activities ranged from 7 to 11 hours compared to only 1.5 to 3.5 hours per day by women. Haddad (1991) found the burden on women's time to be 20 percent higher than that of men in Ghana, across age groups and occupational status. Additionally, some researchers such as (Ellis 1992) have observed an African woman's day to be even longer than her counterpart in other developing countries.

Fetching water and fuel wood collection are the most time- and energy-consuming activities. Energy related activities in SSA consume from 13 to 36 percent of total women's time and consume from 5 to 20 percent of total household expenditure (Cecelski 1987). Increasing decline in the quality and quantity of forests have affected the quality of fuel wood (Cecelski 1987). Similarly, the availability of water has been affected by increasing occurrences of drought in SSA (Tichagwa 1994). This has implications for food production and consumption in terms of a household's time expenditure (Charlton 1984).

3.4.2 Women and Population

The available literature on food security partly attributes food insecurity in Africa to the rapid population growth the continent has experienced over the years. Africa has the highest population growth rates in the world. SSA recorded 2.8 percent annual population growth rates for the period 1970-1995, which is higher than all other developing countries at 2.2 percent and well above the world growth rate of 1.8 percent. The SSA countries which recorded a higher annual growth rate than that of the region during the same period included Uganda, Kenya and Cote d'Ivoire with annual rates of 2.8 percent, 3.5 percent and 3.9 percent, respectively (UNDP 1998). Poverty partly contributed to the rapid population growth rates, as did limited access to health services and education, leading to low contraceptive prevalence rates and young age at marriage. The average age at first marriage over the period 1980 - 1990 for SSA was 19 years, lower than the rate for all developing countries of 20.8 years, with Uganda recording the lowest age of 17.7 years in the East African region. The world total fertility rate as per 1992 is reported at 3.4 percent well below that of all developing countries of 3.8 percent. During the same period Uganda recorded a 7.1 percent total fertility rate, higher than that of the SSA region of 6.5 percent (UNDP 1998).

3.4.3 Women and Productive Resources

Inadequate access to productive resources is among the determinants of undernutrition in developing countries (McGuire and Popkin 1990). FAO studies confirm that women have more difficulties in gaining access to resources and agricultural inputs than men due to cultural and social factors. Ensuring equal access to productive resources to both women and men would lead to significant increases in agricultural productivity and improvements in household food security in developing countries (Quisumbing *et al.* 1995, p.7). This is supported by empirical studies (see Quisumbing *et al.* 1995) that have shown that given equal access to resources, women often achieved higher yields than men. This has led researchers and donor agencies, notably FAO and the World Bank, to suggest investments aimed at improving access of women to productive resources. As yet, little emphasis has been placed on the control of productive resources.

As in case of Uganda (see section 2.5.1) most patrilineal societies elsewhere in Africa, women gain access to but not control over land through marriage. Additionally, men control the cropping patterns on the so-called 'women fields' in some societies. Henn (1983) found that husbands in some societies in Cameroon and Tanzania prohibited women from growing cash crops. Clearly, lack of effective access to productive resources negatively impacts agricultural production. Yet to receive attention is the quality of these resources. For instance, would having effective access to, say, land that is marginal be considered adequate for improving agricultural productivity?

Access to and control over formal credit has been and still is a major barrier to increasing agricultural productivity. Women's access to financial credit is now recognised by the World Bank as a critical ingredient in their path out of poverty. IFPRI Report (Feb 1997) cite studies carried out in Africa that found that improving access to credit of the poor through micro-credit schemes and other approaches could raise incomes and relieve poverty in developing countries. However, Quisumbing *et al.* (1995) contend that access to credit may not reduce poverty unless appropriate policies and good governance make a difference to the poor. It is well established in the literature that traditional banking institutions have failed to work for the poor. Rural women's participation is mainly hindered by the lack of physical collateral requirements. The high bank interest rates and non-interest transaction costs[24] prohibit the poor in rural areas to access credit (Berger 1989). Women experience a higher opportunity cost than men in terms of lost labour because of their higher longer workloads. Inadequate flow of information on credit, targeting credit to particular economic activities that are not in line with women's activities and inability to accompany credit with technical assistance are additional institutional constraints that need to be addressed.

---

[24]Such non-interest transaction costs include applicant's efforts in terms of time lost and income, in addition to transportation cost and bribes (Berger).

3.4.4 Invisibility of Women in Rural Development

The sluggish development process in most African countries is partly attributed to the invisibility of women's role in such a process. Culture partly contributes to this invisibility (Charlton 1984; Weekes-Vagliani 1985). Women are excluded at both the planning and implementation stages of most rural development projects (Weekes-Vagliani 1985), which is detrimental to such projects since women indirectly affect their success. Such programs have also been reported to increase women's workload, hence making competing demands on their time (Barrett and Browne 1994). The invisibility of women in the rural development programs is also evident from agricultural research, which has ignored research on food crops.

Researchers have been critical of targeting beneficiaries in rural development projects. Weekes-Vagliani (1985) observes that there is a tendency at the implementation stage to implicitly narrow the definition of the target group. In some cases, targeting the rural poor has been translated into the adult male household head, resulting in failure to recognise the economic role and contribution of women. Some programs have directly targeted men on the presumption that the benefits accruing from such programs will trickle down to all members of the household. Unfortunately, such policies or projects fail to achieve their set objectives due to the neglect of the role of women in the process that they aim to influence. On the contrary, McGuire and Popkin (1990) cite studies where rural programs have been effective in increasing women's productivity.

Rural development policies have had impacts on the resource base and access to resources by women. As a means to finance its development programs, the Senegalese government allocated land to export crops that increased at the expense of food production, and women's labour allocated to food production decreased not only to supplement male labour but also to replace the absent male migrant workers (Savene 1986). Like Savene, Whitehead (1990a) points to development policies by governments that have worked to the detriment of rural women, not only in the sense of increasing women's workload but also in reducing their share of the household resources over which they have control. Whitehead argues that the economic modelling of most development planning falls short in capturing the real conditions of women's farm work. Like Whitehead, Marangu (1989) suggests that women should be at the centre in finding ever-lasting solutions to Africa's food crisis. The literature suggests that prior identification of women beneficiaries is necessary to avoid rural programs that are detrimental to women's welfare.

3.4.5 Women and Statistics

Researchers (such as Charlton 1984; Evans 1994; Whitehead 1994) have partly attributed the continued invisibility of women in the development process to the lack of statistics on women. Statistics are a vital component in development. Before the UN Decade for Women 1976, the statistics collected did not reflect women's active and productive role. This stemmed from the welfare approach (see section 3.3.1) that regarded women as passive beneficiaries in development. With the rise of the WID lobby, it was realised that governments had little, if any, data on women which was useful in planning development. The UN Decade for Women called for disaggregation of data by sex for all national economic and social statistics, to make visible the full extent of women's participation in economic and social life, and their true status in terms of income, health and education. Despite this call, Evans (1994, p.11) argues that the data are still inadequate and tend to distort women's contribution to development. Distortions stem from the disaggregation of data by sex that is not matched by corresponding changes in the concepts and definitions used in data collection, which are still biased towards men's activities. It is evident from the officially published economic statistics, such as national income accounts, that home production activities where women predominate are not included.

Similarly, at the designing stage of census/survey there are some issues, such as the main survey respondent and pilot surveys, which are always overlooked. Paradoxically, agricultural household surveys and censuses have and still are targeting the adult male head as the main respondent despite his peripheral role. Embarking on actual surveys without thorough pilot surveys is on the increase. Although many of these issues may seem minor to most researchers and policymakers, their impact is tremendous in affecting the accuracy of the data on which policies are based.

3.4.6 Women and Post-Harvest Technologies

Women are responsible for post-harvest operations, which they perform without support or training. Poor post-harvest technologies have negatively affected food availability at the household level. This situation is happening in the presence of declining agricultural productivity. The amount of losses at all levels for individual countries is rarely documented but the losses are great according to anecdotal observations and FAO studies. For instance, the post-harvest losses for cereals have been estimated to be between 5 and 30 percent; 15 to 60 percent for roots and tubers (Marangu 1989, p.147). In Uganda, food crops losses are estimated to be in the range of 15 to 40 percent at the national level (see section 2.3.5). Little, if any, efforts have been taken to improve on the current traditional post-harvest technologies. Lack of necessary knowledge and skills, needed by women to perform their rural role in food production effectively, leads to unnecessary losses in food production.

3.4.7 Women and Income

In most societies in Africa, women are not only responsible for providing food to their families by producing it but also by buying it from their incomes in case of any deficit. For instance, Luo and Kikuyu women in Kenya are fully responsible for the provision of food to the household members. Some studies (such as Hoddinott and Haddad 1995; Garcia 1990) have shown that women's income has a greater impact than men's income on improving household nutrition intake. In contrast, Kennedy and Oniango (1993) argue that increasing the income of women may not necessarily translate into increased intake of all nutrients when foods perceived as low-status foods are the major source of a specific nutrient. The perception that income earned by women gives them much greater authority in household decision-making (Sen 1990) led policymakers, politicians and donors to conclude that women should be targeted since their incomes meet the global societal objectives (Hopkins *et al.* 1994).

The impact of women's income on improving the household food situation and household expenditures, in general, has raised a debate as to whether the impact is due to flow of income, gender of the income earner or both. Allowing for seasonality, Hopkins *et al.* (1994) concluded that gender does influence food expenditures. Trenchard (1987) found gender and flow of income to influence food expenditures in all the five cases considered. Women were found to have a more regular flow of income than men. Like Trenchard (1987), Ardayfio-Schandorf (1993) found that flow of income other than gender contributed to the household economy in the Savanna Village of Ghana.

The socioeconomic changes taking place in rural areas have left women without any alternative other than to seek a source of income to sustain their households' daily basic needs. Given their low education and skills, and few employment opportunities, rural women have always turned to self-employment as a means of supporting their families and themselves, and this is done on top of their heavy burden. Unfortunately, the informal activities in which women participate do not raise sufficient income to raise them out of poverty (Berger 1989, p.1017).

Some sources of income have had an unbearable impact on household food availability. Firstly, the subsistence sector is no longer synonymous with the non-market economy. Farmers sell food including those with food deficits (Whitehead 1990a 1990b; Riley 1994). Several researchers allege that the prevailing poverty in rural areas leaves farmers with no choice other than selling foods meant for subsistence. Whitehead (1990a 1990b) cites some studies, which found that the poorer the household the more coercively it was engaged in selling food not in surplus. Conversely, some households sell off food as a surplus. Trenchard (1987) reports that in polygamous families of her case study areas, a woman had a right to dispose of any surplus after meeting the household needs. Secondly, brewing local alcohol drains not only household food supply but also puts pressures on women's time allocation. UNICEF (1994, p.110) reports diversion of millet that was meant for food consumption into local beer brewing in some parts of Uganda.

Proponents of income-generating and employment opportunities for women, as a means of getting them out of poverty, make no provisions for women's other household responsibilities. They fail to take into account the burdens that such strategies may place on women. Firstly, they ignore the time constraints faced by rural women (see section 3.4.2). Empirical studies (such as Henn 1983) have shown that time constraints have worked against women's participation in income generating activities.

Secondly, proponents ignore the cultural norms, in particular the position of women in some societies. A woman may have little control over her conditions of work or the disposition of the products of her labour and less control over her earnings. Her husband for fear of being unruly may prevent her from participation, and some activities may not be culturally acceptable. Some studies such as Henn (1983), Trenchard (1987) and Jiggins (1989) have reported that income is mainly controlled by men or in other circumstances men abandon their cultural obligations such as education and health once women get involved in income-generating activities. In protest, women in some societies have responded by joining women's groups to prevent male interference and manipulation.

3.4.8 Women and Education

Literacy rates among rural women are increasing at very low rates in most developing countries despite a campaign to invest in their education, confining women to informal sector activities, which have very low returns. In part, illiteracy hinders their participation in the labour market and development of entrepreneurial skills necessary for running small businesses.

Empirical studies such as Behrman and Wolfe (1984) have indicated that woman's education is important in agriculture and ensuring food security. Donor agencies and individual countries have come to conclude that investing in women may reduce poverty and hence improve household food security. The World Bank (1994a 1994b) has gone beyond this to assert that investing in women is central to sustainable development. The social and economic losses are enormous when women are denied access to basic education and health services (IBRD 1995). The study argues that greater benefits accrue when investments are made in women's education than if the same investments are made in men. A World Bank study found that each additional year of schooling brings a return of 2 to 15 percent in agriculture, comparable to those of men. Some demographers report that an additional year of women's education reduces fertility by 5 to 10 percent, which enhances their participation in the development process.

Conversely, some researchers have argued that educating women may not necessarily increase agricultural production. They argue that because agriculture is considered a low status occupation, the more women are educated the more they will more away from agriculture. Accordingly, investing in education should be structured in a way that women are motivated to like agriculture.

3.4.9 Women and Nutrition

Nutritional losses due to traditional methods of food preparation in some areas are reported albeit not supported by empirical evidence. Women are not equipped with nutritional knowledge (World Bank 1993c), which is exacerbated by the high illiteracy rates. Women's lack of knowledge on food and nutritional needs of the household members hinders full access to the food requirements. To increase the intake of micronutrients, the World Bank (1993c) suggests that governments can play an effective role through nutrition education measures to mothers.

Some studies have found the nutritional intake of women and children to suffer most in times of food scarcity. Children and women suffer disproportionately from micronutrient deficiency (World Bank 1993c; ACC/SCN 1997). The World Bank (1993c) reports that 450 women in 10,000 suffer from protein deficiency compared to 400 men and 458 women suffer from iron deficiency compared to 238 men, globally. What could explain such wide disparities in nutritional intake? Toulmin (1991) cites Svedberg (1988) that there is no compelling evidence at the household level of gender bias in SSA as a whole in terms of food intake and nutritional status. Quisumbing *et al.* (1995) concur with Svedberg on the existence of gender bias in food intake, which is stronger in South Asian countries than in SSA and Latin America.

3.4.10 Are Women a Homogeneous Group?

A tendency of treating women as if they are a homogeneous group is common in most studies carried out on women in developing countries. This is also true with WID approaches designed to integrate women in the development process. Such tendencies fail to give guidance to governments on how best to raise rural women's status. Consequently, uniform intervention strategies to raise the productivity of rural women have been followed and presuppose the impact to be uniform on all women.

Some studies have gone a step further to disaggregate women according to head of the household, that is, as male-headed households and female-headed households[25]. The percentage of female-headed households has varied greatly across regions, countries and localities, ranging from 5 to 40 percent. These figures need to be deciphered cautiously, as some studies (such as Mencher *et al.* 1986; Todaro 1994) are silent on whether female-headed households are *de facto* or *de jure*. *De facto* female-headed household is where the husband is absent for much of the time. *De jure* female-headed household is where the woman has no current husband and is recognised as the head of the household.

Regardless of the definition of female-headed household used, researchers have treated male-headed and female-headed households to be homogeneous groups within themselves. There is a tendency of equating the female-headed household concept to poverty and disadvantaged groups; and some donor agencies and government have equated WID to the female-headed household concept (Peters 1995). It is evident from the available literature that donor agencies and NGOs have tended to promote or sponsor projects for female-headed households, paying less attention to women in male-headed households.

Some researchers (Due and Gladwin 1991) argue that problems of female-headed households, in terms of access to productive resources, are more pronounced than their counterparts in male-headed households. Like Due and Gladwin, Todaro (1994) argues that female-headed households have lower education, lower income and higher fertility. Rosenhouse (1989) argues that poor female-headed households are at a greater economic disadvantage than their counterparts in male-headed households because of their lower earnings and dual nature of their work burden. Does it follow that the female-headed households are more vulnerable to food insecurity than male-headed households? If so, it questions the validity of the argument by some researchers that income in the hands of women is better spent on improving food security than that of a man. Assuming the percentages reported for female-headed households are

[25] See Peters (1995) for a review of the origin of the female-headed household concept.

correct, would targeting women in these households have a significant impact on reducing food insecurity in developing countries?

On the other hand, Gender CG Newsletter (1995) cites studies with contradictory findings. Brown found *de facto* female-headed households in Lesotho, as a group, less poor, as they were receiving remittances from their husbands in South Africa. Russell asserts that the female-headed household category is extremely heterogeneous and not a particularly useful category *per se* for analytical purposes. The tendency to associate female-headed households to poverty is motivated by an eagerness to show the importance of women rather than analytical correctness, Zwarteveen argues. The association of female-headed households with poverty lacks empirical evidence (IDS BRIDGE 1996).

3.5 Agricultural Household Model

Several studies have modelled household food consumption behaviour in SSA for rural and/or urban environments. Some of these studies have been summarised by Teklu (1996). Few studies (for example, Strauss 1984, 1986) have been explicitly aware of the interdependence of consumption and production behaviours especially in rural areas and have employed the agricultural household model.

The empirical agricultural household models have heavily appealed to theoretical frameworks of the new household economics (see section 4.3.1) or Chayanovian household theory (see section 4.3.2) or both. The first empirical application of agricultural household models can be traced back to the work of Lau *et al.* (1978) in Taiwan, which draws heavily on the Chayanovian household theory. Barnum and Squire (1979) were among the first researchers to incorporate the consumption and production aspects of the household into the same model, drawing heavily on the pioneering work of Becker (1965). Low's (1986) model draws upon many aspects of new household economics and Chayanovian theoretical frameworks. This was the first application in Africa. Singh *et al.* (1986) present a collection and synthesis of agricultural household works carried out up to the mid-1980s; theory of agricultural household models and excellent case studies examining a diversity of problems within this framework. The agricultural household models incorporate farmers' interactions with outside markets and are sources of testable implications regarding these interactions (Benjamin 1992). They are powerful tools for both the theoretical analysis of the behaviour of such households, and generation of empirical predictions regarding their response to various policy measures.

A household is assumed as a unit of analysis where all members of a household act as if they were maximising a joint welfare function, faced with a single budget constraint, unified production decisions and pool factors of production especially labour. The household is said to maximise utility subject to a time constraint, production constraint and income constraint (Singh *et al.* 1986, pp.17-18). Roe (1983) notes that these constraints serve to identify the environmental and informational conditions faced by a household. The constraints are then collapsed into a single constraint with the household expenditure on one side and the total income on the other. The expenditure side comprises of expenditure of the household on consumption from its own production, purchased goods and leisure (that is, household purchase of its time in terms of leisure). On the other side of the constraint is the concept of the full income - a concept derived by Becker (1965) in which the value of time endowed by the household is explicitly recorded. Holding constant the full income, the agricultural household demand functions satisfy the usual constraints of the traditional demand theory (Singh *et al.* 1986, p.20).

While income is exogenously determined under the traditional consumer demand analysis, it is determined by the household production activities under the agricultural household model. This implies changes in the factors influencing production activities will change the full income value and hence consumption behaviour. The main distinguishing feature between traditional neoclassical consumption analysis and agricultural household analysis is the inclusion of the profit effect in the latter analysis (Singh *et al.* 1986, p.17). The profit effect ties together the production and consumption activities of the household.

While the advantages of employing agricultural household models are obvious in the peasant economies, some researchers, especially from the feminist movement (such as Katz 1995; Koopman 1991) have criticised these models based on the unit of analysis and underlying assumptions. Firstly, the definition of a household is an intractable theoretical problem especially in developing countries that elicit considerable attention.

Sometimes it is difficult to determine the boundaries of a household especially in those communities where people live in compounds that may or may not reflect production and consumption units (for example, Koopman, 1991 in the case of Cameroon). Equally important is the stability in the composition of the household members, especially if consumption behaviours are to be well understood - as members may leave or join a household any time. Subsequently, researchers need to explicitly define the context in which a household is used in their empirical work, since there seems not to be a general definition of a household that fits all circumstances. A few of the empirical models to date have discussed their definition of a household. May's (1992) study is a prime example where many household production and consumption units were found within one family compound. To overcome this, May (1992) defined a household within a compound as that operating a common field, granaries, consumption and contiguous dwellings. Even in the wake of these may-be definitional problems, a household is still an important unit of analysis as it mediates between the macro policies and individuals.

Secondly, agricultural household models have not escaped criticisms based on the assumptions mentioned above. Some researchers (such as Chiappori, 1988; McElroy and Horney, 1981; Koopman, 1991; Fleming and Hardaker, 1993; Katz, 1995; Alderman *et al.*, 1995) have argued that these assumptions are too restrictive, especially in circumstances where resource allocation happens to be a source of competing interests, conflict and negotiations. This has led some researchers (for example, Fleming and Hardaker, 1993) to doubt the effectiveness of the results derived from this framework in terms of rural development policy making. Concomitantly, a second school of thought has sprung up that focuses on intra-household modelling framework.

These alternative models have the advantage of going beyond the household, and examine the individual behaviour within the household. This is especially important where the burden of risks is not shared equally or there is compelling prevalence of maldistribution of food and other resources among members. However, these models are very demanding in terms of data; they face the difficulty of not being able to observe individual allocation of resources, food and welfare within the household, and fail to incorporate more than two individuals in a model. Additionally, these models fail to acknowledge that, within household, resource distribution is not static (shifts in burden) and also fail to predict the response of the opponent. As much as it may seem true that understanding resource allocation within a household permits a more accurate evaluation of the outcome, it may not influence the social relations among household members. Based on these obvious weaknesses, this study argues that agricultural household modelling framework is still a superior alternative for understanding rural household consumption and production behaviours in developing countries in general and particularly in Africa.

3.5.1 Separable and Nonseparable Agricultural Household Model

There are two approaches of agricultural household modelling which are very much dependent on the functioning of the output and input markets: a separable (recursive) approach and a nonseparable approach. The first generation of agricultural household models assumed separability between production and consumption decisions when studying household behaviour in developing countries. In this case, a two-stage decision-making process is assumed, where production decisions are made first and thereafter followed by the consumption decisions. At stage one, the production outputs and inputs are decided according to their different market prices only, and at stage two, consumption and leisure decisions are made according to their different market prices and to the farm profits earned only. In other words, optimal production choices are made independently of the consumption and labour supply decisions.

The existence of competitive markets for all commodities and factors of production is the strongest assumption of separable models (Strauss 1986). The availability of competitive commodity markets implies that households need not worry about producing for their own consumption. Since, they can always purchase what they need at prices no higher than the opportunity cost of home production and the prices cannot be affected by households' actions. The households are price takers for all commodities. Similarly, for factors of production notably labour, the existence of competitive labour markets implies a household maximises its utility by allocating each household member's labour to market or household production according to that person's opportunity cost in economy-wide labour markets. A household will hire labour up to the point where the marginal revenue product of labour is equal to the market wage rate and the implicit price of family labour is equal to its market price. It further assumes riskless production and zero transaction costs. The discussion depicts how highly restrictive and unrealistic the assumptions of the separable approach are in the rural settings of most developing countries. Studies that have employed a separable model include Strauss (1984, 1986), Kyereme and Thorbecke (1991), Njoku and Nweke (1994), Muller (1994). Some researchers (such as Kyereme and Thorbecke 1991; Muller 1994) have admitted to doing so due to data constraints.

The separable approach has come under criticism by several researchers (such as Singh *et al.* 1986; Delforce *et al.* 1987; Koopman 1991; Ellis 1993) where markets are nonexistent, incomplete or highly imperfect. They argue that the model becomes less useful because choices come to depend on variable rather than uniform prices faced by individual households as well as subjective valuations of some goods and services. Nonexistence of labour markets implies that the household must equate its labour supply and demand according to an implicit or virtual wage determined by all the variables that influence household decision making (Singh *et al.* 1986, p.8). Additionally, Jacoby (1992) argues that the prevalence of gender division of labour that is common among peasant households would definitely violate the assumption of perfect substitutability. Imperfections in the commodity markets, for instance, cause market price differences between buying and selling a commodity that would invalidate the assumption of a household being indifferent between buying and producing that commodity (Delforce 1993). Nonseparability can also arise from the seasonal dimension in production, financial constraints (Iqbal 1986; Coyle 1994) and risks and uncertainties (Roe and Graham 1986; Coyle 1994; Saha 1994).

Accordingly, researchers are continuing to modify the original model to incorporate the nonseparable nature of rural household consumption and production activities. The World Bank (1990) strongly supports this modification in Africa because of the existence of undeveloped or malfunctioning markets for labour, food and household services. Both theoretically and empirically the nonseparable model is beginning to receive attention from researchers. Zindi (1997) and Jacoby (1992) are such studies that have applied the nonseparable agricultural household model.

By contrast, there are some circumstances where application of a separable model is justifiable. Firstly, if the interest is on household consumption activities, Delforce *et al.* (1987) argue that a separable model is adequate, since the production side will be reflected into the consumption model through a profit effect. However, if details of the production activities are of interest it is unreasonable to assume production decisions to be independent of the consumption decisions. Secondly, when data availability precludes application of a nonseparable model. Thirdly, lack of skilled human resources as argued by Roe (1983) and Fleming and Hardaker (1993) to carry out a complete agricultural household model. This is exacerbated by a wide gap between researchers and policymakers. Taking all this into account, despite the merits of the separable approach as suggested by Singh *et al.* (1986) and Lyne (1988), there are situations where justification of the approach is difficult. Muller (1994) suggests that the fragility of the separable approach hypothesis in developing countries, where consumption from own production is common and the length of the day not fixed, be taken seriously.

While the nonseparable model is beginning to receive attention of researchers, there is the issue whether the specification of an agricultural household model should follow a primal or dual approach. Most empirical studies have adopted the primal approach since the dual approach requires sufficient variations in prices. Lopez (1982) argues that a dual approach permits one to empirically test the theory of the agricultural household models and to explicitly derive econometrically the estimating equations from the theoretical model, thus preserving the links between the theoretical model and the estimating equations. Coyle (1994) discusses the merits of the dual approach over a primal approach to the specification of the production side of the agricultural household model when separability is assumed. The application of linear duality theory to nonseparable agricultural household models assuming the nonexistence of the labour markets is also discussed by Coyle (1994). He contends that the dual approach has greater advantages over the primal approach in the theoretical specification of many nonseparable models than in the case of separable models. This study argues that the approach to be used is an empirical issue. The researcher has to clearly establish what s(he) wants out of the model. For instance, is the interest in detecting the significant variables or making predictions to test the household theory?

3.5.2 Modelling Procedures

Modelling the Consumption Side

a) Demand Systems Specification

Estimation of demand equations as a system explicitly derived from consumption theory dates back to the works of Stone (1953). Since then different specifications and functional forms have been proposed and applied by researchers. Specification of demand equations as a system of equations is continuing to receive a wider application (see, for example, Pollak and Wales 1992). The empirical agricultural household models (such as Strauss 1984, 1986; Njoku and Nweke 1994) have employed a system of demand equations rather than single demand equations, which are derived from a class of flexible functional forms.

There are three general categories of the demand systems. First, there are demand equations that are derived from an indirect utility function of specific functional form using Roy's identity, such as the Quadratic Expenditure Systems (QES) and Logarithmic Linear Expenditure System (LLES). Second, there are the demand equations that are derived from first-order conditions for constrained utility maximisation, from a direct utility function of specific functional form, such as the Linear Expenditure Systems (LES). Lastly, there are the demand equations that are not related to any particular utility function, such as the Almost Ideal Demand Systems (AIDS) and New Working Lesser model for food consumption analysis.

The first generation of agricultural household models estimated the consumption side using the LES (such as Barnum and Squire 1979; Hardaker *et al.* 1985) and the LLES (Adulavidhaya *et al.* 1983/84) which are very restrictive as they assume linear Engel curves. That is, they portray the demand for a good to be a linear function of prices and expenditures. Linearity implies that the marginal shares are independent of the level of expenditure, such that spending the extra dollar on each good is the same for both rich and poor households. A household whose demand system is LES is often described as first purchasing subsistence quantities of each good and then dividing the remaining expenditure among the goods in fixed proportion. Lau *et al.* (1978) applied the LES and admitted to the stringent restrictions imposed by the homogeneity assumption that the total expenditure elasticity of demand for each commodity be identically one. Equally important is the failure of the LES to permit inferior foods mainly eaten by poor households and also failure to permit substitution or complements across foods. Accordingly, its application to rural households may yield unrealistic results.

There is now a wider application of less restrictive systems, such as the QES (see Strauss 1986), New Working Lesser model (see Njoku and Nweke 1994) and the AIDS (see Bezuneh *et al.* 1988; Delforce 1993). The QES meets the neoclassical restrictions except for the negative semi-definiteness of the Slutsky matrix. It is parsimonious in parameters, yet less restrictive than the LES and LLES. It allows for quadratic Engel curves and inferior goods (Strauss 1986). Like LES, the QES incorporates minimum subsistence levels, a feature that is relevant for the semi-subsistence farmers in developing countries.

The AIDS developed by Deaton and Muellbauer (1980b) has received a wider application in demand analysis. It has the advantage of being flexible in terms of its properties in estimating price and income elasticities, distinguishing between luxury and necessity goods; and testing the validity of the homogeneity and symmetry conditions through linear restrictions on fixed parameters. It does not impose additive preferences, which is consistent with economic theory. Furthermore, the functional form of the AIDS model is consistent with household budget data by allowing for nonlinear Engel curves and is relatively simple to estimate. Despite its advantages, the AIDS faces an empirical problem of selecting the most appropriate price index to deflate income or expenditure. Several studies have used Stone's share weighted price index to approximate Deaton and Muellbauer's (1980b) translog price index to ensure the system linearity. Some studies have referred to such a system as a linear version of AIDS. Notwithstanding the simplicity in estimation process derived from the use of Stone's price index, Moschini *et al.* (1994) asserts that it is not invariant to changes in the units of measurement for prices and quantities, making the derived estimates questionable. In other words, Stone's price index fails to satisfy the fundamental properties of the index numbers.

Deaton and Muellbauer (1980a) observe that the New Working Lesser model is a variant of the ordinary least squares regression model and relates the value of the budget shares to the logarithm of total expenditure/income. The model is less restrictive than the LES, LLES and QES in terms of using budget shares as dependent variables, which are obviously unitless. Furthermore, it does not assume linear Engel curves, as is the case with the LES and LLES. Clearly, the AIDS specification of Deaton and Muellbauer (1980b) is a modification of the Working Lesser specification. Kumar (1994) seems to have employed the Working Lesser specification in estimating the household consumption function although it is not explicitly stated anywhere in the study.

b) Incorporation of Socio-Demographic Variables

A remarkable feature of the above demand system specifications is the incorporation of demographic characteristics[26], permitting a richer specification. Models based on the traditional consumption theory have also incorporated these characteristics despite their shortcoming of being unaware of the predictive power embedded in the agricultural household models. Theoretically, the incorporation of demographic variables is supported by the household theories discussed in Chapter 4. This accounts for the consumption variability caused by the socio-demographic differences between the households (Strauss 1986).

Incorporating socio-demographic variables into the demand equations has either been direct or indirect. Some empirical studies such as Lau *et al.* (1978), Adulavidhaya *et al.* (1983/84) and Bezuneh *et al.* (1988) included the demographic variables in the utility function as separate arguments. Including these characteristics in a direct manner implies that they will be independent variables in the demand equations as well as in utility functions. Discussion of the estimation problems associated with this approach is presented in the latter sections.

Indirect methods of incorporating the demographic characteristics in the household utility functions have been discussed by Pollak and Wales (1980, 1981, 1992) and Prais and Houthakker (1971). The indirect approaches include demographic translating, demographic scaling, adult equivalent scales, Gorman procedures and modified Prais-Houthakker. The first two have dominated where agricultural

[26]These characteristics also include the socioeconomic characteristics of the household.

household models have been applied and are the ones discussed further. These are general procedures for incorporating demographic variables in the sense that they do not assume that the original demand system has a particular functional form. The demographic translating (scaling) introduces translation (scaling) parameters into each original demand system and postulates that only these parameters depend on the demographic variables. The parameters are commodity independent. In the case of the demographic translating procedures, everywhere the full income appears in the utility function and the demand systems, the value derived from the multiplication of the translation parameters by prices of the goods is deducted. In other words, the effect of household characteristics comes through the full income. Unlike the translation procedure, the scaling procedure introduces the scaling features into the original demand systems in a distinctive manner. Everywhere, the prices that appear in the utility function are multiplied by the scaling parameters and the full income remains the same as it was in the original functions. In other words, the effect of household characteristics comes through the prices. Demographic translation preserves the linearity of the system whereas demographic scaling is a highly nonlinear specification.

To complete the specification, a functional form relating the translation (scaling) parameters to demographic variables must be postulated. Pollak and Wales (1980, 1981, 1992) postulate a linear demographic translating (scaling) functional form. Strauss (1986) employs the demographic translating procedure to enter the household characteristics into the demand systems and assumes a linearly homogeneous specification for the translation parameters. Barnum and Squire (1979) use a linear translation to enter the characteristics. Unlike Strauss, Savadogo and Brandt (1988) incorporate the demographic structure into demand analysis through demographic scaling and assume a log-linear functional form for the scaling parameters. The demographic translating methodology has been widely employed by some researchers because of its flexibility and simplicity. It allows subsistence parameters of the demand systems to depend on the demand variables (Pollak and Wales 1981, p.1534).

Besides the demographic characteristics as emphasised by the Chayanovian household theory and the new household economic theory, incorporation of other socioeconomic variables is observed. Such as the household general characteristics of the head of household (such as Hardaker *et al.* 1985) or women (such as Wolfe and Behrman 1983; Ward and Sanders 1980) or both. For the few food demand studies where characteristics of women are explicitly included, some variations in what each characteristic measures are noted. For instance, education of a woman is used as a proxy for efficiency in the household production theory (for example, Wolfe and Behrman 1983) and as a proxy for taste differentials (such as Ward and Sanders 1980; Njoku and Nweke 1994). In human capital models, education of a woman is used as a proxy for efficiency in the market activities (such as Kyereme and Thorbecke 1991); and by the World Bank as a proxy for empowerment.

Like the case of a firm, economies of scale have featured in nutrition or food consumption studies. The household models have incorporated household size to measure such scale effects in consumption. The magnitude of the household size with respect to nutritional intake is important. Some studies treat constant returns to household size as a maintained hypothesis by incorporating average per capita income or expenditure as an explanatory variable (Behrman and Wolfe 1984, p.109). This is too restrictive and has been rejected in studies such as Wolfe and Behrman (1983) and Ward and Sanders (1980).

c) Disaggregation of Households

Disaggregation of households into more homogeneous socio-economic groups is now a common feature of most models (Waterfield 1985). There is evidence that changes in exogenous factors impact differently on different segments of households. Disaggregated estimates provide useful information to policymakers on the direction and extent of the exogenous effects. They also assist in identifying the beneficiaries and losers from the suggested policy reforms and in designing cost-effective targeted interventions. This implies that the parameters necessary for such intervention must be determined for each disaggregated category. Most studies have categorised households according to income or expenditure (such as Strauss 1986), geographical location and income (such as Alderman and Garcia 1993) to name a few, including studies that employed a descriptive analysis. Disaggregation presents a big challenge to policymakers, politicians and donor agencies, who have treated and still are treating women as a homogeneous group in the decision-making process.

d) Dependent Variable Issue

A remarkable variant in previous studies is related to the issue of the dependent variables used for food consumption. The use of commodity budget shares or expenditures as dependent variables, which has its origin in the Engel's curve, has dominated such studies particularly by economists. By contrast, nutritionists have used nutritional intake as a dependent variable which is consistent with the new household economics theory. With either approach, the impacts of changes in exogenous variables on the nutritional intake can be derived. The former method is termed by Behrman and Deolalikar (1987, p.496) as an indirect expenditure approach and the latter as a direct expenditure approach. Kumar (1994), Ramezani *et al.* (1995), Alderman and Garcia (1993) have employed the direct approach. Strauss (1984, 1986) has employed the indirect approach. It uses a demand model to identify the determinants of food choice and in turn caloric intake. Food choice is central to this method, providing implications concerning nutritional intake. Behrman and Deolalikar (1987), Bouis and Haddad (1992) and Teklu (1996) report wide variations in the income elasticities estimated from both approaches. Hence care must be taken in selection and justification of either approach must be well spelt out.

e) Aggregation across Commodities

Considerable variations in aggregation across commodities are observed across previous empirical models. Commodity aggregation is one of the fundamental aggregation problems in consumer studies (Muellbauer 1975). Muellbauer argues that such a problem is solved theoretically by the imposition of separability restrictions on direct or indirect utility functions. With a single commodity, the aggregation problem does not arise. Studies where a single food item has been considered include Barnum and Squire (1979), Lau *et al.* (1978) and Hardaker *et al.* (1985) and Zindi (1997).

In studies where households consumed a variety of foods, aggregation of some kind has been inevitable. The food items have been either aggregated into a single aggregate food item or into different aggregate food items according to specific food groups. Adulavidhaya *et al.* (1983/84) aggregated 29 food items into a single aggregated commodity. Aggregation of a variety of foods consumed into a single aggregate group precludes the insights to be gained from the analysis of policy measures that strive to mitigate adverse effects of inadequate food intake. Strauss (1984, 1986) aggregated food items into five aggregated commodities (that is, rice, root crops and other cereals, oils and fats, fish and animal products, and miscellaneous foods); and Bezuneh *et al.* (1988) aggregated food items into seven commodities (that is, sorghum, maize and beans, meat, milk, eggs, fish and other foods). These food items were converted into either their nutritional equivalents or their expenditure terms.

Unfortunately, no systematic food grouping criteria seemed to prevail among the available empirical studies. Food aggregation has been research -, area - or regional - specific, ranging from nutritional grouping to the food position in the overall household consumption patterns. Although aggregation mitigates the problem associated with estimation of a large demand system, Deaton and Muellbauer (1980a) caution that choice of food groups should not be taken lightly. For instance, Ramezani *et al.* (1995) suggest that food groups based on a nutritional grouping must yield enough information on the nutrient content of foods to accurately represent the nutrient consumption of households. Aggregation of nonfood items into a single aggregated commodity is common to all previous studies.

Modelling the Production Side

Modelling production activities is more complex than consumption activities. In most developing countries it is rare to find a household involved in a single production activities. Some engage in multicrop production or livestock rearing or a combination of both. The seasonal variations, mixed cropping, continuous harvesting and risks and uncertainties that characterise a household's production activities renders the modelling exercise to be a complex task. Most empirical application has concentrated on the crop production activities paying no attention to the livestock/poultry production activities.

The first generation of agricultural household models considered a single crop on the production side, which is very unrealistic for those households engaged in a variety of productive activities. Data constraints on the productive activities have partly led to application of very restrictive functional forms such as Cobb-Douglas and Constant Elasticity of Transformation functions. With increasing availability of data on productive activities, studies are beginning to employ more flexible functional forms such as the Translog and Generalised Leontief. The output supply and factor demand functions have been derived either directly from specification of production function or indirectly from a profit function. Derivation of output and factor demand functions from a profit function is indicative of increasing application of duality theory. The profit function specification is less restrictive than a production function. Adulavidhaya *et al.* (1983/84) specified a normalised restricted profit function approach with a single commodity rice, Barnum and Squire (1979) specified and estimated a single crop function for rice production directly, and Hardaker *et al.* (1985) specified a single commodity, rice, directly using a Cobb-Douglas production function.

Unlike the first generation of agricultural household models which considered a single crop, Singh and Subramanian (1986) extended the model to accommodate multicrop output on the production side. This is a valid and more realistic extension in many SSA countries where semi-subsistence farmers grow a variety of crops. Strauss (1986) modelled a multicrop production function for Sierra Leone. Data inadequacy hindered the practical estimation of a separate production function for each crop. Instead, outputs were aggregated using a Constant Elasticity Transformation function and the inputs for all outputs were aggregated into total labour, total capital and total land.

Some researchers have included total time available to the household in a direct manner and others (for example, Strauss 1986) have modelled it as being dependent on household characteristics. The indirect approach assumes total time to be endogenous to the household. Few studies such as Jacoby (1993) and de Janvry *et al.* (1992) explicitly took into consideration the gender division of labour in developing countries. To derive more reliable results, the prevalence of gender division of labour in most African societies and time allocated to domestic chores by women need be taken seriously in modelling household behaviours.

As with consumption activities, the assumption of separability is inevitable given the variety of crops produced by rural households. The problem usually encountered is the fact that input data are never available by crop and this is compounded by mixed cropping which is predominant especially in Africa. The commonly used method of aggregation in production analysis involves aggregation of output and input into separate groups, a method followed by Strauss (1986).

3.5.3 Estimation Procedures and Techniques

The separable approach has received a wider empirical application while application of the nonseparable approach is still limited. The estimation of the separable model implies that the production side is estimated first and the results are then used in estimating the consumption side of the model. On the other hand, the estimation of the nonseparable model implies the production and consumption sides of the agricultural household model are estimated simultaneously as a system of equations.

Simplicity in estimation and interpretation (Singh *et al.* 1986), and being conceptually tractable and lending themselves to econometric estimation (Lyne 1988) have led to a wider empirical application of the separable approach. For instance, fewer parameters need to be estimated for each model, which is especially important if the equations are nonlinear in parameters. Singh *et al.* (1986) assert that nonseparability affects the empirical agricultural household modelling by changing the comparative statics and rendering statistically inconsistent the usual demand and supply parameter estimates. Like Singh *et al.* (1986), Muller (1994) affirms the introduction of econometric problems due to the size of the vector of parameters and the likely endogeneity of some explanatory variables when a nonseparable approach is used. On the contrary, Lopez (1986) argued that the non-availability of powerful software packages to run the nonseparable models by then rendered their estimation difficult.

Studies employing a nonseparable approach have used econometric techniques to derive parameter estimates. By contrast, where the separable approach has been employed, econometric techniques have dominated the consumption side and linear programming the production side of the model. Studies such as Adulavidhaya *et al.* (1983/84), Hardaker *et al.* (1985), and Strauss (1986) have employed econometric techniques to estimate the production side of the model. In contrast, studies such as Bezuneh *et al.* (1988) and Delforce (1993) have applied linear programming techniques. Critics such as Singh and Subramanian (1986) argue that linear programming neglects the interdependence of household decision-making between consumption and production that characterises rural farms. On the contrary, it has proved to be a better option where price data lacked variations, some of the households did not produce some of the crops and inadequacy in the range of data available on explanatory variables.

Estimating the agricultural household model using a separable approach would imply the error terms on output supply and factor input functions to be uncorrelated with those of the demand systems. However, correlation between the commodity demand equations is necessary given the fact that the adding-up property has to be satisfied. To satisfy this property the errors, or a linear combination of them, must add up to zero for each household. The assumption of a constant covariance matrix for disturbance terms is less appropriate for expenditure demand equations and entirely inappropriate for quantity demand equations (Pollak and Wales 1992).

Estimating demand equations as a system rather than as a single equation is advantageous in the sense that economic theory can be used in imposing parameter restrictions. In other words, estimating the equations as a system accounts for the cross-equation parameter restrictions, which occur because the equations are derived from a common optimising problem. Incorporation of these restrictions improves the statistical efficiency of the estimates. Furthermore, estimating the demand equations as a system permits the testing of hypotheses about various commodity aggregation groups according to alternative separability rules.

The estimation procedures commonly used in agricultural household models are the Zellner's Seemingly Unrelated Regression (ZSUR[27]) and the Maximum Likelihood Estimation (MLE) procedures. Despite the fact that both procedures provide estimators that have asymptotic properties, the ZSUR procedure seems to be favoured. The former assumes no autocorrelation within the equations but cross-equation correlation does exist. The Iterative version of Zellner's Seemingly Unrelated Regression (IZSUR) estimation procedure has also received wider application in estimating nonlinear demand equation systems. It is an extension of ZSUR; the former updates the estimates of variance-covariance matrix (Ω) and iterates Zellner's

[27] Also known as Seemingly Unrelated Regression (SUR) or Minimum Chi-Square Estimator.

procedure until changes from one iteration to another are negligible. The IZSUR is said to yield numerically equivalent parameter estimates as the MLE for linear equation systems. The Three-Stage Least Squares (3SLS) method has also received a wider application, especially in circumstances where some explanatory variables are also endogenous to the system.

Studies such as Ramezani *et al.* (1995) and Bezuneh *et al.* (1988) have applied the iterative, nonlinear seemingly unrelated regression procedure and nonlinear seemingly unrelated regression method by studies such as Fan *et al.* (1995). The maximum likelihood estimation has been used in studies such as Hardaker *et al.* (1985), and the generalised least squares in studies such as Lau *et al.* (1978). Savadogo and Brandt (1988) estimated an AIDS using OLS on the assumption that there is no cross correlation between the equations. Some researchers (for example, Njoku and Nweke 1994) are silent on the estimation procedure used. On the production side, Hardaker *et al.* (1985) and May (1992) estimated the single crop Cobb-Douglas production function using OLS procedure. Zindi (1997) employs Two-Stage Least Squares (2SLS) and 3SLS to estimate a nonseparable agricultural household model for smallholders in Zimbabwe.

While researchers continue to apply estimation techniques with asymptotic properties, there are other estimation problems yet to receive their attention. The most obvious is the singularity problem when a full system of equations is estimated in a share form. Generally speaking, this has been taken care of by most studies, which involves dropping one equation from the system to be estimated. The dropped equation parameter estimates are easily derived from the $n-1$ equations estimated in the system. Whereas some researchers deleted the equation at random, other researchers (such as Hardaker *et al.* 1985) used an elimination method based on the performance of the individual demand equation. Using a random approach, the parameter estimates have been proved by Barten (1969) to be invariant in some instances with respect to the deleted good equation. This is a major advantage of MLE over a two-step Zellner type procedure for which the estimates depend on the choice of deleted good equation provided serial correlation does not exist. The findings of Capps Jr (1983) and Berndt (1991) concur with Barten's that the parameter estimates derived from using the MLE procedure are invariant to the deleted equations. If autocorrelation does exist, IZSUR will yield more efficient parameter estimates than the MLE and also be invariant with respect to the deleted equations (Capps Jr 1983). Thus, random dropping of an equation from a system seems to depend on whether the chosen procedure is invariant with respect to the deleted equation.

Yet to receive attention is, firstly, the problem of zero production and/or consumption by some households. This is a theoretical problem (Sahn 1988; Heien and Wessells 1990; Ramezani *et al.* 1995) in the sense that theoretically demand/production is constrained to be non-negative (see, Chapter 4 section 4.1.1). If error terms are added to the system of equations, a large number of zero values in the equations will bias the estimates of the coefficients. These error terms will have a nonzero mean and will not be normally distributed. This has been empirically proven by Heien and Wessells (1990, p.370) who found the bias to be proportional to the probability of a limit observation. However, some empirical agricultural household models so far estimated (for example by Bezuneh *et al.* 1988) are silent on how this problem was overcome in their studies.

Researchers in general have applied different methods to minimise the consequences of zero consumption or production problem. These include some sample selection bias-correction procedures that rely on the notion that consumers do not consume a particular commodity because market prices exceed their reservation prices (Heien and Wessells 1990). This can be carried out using a two-stage procedure for estimating the parameters. This involves combining two separately specified functions. The first is a binary choice model such as probit or tobit. The dependent variable is 'consumes or does not consume' or 'produces or does not produce' a commodity in question. These models are more efficiently estimated by using MLE than any other estimation method. The results from the binary choice model are then used to derive the inverse of Mill's ratio which is included among other explanatory variables as an instrumental variable in the second stage specified model of the demand or production systems. Strauss (1986) applied a tobit approach for the production side and employed numerical maximum likelihood techniques to estimate the equations in the second stage.

Some researchers such as May (1992) have followed an *ad hoc* procedure of deleting all observations with zero consumption or production, or restricting the sample to households with nonzero, consequently reducing the sample size. As Battese (1997) argues, such an approach conceals information on households with zeros that may be useful in the estimation of parameters which are common to all households. Studies such as Jacoby (1992) have transformed the original production/consumption function by adding a constant greater than zero, which is arbitrarily chosen. Battese (1997, p.250) asserts that incorporating a dummy variable associated with the incidence of zero observations as one of the explanatory variables makes it possible to derive efficient estimators by using the full data set. While refuted by Ramezani *et al.* (1995), this study argues that consistent aggregation across commodities could, to some extent, lessen the impact of zeros on the parameter estimates.

The second is the derivation of weighted group prices for the corresponding commodity groups. The common practice is to assume households to be faced with the same price for the same commodity. These prices are then weighted by the share of a household expenditure (that is, household specific weights) in a particular food to the weighted group prices. Cautiously, Singh *et al.* (1986) assert that such an approach is bound to introduce spurious variations in prices and may suffer from the endogeneity problem. Strauss (1986) overcomes this problem by using regional average weights rather than household specific weights and Jacoby (1992) uses village level media prices.

It is a common practice in econometrics to test the significance of the parameter estimates and to test any restrictions that may be imposed on the parameters. Most empirical studies have not gone beyond testing the significance of the parameter estimates. However, the many assumptions made in modelling the agricultural household models make it necessary to go beyond simply testing the significance of parameter estimates. For instance, the choice of food groups, extent of commodity aggregation, and functional form, influence the overall performance of the empirical food demand model (Ramezani *et al.* 1995, p.530). None of the previous agricultural household models has tested for the validity of the underlying assumptions.

The few studies that have tested the optimisation hypothesis include Lau *et al.* (1978) who also test some of the preferences axioms, for instance, monotonicity, quasi-convexity and symmetry restrictions. Some researchers (Heien and Wessells 1990; Ramezani *et al.* 1995; Bezuneh *et al.* 1988) have imposed the regularity restrictions *a priori*. They argue that it simplifies the elasticity formula, reduces the number of parameters to be estimated, ensures model convergence and preserves the normal properties of the demand theory. However, this should not prevent researchers from testing such restrictions. Because economic theory does not give a hint on the choice of the functional form, it is important to test its appropriateness. The few studies, which have done so, include Lau *et al.* (1978) and Bezuneh *et al.* (1988). Bezuneh *et al.* (1988) uses the Theil Mnoukin Information Inaccuracy measure to assess how well the AIDS specification fits the sample data. Furthermore, theoretical literature provides little guidance concerning how to aggregate commodities without obscuring the economic structure of the household.

While the application of nonseparable agricultural household models is still limited, some tests have been developed to test the validity of the separability assumption. Statistical criteria for testing for the possibility of assuming separability are suggested by Muller (1994) and Lopez (1986, p.315). Jacoby (1992) and Benjamin (1992) present a test of separability that seems to be more appealing than that of Lopez (1986).

3.5.4 Data Implications

The data collection methodologies used by previous studies have varied considerably from sampling technique to sample size. Agricultural household models to date have used cross-sectional data collected at the household level. The household budget surveys conducted by most governments have been a major source of consumption data. These surveys have dominated as a data collection technique because of the low-cost involved as opposed to the alternative, food consumption surveys. Some studies such as Bouis (1994) have empirically demonstrated nutrient-income elasticities derived from using data from household budget surveys to be higher than those derived from food consumption surveys. However, contrary results have been reported by Ohri-Vachaspati *et al.* (1998). In the case of production data, most of these studies have relied on data provided directly by farmers. None of the studies cited above collected production data through the method of crop cutting despite the reliability of production data collected via these method. However, this method is costly. A further problem is encountered where input data are never available by crop and the mixed cropping nature of most farms in Africa.

The major limitation with the cross-sectional data is the lack of price variations, which has in some instances led to estimation of models without a price variable. Clearly, with increasing semi-subsistence farming among rural households, assuming *a priori* that prices are not important seem to be unrealistic. Price variability seems to be related to the sampling technique used in selecting the representative sample. For instance, studies such as Strauss (1986) which drew samples from a wider geographical and temporal diversity were able to capture price variations. However, this is an expensive solution.

Data constraints are among the shortcomings that led some researchers cited above to use a separable agricultural household model. The enormous amount of data required in estimating a nonseparable model as opposed to a separable one should not be taken lightly as the former involves more parameters to be estimated. Increasingly, researchers have found themselves trading sample size against a comprehensive data set with quality. Consequently, estimation of a complete model is rendered extremely difficult with small samples because of the large number of parameters involved. On the other hand, the complexities that surround the production activities noted above are also reflected in inadequacies of data on production. The seasonal cropping patterns, continuous harvesting and mixed agricultural practices also pose problems in the collection of reliable and adequate data.

Equally important is the timing and frequency of surveys at the household level. Data on consumption and production need to be collected during the same time and on the same households (Singh *et al.*, 1986). This is particularly important if a complete model is to be estimated. However, in reality this may not always be the case, especially in African countries where inadequate resources are earmarked for data collection and data are only collected when there is a need especially from donor agencies. The study by Adulavidhaya *et al.* (1983/84) used household consumption and production data collected from two different regions over different periods. The estimation of the models was done under a very restrictive assumption that the households in both regions had the same utility function.

Other researchers such as Strauss (1986) and May (1992) used production data collected for a single season and consumption data on the same households. This further raises the issue of the validity of results based on a single season. Single period production data set may fail to lead to effective policies depending on whether the surveys are conducted over, say, a good or bad farming season. In other words, this precludes capturing the seasonal dimensions. This is also true for consumption data if collected only through a single cross-sectional survey. This makes it difficult to incorporate the time dimension, which is a core in understanding household food security.

Clearly, data availability is still a major hindrance to a wider application of nonseparable agricultural household models. However, this should not muffle the breakthroughs in data achieved since the mid-1980s when researchers believed that it was impossible to estimate such a model for developing countries in general and in particular Africa. In this study it is surmised that with more breakthroughs more and more consistent and efficient parameter estimates will emerge through nonseparable models. The massive data requirements and data collection costs involved in the intra-household modelling framework not only preclude conducting regular surveys but also limit the sample size. Thus, in terms of data requirements this study makes no suggestions for other better alternatives modelling framework for understanding household food security other than the agricultural household model, at least in the short run.

3.6 Concluding Remarks

The main emphasis of this chapter was to review literature on food security at the household level, the role of rural women in Africa, modelling procedures and estimation techniques that will facilitate the examination of the impact of changes in women's entitlements on household food security in Uganda.

While progress in global per capita food availability has been reported since the World Food Conference of 1974, the number of undernourished persons is on the increase, especially in SSA and South Asia. The food insecurity problem in SSA is alarming, given its natural resources, abundant labour and land. FAO and IFPRI predict the situation to remain the same by the year 2020 unless more investment is undertaken in the agricultural sector. Efforts have been taken to improve the situation but have been ineffectual because symptoms rather than causes, including the low status of women, are being addressed.

Although most governments have recognised their role in the development process, little has been put into practice. Even the shift from WID to GAD has had little impact on the status of women, especially in rural areas. This is partly due to the fact that most strategies suggested have their roots in the WID perspective rather than the GAD perspective. This explains the slow rate in policy reforms toward reducing gender biases. Improving household food security through improving the status of women is not an easy task. Rural women as a group are not homogeneous. There is a need to identify the constraints and needs that prevent these women from fully realising their role according to their socio-economic status.

There has been a shift within the objective measures of household food security from only in terms of caloric intake to consider other nutrients; however, the choice of other nutrients remains an empirical issue. It cannot be generalised across localities. Additionally, a shift from objective measures to subjective measures is observed. A combination of these measures would provide more insights into the food insecurity problem than focusing on a single measure.

Despite the continued criticisms of agricultural household models, a wider application of the same has taken place. These models have been applied in investigating the consumption activities and/or production activities and/or labour allocation of the household. The empirical evidence so far has demonstrated that rural households behave rationally. Additionally, significant progress has been made to estimate theoretically consistent parameters. This is obvious from the continued application of flexible functional forms, estimation techniques with asymptotic properties, the duality approach and some improvements in data collection and taking the nonseparable nature of consumption and production activities into account. The flexibility inherent in the original framework is obvious from the diversity of problems that can be handled.

The main weaknesses of the previous studies included the continued neglect of explicit inclusion of women's roles, the prevalence of output and input market failures, and a continued assumption of perfect substitutability between labour of husband's and wives' time, especially in domestic activities. Women in developing countries, in particular in SSA, play a vital role in ensuring household food security via production and consumption. Time is the scarcest productive asset to rural women that they allocate between productive and domestic activities. Consequently, their opportunity cost between these activities has implications that cannot be neglected.

In conclusion, an agricultural model for rural households in Uganda should take into account the following. First, the prevalence of household market failure; second, imperfect substitution between family and hired labour; and the between husband's and wife's labour time. Third, the monetary and non-monetary entitlements should be incorporated. The key players in production and consumption, the women, should be taken into account explicitly by the model. A dual approach will be used as it permits testing of the agricultural household model empirically and explicit derivation of the system of equations from the theoretical model. The theoretical underpinning of the agricultural household model is presented in the next chapter.

4 Theoretical Considerations

In the previous chapters the prevalence of semi-subsistence farming in the rural areas of SSA in general, and Uganda in particular was observed. The theory that will assist in the understanding of the complexities of households in rural Uganda is the subject of this chapter. A review of the consumption theory and production theory that are relevant to this study are presented in sections one and two, respectively. The traditional consumption analysis does not fully explain the rural household behaviour in developing countries nor does the conventional production analysis. A farm household framework that takes account of the interdependence that exists between production and consumption in rural areas is a better way of comprehending such behaviour. The framework has underpinning from the household theories. The new household economics and Chayanovian household theories, which have theoretical underpinnings from consumption and production theories, are considered. The farm household framework is discussed in section three prior to concluding remarks in section four.

4.1 Traditional Neoclassical Consumption Theory

4.1.1 Preferences and Utility Function

In this section a discussion on the axioms of preferences and utility function assumptions is presented. The preferences axioms are important in testing other restrictions imposed by economic theory. A utility function is a concept derived from a consuming unit's preferences that need to be considered in understanding its behaviour.

Assume a consuming unit is faced with a consumption vector of commodities X, where $X=(X^1,X^2,\ldots,X^N)$ and X^i for $i=1,2,\ldots,N$ are complete sub-vectors to choose from. Each sub-vector is assumed to contain various quantities of different food and nonfood items, such as beef, chicken, cassava, orange, clothing, health to name just a few items. Vector X is assumed to satisfy the properties of non-negativity, divisibility and unboundedness. The non-negativity property states that the consumption vector should never have zero components, a property that is hardly ever satisfied especially when the consuming unit is a household. A consuming unit is assumed to have preferences over X, that are needed to order the sub-vectors. These preferences have axioms that must be satisfied; however, some axioms are more important than others and there are some that have very little economic content. The consumer is further assumed to be faced with a vector of prices of the consumed items P where $P=(P^1,P^2,...,P^N)$ and P^i for $i=1, 2, ..., N$ are sub-vector prices for X^i, and the consumer has fixed income M. The prices and income are postulated to be exogenously determined. The notation $\supseteq$ stands for the preferences to be 'at least as good as'; $\subseteq$ stands for 'strongly preferred'; and $\approx$ stands for 'indifferent'. A discussion of some axioms follows.

a) Completeness

For any two sub-vectors X^i and X^j for $i \neq j \in X$, either $X^i \supseteq X^j$ or $X^j \supseteq X^i$ or both. This implies the consuming unit would prefer sub-vector X^i with more nutritious food compared to X^j, be indifferent if both contained the same nutritional value or prefer sub-vector X^j with more nutritious food compared to X^i. That is, a continuous path exists that connects the sub-vectors X^i and X^j. The completeness axiom implies that any two sub-vectors can be compared. A consuming unit is said to be able to rank its preferences across different bundles for its nutritional well being.

b) Transitivity

For any sub-vectors if $X^i \supseteq X^j$ or $X^j \supseteq X^k$ then $X^i \supseteq X^k$ for $i \neq j \neq k \in X$ implying that preferences are transitive. However, there are circumstances when transitivity fails, especially when a consuming unit is a household where decisions are made by majority rule (Al-Najjar 1993). The transitivity axiom is at the centre of the theory of choice and has greatest empirical content of those axioms responsible for the existence of preferences (Deaton and Muellbauer 1980a, p.27). It is a necessary axiom for the discussion of preference maximisation (Varian 1992, p.95) and necessary for non-intersection of the indifference curves.

c) Reflexivity

This axiom implies that each sub-vector in X is as good as itself. That is, $X^i \supseteq X^i$ for $i \in X$. This axiom implies weak preferences.

d) Continuity

For any sub-vector, $X^i \supseteq X^j$ and $X^i \subseteq X^j$ for $i \neq j \in X$ are closed, containing their own boundaries. This axiom rules out any discontinuous consumer behaviour. The axioms (a) - (d) are sufficient to have the preferences ordering represented by a continuous utility function $U(X^i)$. This implies that if preferences $X^i \supseteq X^j$ it is equivalent to $U(X^i) \supseteq U(X^j)$ and vice versa. The utility function is a convenient way of representing preference orderings.

The locus of all sub-vector combinations from which the consumer derives the same level of satisfaction forms an indifference curve. Given the above standard axioms, the indifference curve is characterised by a negative slope since more of the commodity is preferred to less, higher indifference curves represent greater levels of satisfaction than lower levels and, if $X^i > X^j$ then $U(X^i) > U(X^j)$ and hence the indifference curves can never intersect. The slope of the indifference curves represents the marginal rate of substitution of, say, X^i for X^j.

In addition to the above standard axioms, there are other axioms and assumptions which are necessary for the existence of a well-behaved utility function. These are presented in the next subsections.

e) Convexity

For any sub-vectors, X^i and X^j for $i \neq j \in X$, if $X^i \supseteq X^j$ then, $\lambda X^i + (1-\lambda)X^j \supseteq X^j$, for all $0 < \lambda < 1$. Convexity implies that an individual consumer prefers averages to extremes. For instance, a consuming unit would prefer a balance of nutritious foods to extremes (for example, where foods are richer in one nutrient and deficient in others may lead to health problems). For the preferences to be strictly convex implies that the linear combination must be strictly preferred to X^j. If weak preferences are convex then the underlying utility function is said to be quasi-concave. That is, if $U(X^i) \supseteq U(X^j)$ then, $\lambda U(X^i) + (1-\lambda)U(X^j) \supseteq U(X^j)$ for all for $0 < \lambda < 1$. For empirical application, utility functions have been assumed to be strictly quasi-concave. The $\supseteq$ in the linear combination is replaced by $\supset$. This is translated from preferences, which are strongly convex. A strictly quasi concavity assumption of the utility function restricts the shape of the indifference curves. It also ensures that the constrained utility maximisation solutions are unique.

f) Monotonicity

The definition of monotonicity applies if there is pre-ordering $\geq$ defined on the consumption vector X. Pre-ordering assumes that the transitive and reflexive axioms are satisfied. Thus, if $X^i \geq X^j$ then $X^i \supseteq X^j$ for $i \neq j$ and $i, j \in X$. This is usually referred to as weak monotonicity. If X^i has more nutritious foods than X^j, a rational consuming unit would prefer X^i to X^j. It says that, as much of everything is at least as good. Likewise strong monotonicity is defined such that if $X^i \geq X^j$ and $X^i \neq X^j$, then $X^i \supset X^j$ for $i \neq j \in X$. It says that at least as much of every good and strictly more of some good is strictly better. In the real world, this may hold only up to a certain point. The implication of this axiom for indifference curves is that they have a negative slope.

g) Local Nonsatiation

For any sub-sectors X^i and X^j for $i \neq j \in X$, if X^i contains at least as much of every commodity as in X^j and more of at least one commodity as X^j, then $X^i \supseteq X^j$. That is to say, a consumer will be a little bit better off with more of each nutritious food to less. The foods are regarded as goods rather than bads.

i) Differentiable Preferences and Utility Function

Since a utility function is a concept derived from preferences, it follows that differentiability of a utility function requires differentiability of the preferences. Satisfaction of the strong monotonicity and strict convexity axioms is necessary for the preferences to be differentiable. Translated into a utility function, this implies the function satisfies the continuity, strict monotonicity and strict quasi concavity assumptions. The utility function is said to be twice continuously differentiable if all its second-order partial derivatives exist and are a continuous function of X^i. The first-order partial derivatives are assumed to be strictly positive, that is $U_x > 0$ (where, U_x represents a matrix of first order derivatives). That is, the marginal utilities are positive. The second partial derivatives $U_{xx} \leq 0$, that is, the diminishing marginal returns are negative. To attain maximum utility, the second-order condition as well as the first-order condition must be satisfied. The second-order condition for a constrained utility maximum function requires the relevant bordered Hessian determinant to be positive (negative, that is, diminishing marginal utilities) and this is satisfied by the strict quasi concavity assumption of the utility function. This assumption ensures that the second-order partial derivatives are satisfied at any point at which the first-order partial derivatives are satisfied. However, Barten and Bohm (1982) argue that strict quasi concavity is not strong enough to obtain everywhere differentiable demand functions and hence instead suggest strong quasi concavity.

j) Homogeneity and Homotheticity

A utility function is said to be homogeneous of degree k if $U(tX^i) = t^i U(X^i)$ for an arbitrary scalar $t > 0$ and k is a constant. The partial derivatives of a function that is homogeneous of degree k are homogeneous of degree $k-1$. A utility function is said to be homothetic if $U(X^i) = f(g(X^i))$ where f is a strictly increasing function and g is a function which is homogeneous of degree k. A homothetic function is a monotonic transformation of a homogeneous function but the utility functions are defined up to a positive monotonic transformation. Therefore, if preferences are assumed to be represented by a homothetic utility function, it is equivalent to assuming that they can be represented by a function that is homogeneous of degree k. In most cases k is taken to be either zero or one. Little distinction exists between homogeneity and homotheticity in utility theory (Varian 1992). In the case of a homothetic utility function, the rate of commodity substitution depends upon relative rather than absolute commodity quantities.

While the validity of some of the axioms of preferences are not questioned in most consumer theory, they do present assumptions that are subject to empirical tests such as the transitivity axiom. Notwithstanding its central role in the discussion of preference maximisation and hence existence of a demand function, transitivity as an axiom has elevated contentions among economists. For instance, Sonnenschein (1971) proves the existence of a demand function using only the convexity, continuity and completeness axioms without imposing the transitivity axiom. Studies by Kim and Richter (1986), Vilks (1992) and Al-Najjar (1993) concur with Sonnenschein.

However, Moldau (1996) demonstrates how the convexity axiom implies a relatively weaker form of transitivity such that the transitivity axiom cannot be dropped as an axiom in demand theory. This suggests that the assumption of convexity by the studies cited above implicitly impose the transitivity condition. Despite its weaknesses, transitivity as an axiom of preferences cannot be dropped otherwise the utility function will cease to exist.

The validity of the transitivity axiom as a necessary axiom for the non-intersection of two indifference curves has also received attention from economists. Some economists have argued that transitivity is a necessary but not sufficient axiom, others (such as Van-Marrewijk 1993) as not a necessary but sufficient axiom, and the rest (for example, Varian 1992) have remained silent on the issue. Van-Marrewijk attributes such differences partly to the various definitions of indifference curve.

The discussion above assumes a consuming unit faced with choosing between the sub-vectors which may contain the same commodities but in different quantities. However, a consuming unit, apart from being faced with a choice between sub-vectors, is also faced with the choice among the commodities within the sub-vector. The axioms and assumptions above also apply for the choices within the sub-vector. Thus, the discussion that follows concentrates on the choices within the sub-vector. For simplicity let a consumer be indifferent between the above sub-vectors, that is, $X^i \approx X^j$ for $i \neq j \in X$. For the given prices and income, the consuming unit is faced with choosing the optimal quantities of the commodities at a given income. Let $P^i = (p_1, p_2, \ldots, p_m)$ and $X^i = (x_1, x_2, \ldots, x_m)$ be individual commodity prices and quantities, respectively. A consuming unit acts so as to maximise the monotonic, continuous, strictly quasi-concave and differentiable direct utility function. If the direct utility function $u(X^i)$ is strictly quasi-concave and twice differentiable, then the maximisation of utility subject to a linear budget constraint is formulated as in Eq. 4.1.

$$(4.1) \qquad \max_{X^i > 0} \; u(X^i) \quad \text{subject to} \quad P^i X^i \leq M$$

Given the local nonsatiation assumption the budget constraint is formulated with equality. Hence Eq. 4.1 can be rewritten as in Eq. 4.2.

$$(4.2) \quad \underset{X^i>0}{Max} \quad u(X^i) \quad \text{subject to} \quad P^i X^i = M$$

Solving a primal model in Eq. 4.2 involves a constrained optimisation problem where the Lagrangian techniques are used to derive the Marshallian (uncompensated) demand equations. Maximisation implies that the ratio of the marginal utilities between any two commodities must equal the ratio of their respective prices. Stated differently, this is a point where the indifference curve is tangential to the budget line. In addition, the marginal rate of substitution between any two commodities is equal to their price ratios irrespective of the utility function chosen to represent the underlying preferences. Derivation of demand equations from direct utility functions becomes complicated, especially when multiple commodities are consumed. This has led researchers to opt for less complicated procedures like the dual approach.

Duality theory has received a wider application in production and consumption theories over the primal approach. The proponents of duality theory (for example, Lopez 1986; Coyle 1994) argue that a system of demand equations in the case of consumer theory can be easily derived that is consistent with utility maximisation. Analogously, a system of output and factor input demand equations that are consistent with profit maximisation behaviour could be easily derived. Duality theory postulates that a one-to-one dual mapping exists between utility maximisation and expenditure minimisation, and the reverse holds true. Therefore, the corresponding (dual) expenditure minimisation problem for Eq. 4.2 is formulated as in Eq. 4.3, which states that a consuming unit chooses quantities so as to minimise the expenditure necessary to achieve a given attainable utility level u^*.

$$(4.3) \quad \underset{X^i>0}{Min} \quad P^i X^i \quad \text{subject to} \quad u(X^i) = u^*$$

Shephard's Lemma is used to derive the Hicksian (compensated) demand equations. It is worth noting that while in the primal approach the preferences and utility function are defined over quantities as the choice variable, in the dual approach they are defined over prices and u. The Shephard and Uzawa duality theorem for function recoverability states that duality exists between the direct and indirect utility function or expenditure function. The recoverability theorem implies that with either the indirect utility function or the expenditure function, one can easily recover the underlying direct utility function and the reverse holds true. The convexity of preferences discussed previously plays a vital role in recoverability of these functions (Varian 1992). Full recovery of the underlying function cannot be guaranteed if convexity is not satisfied.

Given Eqs. 4.2 and 4.3, the indirect utility function and expenditure function are expressed as in Eqs. 4.4 and 4.5, respectively.

(4.4) $V(P^i, M) = G(M / P^i)$

(4.5) $C(P^i, u) = F(P^i, u)$

The expenditure function and indirect utility function are related: given one the other can easily be inverted to derive the other. The properties of the indirect utility function are that it is non-increasing in prices and non-decreasing in income, homogeneous of degree zero in prices and income, quasi-convex in prices and continuous at non-negative values of prices and income. The properties of the expenditure function are that it is non-decreasing in prices, homogeneous of degree one in prices, concave in prices and continuous in prices. Given the above properties of the indirect utility function, Roy's identity is applied to derive the Marshallian demand equations and the Shepherd's Lemma is applied to the expenditure function to derive the Hicksian demand equations (Varian 1992). Expressed mathematically, the Marshallian demand equations and Hicksian demand equations are given in Eqs. 4.6 and 4.7, respectively.

(4.6) $x_i(P^i, M) = -\dfrac{\frac{\partial G(M/P^i)}{\partial P^i}}{\frac{\partial G(M/P^i)}{\partial M}}$, for i = 1, 2, ..., m

(4.7) $h_i(P^i, u) = \dfrac{\partial C(P^i, u)}{\partial P^i}$, for i = 1, 2, ..., m

Given the relationship between the indirect utility and expenditure functions, the demand Eqs. 4.6 and 4.7 must be the same, that is, $x_i(P^i, M) \equiv h_i(P^i, u)$. The Marshallian demand equations have all the prices and nominal income as explanatory variables whereas the Hicksian equations have all the prices and real income. In the former, the coefficient of the price is not income compensated as with the latter. Thus imposition of cross-equation symmetry in the former is complicated. In the latter, such restrictions are imposed through linear constraints, which is a major computational advantage.

4.1.2 Regularity Conditions in Demand Analysis

Regardless of the different determining variables in Eqs. 4.6 and 4.7, the same optimal consumption quantities are always derived. However, the utility maximisation hypothesis imposes certain observable conditions on these functions. These regularity conditions (also known as the integrability conditions) include adding up, homogeneity and the symmetric negative semi-definite Slutsky substitution matrix. They have empirical implications in terms of elasticities. The adding up property (that is, Engel aggregation) implies that the sum of income elasticities weighted by their respective expenditure shares must equal unity. The homogeneity condition implies that the sum of direct and cross-price elasticities plus the income elasticity for any commodity must equal zero. The demand equations must satisfy these conditions if derived from a utility maximisation problem. Antithetically, demand equations that satisfy these regularity conditions are integrable into a consistent preference ordering. These conditions assist not only in deriving more efficient estimates but also offer hints on the choice of the functional form.

4.1.3 Separability and Two-Stage Budgeting Hypothesis

In the real world, consuming units rarely consume only a few commodities. A wide range of commodities consumed is always reported, creating problems in the estimation of the demand models. To estimate such models, aggregation (grouping) of commodities is among the possibilities[28]. This is particularly the case with flexible functional forms, where the number of parameters to be estimated increases exponentially with the number of commodities that are modelled explicitly. However, this involves making prior assumptions regarding the interaction between the commodities and the nature of the utility function. Consistency in aggregation must be ensured in the sense that the results obtained from demand equations estimated from aggregated data yield the same results as if the equations were derived from the disaggregated data. This poses such questions as under what conditions can this be

[28]Other possibilities include increasing the sample size or narrowing down to a few commodities.

achieved without leading to misrepresentation of a consuming unit's choices, and how is this aggregation procedure defined?

Separability is envisaged to deal with the aggregation problems in consumption and production theory. Varian (1992, p.148) presents a review on Hicksian separability which imposes constraints on the price movements, and functional separability which imposes conditions on the structure of preferences to permit consistent aggregation. The latter, which ensures consistent aggregation within these structures and allows for decentralised decision-making, is the one discussed in the rest of the chapter.

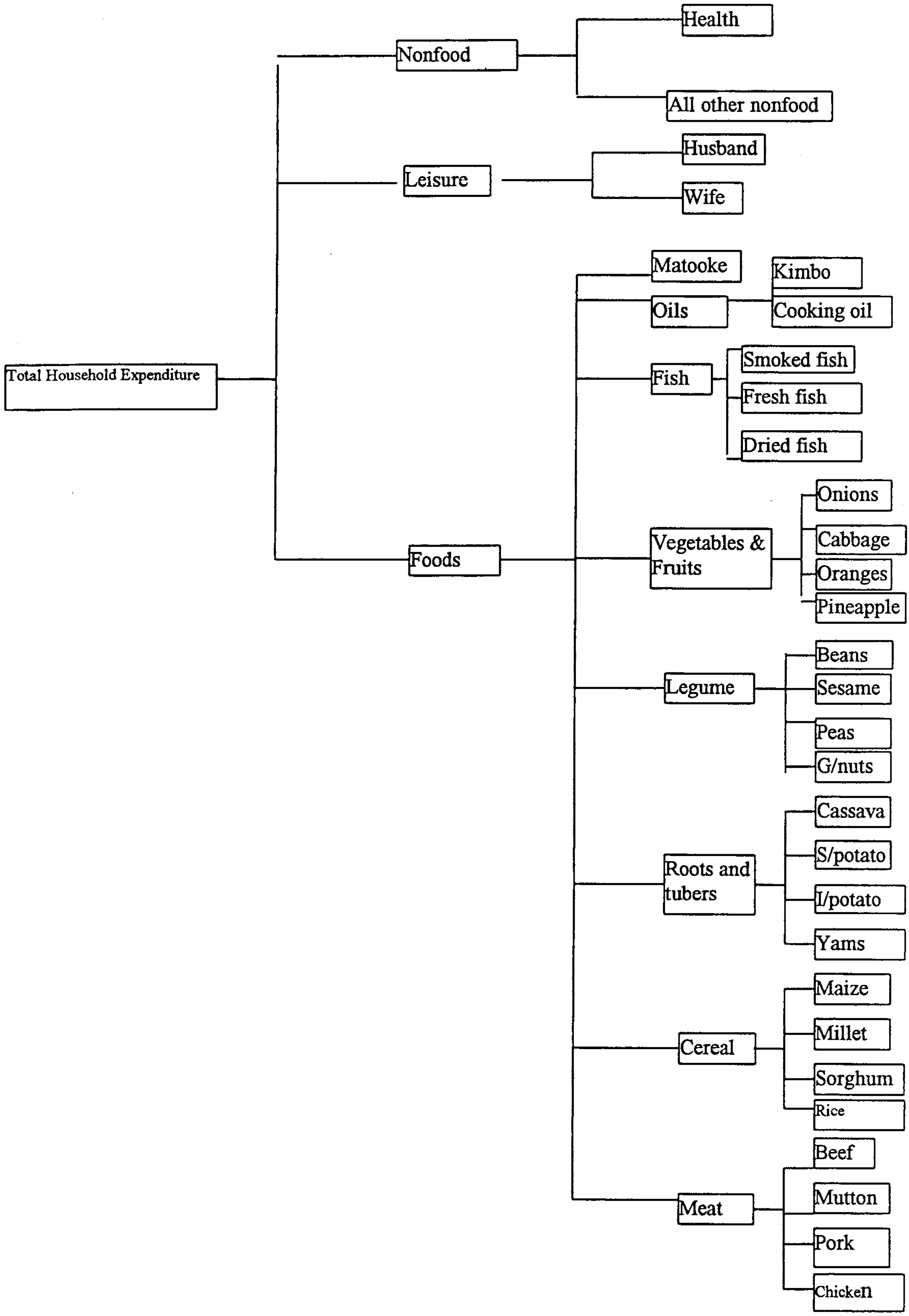
This section discusses separability in consumption theory. Attention needs to be given to selecting among the various definitions of separability as this has implications for model estimation and testing. Separability is a relative concept (Raunikar and Huang 1987) whereby a complete group of commodities is partitioned into mutually exclusive and exhaustive subgroups. Let the m commodities in X^i be partitioned into s $(where \quad s > 2)$ mutually exclusive and exhaustive subgroups. The commodities in each subgroup are indexed as m_s, which implies that $\sum_{i=1}^{s} m_s = m$. Hence the quantities, prices and income sub-vectors can be rewritten as $X^i = (x^1_{m_1}, x^2_{m_2}, \ldots, x^s_{m_s})$, the corresponding price $P^i = (p^1_{m_1}, p^2_{m_2}, \ldots, p^s_{m_s})$ and income $M = (M^1, M^2, \ldots, M^s)$. By way of illustration using the utility tree in Figure 4.1, m commodities include all the commodities at the lowest level before partitioning takes place that make up X^i. Considering food alone, it has been partitioned into seven mutually exclusive and exhaustive subgroups based on their nutritional value.

Given the above commodity partition, the direct utility function in Eq. 4.2 is said to be weakly separable if and only if it can be expressed as in Eq. 4.8.

(4.8) $\quad u(X^i) = H(H^1(x^1_{m_1}), H^2(x^2_{m_2}), \ldots, H^s(x^s_{m_s}))$

For convenience superscript i denoting the sub-vector is dropped. The superscript on the right-hand side of the equation denotes a vector of commodities in the s^{th} subgroup; the subscript m_s as defined before; $H^s(.)$ are sub-utilities that depend on a subgroup x^s; and $H(.)$ is the total utility of the sub-utilities. $H(.)$ and $H^s(.)$ are

Figure 4.1 Utility Tree



assumed to satisfy the conditions required for a well-behaved utility function such as strong monotonicity, strict quasi concavity and twice differentiability. The utility function in Eq. 4.8 is expressed in a non-additive manner. Stated differently, a utility function is said to be weakly separable if and only if every marginal rate of substitution between any two commodities i and j from the same subgroup is independent of the quantities of the commodities from other subgroups. This is algebraically expressed in Eq. 4.9. For instance, from Figure 4.1 considering the meat and root and tubers subgroups, it implies that the marginal rate of substitution between chicken and beef is independent of the cassava quantities consumed.

$$(4.9) \quad \frac{\partial(H_i^s / H_j^s)}{\partial H_k^t} = 0, \text{ for all } i, j \in x^s, k \in x^t, s \neq t \in X$$

Two-stage budgeting hypothesis that dates back to the work of Gorman (1958) is extensively applied in empirical applications. It postulates that at stage one, a consuming unit allocates its expenditure to a broad commodity group, and the second-stage allocates group expenditures among commodities. Here, allocations within groups are only determined by the subgroup price vector $p_{m_s}^s$ and subgroup expenditure M^s. Both allocations have to be perfect in the sense that results of the two-stage budgeting must be identical to what would occur if allocation were made in one step with complete information.

Separability of preferences and the two-stage budgeting process are related in that weak separability is both a necessary and sufficient condition for the second-stage of the two-stage budgeting process. The demand functions derived in the second-stage are referred to as conditional demand functions (on group expenditure) and inherit the properties of utility maximisation discussed previously. The other subgroup prices $p_{m_{s-k}}^{s-k}$, for $s \neq k$, influence demands for $x_{m_s}^i$ only through changes in the optimal levels of the subgroup expenditure M^s. Thus, weak separability is required to ensure the existence of the conditional demand functions. However, this has been criticised on two grounds. First, the first-stage expenditure allocation among the partitioned subgroups is left unspecified and, secondly, the presupposed endogeneity of the group expenditures poses econometric estimation problems (LaFrance 1991). On the contrary, Moschini *et al.* (1994, p.61) argue that these limitations can be overcome if the weak separability restrictions are built into the full demand system.

As previously discussed, separability of preferences imposes restrictions on behaviour that limit the possible substitution effects between commodities in different groups. The empirical implication of direct weak separability as expressed in Eq. 4.9 is that it imposes severe restrictions on the degree of substitutability between commodities in different subgroups. That is, the off-diagonal term in the Slutsky substitution matrix is proportional to the income derivatives of two separable commodities. Algebraically, (see Goldman and Uzawa, 1964, p.562; Deaton and Muellbauer 1980a, p.128) this is expressed as in Eq. 4.10.

$$(4.10) \quad S_{ik} = \Theta_{st} \frac{\partial(x_{m_i})}{\partial M} \bullet \frac{\partial(x_{m_k})}{\partial M} \quad \text{for } i \in x^s, k \in x^t \text{ and } s \neq t$$

where S_{ik} is the Slutsky substitution effect when the quantity of the i^{th} commodity in subgroup s is adjusted as a result of a change in the k^{th} price in subgroup t; Θ_{st} summarises the interrelation between the subgroups, say, meat, and roots and tubers subgroups. Eq. 4.10 implies that the compensated effects of price changes of commodities in other subgroups are felt only through the reallocation of expenditures among the subgroups as discussed above.

If preferences are represented by the indirect utility function V, then to be indirectly separable given the above partition they can be expressed as in Eq. 4.11.

$$(4.11) \quad V(P^i, M) = G(G^1(M / p^1_{m_1}), G^2(M / p^2_{m_2}), ..., G^s(M / p^s_{m_s}))$$

where $G^s(.)$ is quasi-convex, continuous and non-increasing and $G(.)$ is quasi-concave, continuous and increasing. The empirical implications imposed on the Slutsky substitution by Eq. 4.11 can be expressed as in Eq. 4.12 (see Pudney 1981, p.563).

$$(4.12) \quad S_{ik} = \Theta_{st} x_{m_i} x_{m_k} + x_{m_i} \frac{\partial(x_{m_i})}{\partial M} + x_{m_k} \frac{\partial(x_{m_k})}{\partial M}, \text{ for } i \in x^s, k \in x^t, s \neq t$$

If preferences are represented by the expenditure function C, then quasi separability given the above partition can be expressed as in Eq. 4.13.

(4.13) $C(M,u) = F(F^1(p^1_{m_1},u), F^2(p^2_{m_2},u),...,F^s(p^s_{m_s},u);u)$

where $F^i(.)$ is quasi-convex, continuous and non-increasing and $F(.)$ is quasi-concave, continuous and increasing. The empirical implications of Eq. 4.13 that it imposes on the Slutsky substitution matrix can be expressed as in Eq. 4.14.

(4.14) $S_{ik} = \Theta_{st} x_{m_i} x_{m_k}$, for all $i \in x^s$, $k \in x^t$, $s \neq t$

The discussion above concentrated on consistent aggregation of commodities, but not on derivation of a consistent price index for the separable commodity subgroup. Price aggregation bears different implications from aggregation over commodities (Blundell 1988, p.18). The former imposes stronger restrictions than the latter. Weak separability *per se* is not a sufficient condition for price aggregation (Blundell 1988, p.20). It only becomes a sufficient condition when preferences are posited to be homothetic within each subgroup. To consistently aggregate prices requires the sub-utility functions of the commodities to be aggregated to be homothetic.

Considering the utility tree in Figure 4.1 and for simplicity let *m=2*. Generally speaking, the demand for all food items will depend on the prices of all food and nonfood items and on total expenditure *M*. However, with two-stage budgeting hypothesis the demand for food will be influenced by the price of food and food expenditure, that is, $x^1 = f(p^1, M^1)$. Food expenditure, however, is not endogenous to the consuming unit and ignoring this fact leads to biased parameter estimates. The expenditure on food (M^1) depends on all prices and total expenditure as expressed in Eq. 4.15.

(4.15) $M^1 \equiv p^1 x^1 = f^1(p^1, p^2, M)$

Assuming the sub-utility functions $u^1(.)$ and $u^2(.)$ to be homothetic, then the corresponding expenditure functions are $u^1.c^1(p^1)$ and $u^2.c^2(p^2)$, respectively. Thus, the food expenditure in Eq. 4.15 can be rewritten as in Eq. 4.16.

(4.16) $M^1 \equiv p^1 x^1 = f^1[c^1(p^1), c^2(p^2), M]$

Combining the idea of preferences being homothetic and positing homothetic functional forms for expenditure functions $C^1 = u^1.c^1(p^1)$ and $C^2 = u^2.c^2(p^2)$, the indirect utility function (see Blundell 1988, p.21) is given in Eq. 4.17. This is also known as the Gorman generalised polar form.

(4.17) $V^1(.) = \frac{M^1}{c^1(p^1)}$

The estimating food demand equation can be derived from Eq. 4.17 and the functional forms of $c^1(p^1)$ and $c^2(p^2)$ can be used in Eq. 4.16.

4.2 Traditional Neoclassical Production Theory

A review of production theory, which has many similarities with consumption theory discussed above is the subject of this section. Consider a general constrained multicrop production transformation function (implicit production function) given in Eq. 4.18.

(4.18) $T(Y, L; F) = 0$

where $T(.)$ is a vector function, $Y = (y^1, y^2, ..., y^m)$ vector of m outputs, $L = (l^1\ , l^2, ..., l^n\ )$ vector of n variables and F is a t-dimensional vector of quasi-fixed inputs, such as land. This is a restricted technology where some of the inputs are fixed in the short run. $T(.)$ is a set of all feasible outputs, variable and quasi fixed inputs. It is assumed to be a nonempty, compact and convex set, strictly increasing in Y and strictly decreasing in L. Let the corresponding output and input prices vectors be denoted as $Q = (q^1, q^2, ..., q^m)$ and $W = (w^1, w^2, ..., w^n)$, respectively. The explicit multi-crop production function of Eq. 4.18 can be expressed as in Eq. 4.19:

(4.19) $Y = f(L; F)$

where $f(.)$ is said to be finite, non-negative, real-valued, and single-valued for all non-negative and finite L. Under the assumptions made on $T(.)$, the production function in Eq. 4.19 is assumed to have the following standard properties.

4.2.1 Properties of the Production Function

a) Concavity

The function $f(.)$ is said to be concave if for any l^i and l^j, $i \neq j \in T$, $f(g(l^i) + (1-g)l^j) \geq g.f(l^i) + (\lambda - g).f(l^j)$ for $0 \leq \lambda \leq 1$. This property holds if a production technology is subject to diminishing marginal rates of transformation of outputs for inputs, increasing marginal rates of substitution of output for output and diminishing marginal rates of substitution of inputs for inputs (Diewert 1973, p.286). That is, the input requirement set (that is, all input combinations capable of producing output level *Y*) is convex. If $f(.)$ is twice continuously differentiable, concavity implies that the Hessian matrix of $f(.)$ is negative semi-definite. This in turn implies that the diagonal elements of the second-order partial derivatives matrix of $f(.)$ is positive. If the input requirement set is said to be strictly convex, then $f(.)$ is said to be quasi-concave if ≥ in the above linear combination is replaced by >.

b) Monotonicity

For any $l^i \geq l^j, i \neq j \in T$, then $f(l^i;F) \geq f(l^j;F)$. This is referred to as weak monotonicity. Monotonicity implies that additional units of any input can always yield some non-negative amount of additional outputs. Translated into a production function, this property says all marginal productivities are positive. For strict monotonicity, ≥ is replaced by >.

c) Continuity

$f(.)$ is said to continuous everywhere. This property is required to ensure that a production technology does not allow discontinuous behaviour.

The above properties of the production function will hold when the input requirement set is closed and non-empty for all $Y > 0$. A set is closed if it contains all its boundaries and non-emptiness requires that there is some feasible way of producing any given level of output. These are both weak mathematical regularity properties that cannot be contradicted by empirical data (Wall and Fisher 1988, p.384). All inputs must be strictly essential as to have interior solutions.

Standard production theory assumes certainty and profit maximisation as maintained hypotheses (Wall and Fisher 1988). The section that follows, therefore, presents a brief review of that part of multicrop profit maximisation that is relevant for this study.

As in the case of consumption theory, duality theory also plays a crucial role in production theory. Because of the advantages intrinsic in duality theory, most applied production analysis has adopted a profit approach rather than a production approach when inferring the underlying technology. The profit function approach specification is less restrictive than a production function approach. Duality exists between a production function and a profit function provided that these functions satisfy some regularity conditions. If duality exists between a production function and a profit function, the structure of the production function can be inferred directly from the profit function. Given the assumptions on $T(.)$ and Y, a dual restricted multi-output profit function is said to have the following properties. It should be strictly non-decreasing in output prices and non-increasing in input prices; convex and continuous in output and input prices; positively linearly homogeneous of degree one in output and input prices; the profits should never be negative; and the twice differentiable and Hessian matrix is positive semi-definite. The restricted multi-output profit function is expressed as in Eq. 4.20.

(4.20) $\pi(Q,W;F) = Maximise\ Q.f(.) - WL$

Then the output supply and factor input functions are derived using Hotelling's Lemma. The rate of product transformation for every pair of output holding the levels of all other outputs and all inputs constant must equal the ratio of their prices. The rate of technical substitution for every pair of inputs holding the levels of all outputs and all other inputs constant must equal the ratio of their prices. The value of the marginal product of each input with respect to each output is equated to the input price.

4.2.2 Regularity Conditions in Production Analysis

The standard properties of the production function $f(.)$ *per se* are not restrictive enough in most applied production analysis (Chambers 1988, p.36). Consequently, in modelling of the production technology some regularity conditions are imposed on the structure of the production technology. These include homogeneity, homotheticity, separability and jointness.

a) Homogeneity and Homotheticity

The implicit production function in Eq. 4.18 is said to be homogeneous of degree t when all variable and quasi fixed inputs are increased by the same proportion λ and all outputs increased by the proportion λ^k (Lau 1972, p.282). This can be expressed mathematically as Eq. 4.21.

(4.21) $T(\lambda^t Y, \lambda L; \lambda F) = 0$, for $0 < \lambda < 1$ and $t > 0$

Therefore, the underlying production technology is said to be almost homogeneous of degree t in outputs. Wall and Fisher (1988) cite Aczel (1966) that almost homogeneous is a generalisation of the standard homogeneous property to accommodate quasi-fixed inputs. They suggest that the scale effect may not necessarily be the same for all outputs. The same implicit production function is said to be homothetic if it is expressed as in Eq. 4.22, where g(.) is a monotonic transformation of G.

(4.22) $T(g(Y,L;F),L;F)=0$

If the underlying technology is homothetic and twice differentiable, the corresponding profit function can be expressed as a linearly homogeneous function of the output prices and a single input price. This implies by Hotelling's Lemma that the profit-maximising input ratios are independent of the output prices. The corresponding profit function can also be expressed as a production of an aggregate input price and a function homogeneous of degree zero in the output prices and the aggregate input price.

b) Separability in Production Theory

Under consumption theory it was noted that separability and the two-stage budgeting hypothesis are related. This also holds true in the case of production theory. A two-stage decision process in production theory is formulated explicitly in terms of hypothetical constructs of aggregate outputs, which are to be distributed among their components in the second stage (Coyle 1993). This differs from the two-stage budgeting in consumption theory discussed previously.

Like consumption analysis, separability is inevitable in some circumstances in production analysis. The problem usually encountered in estimating an agricultural production function is that input data are never available by crop and this problem is compounded by mixed cropping which is predominant in developing countries, in particular SSA. In other circumstances, the inputs used in production are numerous (Chambers 1988, p.41). The commonly used method of aggregation in production analysis involves aggregation of outputs and inputs into separate groups (such as in Strauss 1984).

Consider equation Eq. 4.18 above. Let the outputs and variable inputs be partitioned into s and t mutually exclusive and exhaustive subgroups, respectively, that is, $Y = (y^1_{s_1}, y^2_{s_2}, \ldots, y^s_{s_m})$, $L = (l^1_{t_1}, l^2_{t_2}, \ldots, l^t_{t_n})$. Consequently, if $T(.)$ is said to be direct weakly separable then Eq. 4.18 is expressed as in Eq. 4.23.

$$(4.23)\quad T(g^1(y^1_{s_1}, y^2_{s_2}, \ldots, y^s_{s_m}), g^2(l^1_{t_1}, l^2_{t_2}, \ldots, l^t_{t_n}); F) = 0$$

where the $g^i(.)$ are sub-transformation functions. As is the case with consumption theory, the sub-functions are assumed to be homothetic.

While the notion of direct weak separability on $T(.)$ relates to the possibility of partitioning inputs and outputs in the transformation function, indirect weak separability refers to the structure of the profit or cost functions dual to $T(.)$ (Sckokai and Moro 1995). Comparable to the utility function, the separable structure of $T(.)$ has implications for the substitutability of the outputs and inputs belonging to different subgroups. The marginal rate of technical substitution between inputs belonging to the same subgroup is independent of all inputs in other subgroups. Likewise, the marginal rate of transformation between two outputs belonging to the same subgroup is independent of all outputs that are not elements of that subgroup.

The restricted multi-output profit function is said to be weakly separable in input prices if the profit function assumes the general form of:

$$(4.24)\quad \begin{aligned} \pi(Q,W;F) &= \pi(Q, \pi^1(Q,W;F), \pi^2(Q,W;F), \ldots \pi^t(Q,W;F)) \\ &\equiv \pi(Q, h(w^1, w^2, \ldots, w^n); F) \end{aligned}$$

Weak separability of the profit function in input prices implies that (see Chambers, 1988, p.152) derived factor demand ratios within subgroups are independent of input prices from other subgroups, as expressed in Eq. 4.25.

$$(4.25)\quad \frac{\partial}{\partial w^z}\left(\frac{\frac{\partial \pi(.)}{\partial w^i}}{\frac{\partial \pi(.)}{\partial w^j}}\right) = 0 \quad i, j \in I^r, z \notin I^r$$

The empirical consequence of weak separability in input prices is that all factor demand elasticities (ξ) in a given subgroup are equal (Chambers 1988). This is expressed algebraically in Eq. 4.26.

(4.26) $\xi^{iz}(Q,W;F)=\zeta^{jz}(Q,W;F), i,j\in I^r, z\notin I^r$

Likewise, the empirical implication of weak separability of a restricted multi-output profit function in output prices is that all supply elasticities of all outputs in a given group with respect to a price from another subgroup are equal.

Weak separability of the restricted multi-output profit function in output prices and input prices implies that the underlying technology is homothetically separable in outputs and inputs, respectively. Consequently, analogous aggregate output and input quantity indices exist and are homogeneous of degree one in their components. The above profit function assumes that the multi-crop outputs are produced by a production function which is joint in input quantities.

Production studies have mostly assumed strong separability between inputs and output (Wall and Fisher 1988, p.390). Strong separability implies weak separability but the reverse is not true, especially if there are more than two partitioned subgroups.

c) Jointness in Production Technology

There are several definitions of jointness. The commonly used definition is that of Lau (1972, p.287). The production function is nonjoint in inputs if there exist individual production functions $f_i(.)$ such that $y_i = f_i(l_{i1}, l_{i2}, \ldots, l_{im})$ and $l_j = \sum_i l_{ij}$ implying:

(4.27) $T(y^1, y^2, \ldots, y^m; l^1, l^2, \ldots, l^n) = 0$

For instance, rural households can jointly allocate male and female labour to the production of output such as maize and beans. A necessary and sufficient condition for nonjointness in inputs is that the profit function be additively separable in output prices of the form:

(4.28) $\pi(.) = \sum q^i \pi_i\left(\frac{W}{q^i}\right)$

where π_i is the individual profit function for the i^{th} output and the rest of the variables are as defined before. Applying the envelope theorem, nonjointness in inputs is equivalent to :

(4.29) $\dfrac{\partial y^i}{\partial q^j} = 0, \text{for } i = j$

On the other hand, the production function is nonjoint in outputs if there exists an individual input requirements function v^i such that $l_j = v^i(y_{1j}, y_{2j}, \ldots, y_{nj})$ and $y_j = \sum_i y_{ij}$, implying:

(4.30) $T(y^1, y^2, \ldots, y^m; l^1, l^2, \ldots, l^n) = 0$

A necessary and sufficient condition for nonjointness in outputs is that the profit function be additively separable in input prices of the form

(4.31) $\pi(.) = \sum w^i \pi_j \left(\dfrac{Q}{w^i}\right)$

where π_j is the individual profit function for the j^{th} inputs and the rest of the variables are as defined before. Applying the envelope theorem, nonjointness in outputs is equivalent to

(4.32) $\dfrac{\partial l^j}{\partial w^i} = 0 for j = i$

The discussion so far has concentrated on a unit of analysis as either a consumer or producer *per se* that cannot explain the behaviour of rural households. In developing countries, Uganda inclusive, where households are postulated to be both consuming and producing units, a theoretical framework is required that has the ability to capture such behaviours. Such a theoretical framework is discussed in the subsequent section.

4.3 Farm Household Theories

Ellis (1993, p.63) presents a critical review of the theories of a peasant household[29] economic behaviour. These theories share a common theoretical foundation and treat

[29]Peasants households are those which derive their livelihoods mainly from agriculture, utilise mainly family labour in farm production, and are characterised by partial engagement in input and output markets which are often imperfect or incomplete (Ellis 1993, p.13).

the household as a single decision-making unit. It is the alteration of certain key assumptions that distinguish one theory from one another. The profit-maximising and risk aversion household theories do not take account of the consumption side of the decision-making process (Ellis 1993, p.105). This obviously disqualifies consideration of these theories in examining rural household food security issues in developing countries. Chayanovian and new household economics theories take into account both the production and consumption sides of the household decision-making process. Households across the world are both producing and consuming units; however, the integration of production and consumption activities into a single unit is strongest in semi-subsistence farm households that predominate in most rural areas of developing countries (Fleming and Hardaker 1993). The application of Nakajima's (1986) subjective equilibrium theory in African countries is limited; however, the original theory on peasant households as presented by Chayanov has some particular relevance (Low 1986, p. 28).

4.3.1 The New Household Economics Theory

In the traditional neoclassical consumption analysis, an individual is postulated to choose a set of goods and services that maximises his/her utility subject to an income constraint. The utility function represents the individual's preference ordering between a range of marketed goods and services, which s(he) can purchase. In such a case, goods and services provide a direct utility to the individual. The traditional neoclassical consumption theory assumes that demand for marketed goods depends only on the prices and incomes of the consuming units. However, numerous non-market socio-economic factors such as time and education have been found to influence consumption decisions. The new household economics theory has extended the applicability of the traditional neoclassical consumption theory and has motivated the inclusion of household socio-economic characteristics via the household production framework.

In the new household economics, the consuming unit, which is the household, is postulated to maximise its utility in terms of goods produced for consumption within the household (Z-goods). The utility function represents a household ordering between a range of final attributes of the home produced goods and services. Lancaster (1966) advanced the incorporation of the goods' attributes other than the goods *per se* in the utility function. The marketed goods and services are inputs (Chambers 1988, p.245; Lancaster 1966) into a process that generates the final attributes that yield utility to the household. For instance, food characteristics could be defined in terms of macronutrients (such as protein, calories, fats), micronutrients (vitamin A, iodine, iron), taste, time required for preparation and consumption. These attributes of food must be produced within the household.

Time is regarded as input into household production. The inclusion of a time constraint originates in the works of Becker (1965) on time allocation in the household. He argues that goods and services are not the only inputs into the home production process, time is also a key input. Becker's model assumes that time is limited and hence has a value, as does any scarce factor. Time is regarded as a human resource that can easily be transformed into market purchasable input to be used in the household production process. The household does not only sell its leisure in the labour market but it can also buy time in the form of certain goods and services. Becker's model suggests that consumers not only allocate income among different products but also allocate time between consuming and work activities. He states that allocations of time within the household to various activities cannot exceed its total available time[30].

Becker's major emphasis is on the allocation of time between home-produced goods and leisure and wage work. However, as claimed by Gronau (1977), Becker's definition of total time does not distinguish between time devoted for home production activities and leisure. This distinction, Gronau argues, enriches the understanding of household behaviour and shows empirically how home productive activities and leisure are affected differently by changes in the socio-economic variables, such as education and the wage rate. Empirical evidence by Gronau found the impacts to be different between husbands' and wives' time. Clearly, Gronau's findings are indicative of the imperfect substitutability between the time of a husband and a wife. It reveals a need to differentiate time allocation by gender.

[30]Total time available can be in terms of a day, a week, a month, or a year.

Additionally, the new household economics theory treats a household as a production unit which converts the purchased goods and services as well as household members' time and household capital into a set of desired attributes yielding utility in consumption. It emphasises the role of household technology in production of Z-goods. Therefore, a household engages in production activities in addition to consumption activities and hence the inclusion of a production constraint in the household model. In such circumstances, the household will not only choose the optimal combination of the home-produced goods but will also choose the best alternative of producing these goods at a minimum cost (Evenson 1981; Deaton and Muellbauer 1980a). A household will, therefore, respond to prices and productivities of the factors of production as they attempt to minimise their cost of production and at the same time maximise utility. The key point about the new household economics theory is that it attempts to combine the theory of utility maximisation by the consumer with the theory of profit maximisation by the firm. Summarising the above mathematically,

$$
\begin{array}{llll}
 & \underset{Z \geq 0}{Max} & U(Z^i) & \\
(4.33) & \text{subject to} & P^i X^i = N + wT^m & \text{budget constraint} \\
 & & T^m + \sum T^i = T & \text{time constraint} \\
 & & Z = f(X^i, T^i) & \text{production function}
\end{array}
$$

where T^m and T^i are the amount of time worked and the time input into the production of Z- goods, respectively; N is non-labour wage; w is the wage rate. $f(.)$ is said to share all the properties of the traditional production function discussed above and must be inferred from household behaviour. However, the budget constraint is directly observable. The money income constraint, production function constraint and time constraint can be combined into a single 'full income' constraint (see Eq. 4.34) under some strong assumptions about the nature of the production function and the value of time. Collapsing the constraints into one implies that if the consumer satisfies this single constraint then s(he) automatically satisfies the individual constraints.

$$(4.34) \quad P^i X^i + wT^i = N + wT \equiv \overline{M}$$

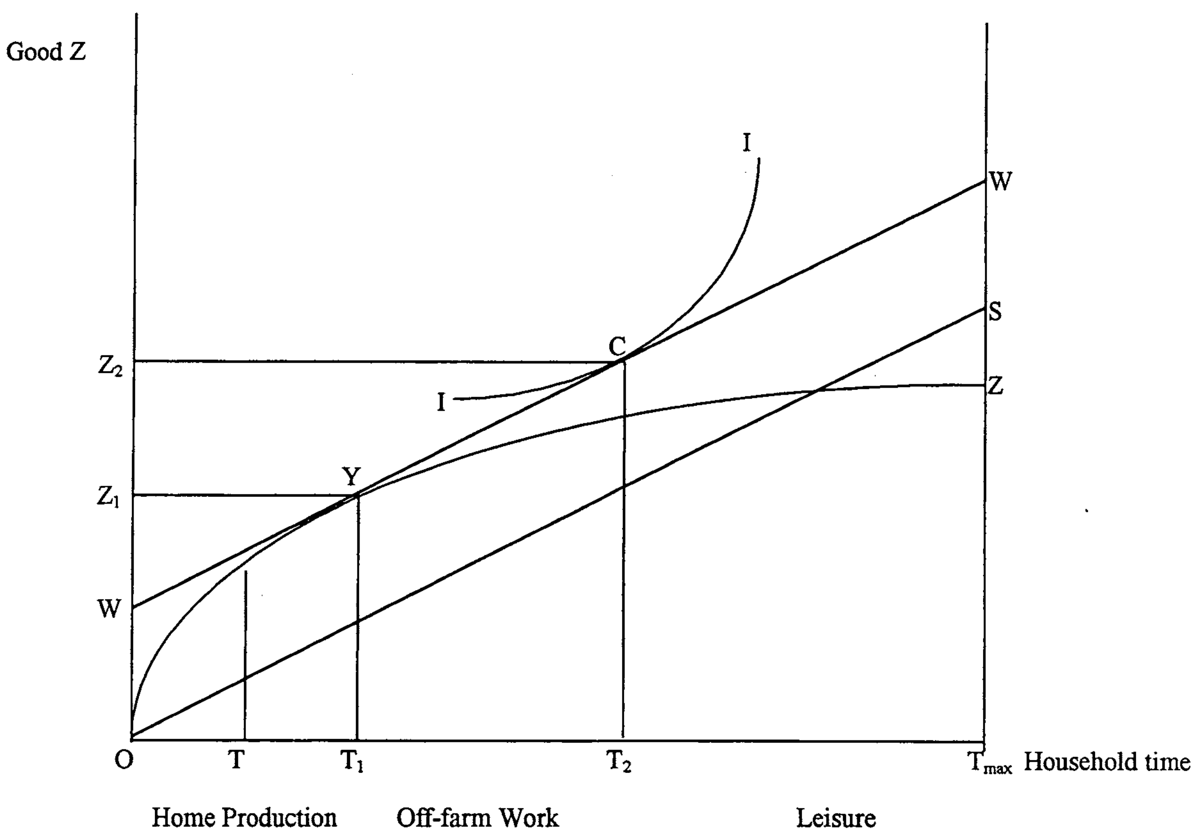
The household's full income $\overline{M}$ equals the sum of any non-labour income and the total time allotment of each household member valued at his or her opportunity cost of time. This full income is allocated to home production activities and through the budget constraint, to expenditure on goods and services in the market place. Income is therefore, no longer constant but depends on the number of hours spent at work. Therefore, money income can be generated by employment in the labour force or from non-labour income. This income is spent either directly on goods X^i or indirectly through forgoing some income by using time for consumption rather than work.

With Becker's model, the household demand for a particular good is dependent on its market price, the prices of other goods, the value of time of household incomes, and the household's full income. The model provides a conceptual framework within which to analyse the consumption patterns including consumption of home-produced goods which are not traded and do not have a market value (Ellis 1993; Low 1986; Evenson 1981). This partly justifies the application of new household economics theory in developing countries where the majority of the rural households produce for own consumption and their produce may not enter the market. Although new household economics assumes perfect information, the predictions of the theory could easily be modified to take into account the nature and impact of the imperfection in circumstances where it prevails.

The graphical representation of the new household economics production model is as shown in Figure 4.2. The production function *OZ* represents transformation of home work time into final home output Z. The household indifference curve is represented by I-I, representing a given level of utility obtained by different combinations of leisure and home production Z. Total time is divided into time for home production represented by distance OT_1, for off-farm work represented by the distance T_1T_2 and for leisure represented by the distance T_2T_{max}. The opportunity cost of time is given by the real market wage (w/p) where w is the money wage and p is the general price level of purchased goods. Line OS, with the slope of w/p, describes the rise in total real income as hours increase. Therefore, point S represents the full opportunity cost of household time obtained by valuing the total hours available (T_{max}) at the real wage. Line ww represents a shifted real wage, representing the opportunity cost of time in terms of market prices.

Point Y represents the equilibrium of the household production of Z and at this point the marginal physical product of home work is equal to the real wage rate. Or stated differently, the equilibrium is reached where the home production function is tangential to the real wage line. At this point, Z_1 units of home production are produced using T_1 units of time. Point C, the equilibrium of the household consumption of Z, is attained. This is where the marginal rate of substitution of leisure for Z is equal to the ratio of the opportunity cost of leisure to the market price, w/p. Stated differently, the equilibrium in consumption is reached, where the real wage line is tangential to the household indifference curve. At point C, home consumption is higher than home production of Z, implying that the household has to hire out labour (of T_2-T_1 units of time) to finance the excess consumption Z_2-Z_1 units of Z through market purchases. On the other hand, a household consuming at point K but still producing at point Y, would need to hire in T_1-T_2 units of time.

Figure 4. 2 Graphical Representation of the New Household Model



The household decisions will change according to changes in wages and general price levels. The time constraint is satisfied by the sum of home production time, off-farm work time and leisure that are depicted along the horizontal line. The money income constraint is satisfied provided the cash outlay on market purchases Z_2Z_1 equals the market wage (w) multiplied by off farm time (T_2T_1). Household full income is given by point S shifted upwards to w to take into account the net product of labour in home production. However, it is assumed in the graphical representation that a complete market of goods and factor markets and production and consumption decisions are made in a recursive manner.

4.3.2 Chayanov's Peasant Household Theory

The Chayanovian household theory suggests that peasants seek to minimise the 'drudgery' of work in production while seeking to satisfy the consumption needs of the household members. Ellis (1993) describes the key assumptions of Chayanov's model as the model of a 'drudgery' averse peasant. It assumes non-existence of labour markets where households can hire in and/or hire out labour; semi-subsistence peasants, who may retain part of their farm produce for own consumption and/or sell part to the market; existence of flexibility in access to cultivable land by all peasant households; and lastly, prevalence of a social norm for minimum acceptable consumption levels for each peasant community. The theory emphasises the impact of household demographic structure (that is, household size and composition[31]) on household economic behaviour via subjective valuation of labour within the household. The model implies that the marginal product of labour is variable between households according to their demographic structure. This contradicts traditional production theory where the marginal labour product is the same between households and equal to the market wage rate.

The household has two opposing objectives, an income objective, which requires work on the farm, and work avoidance, which conflicts with income generation. The main factor influencing this trade-off is the household demographic structure in terms of working and non-working members. Chayanov summarises this factor into a consumer to worker ratio in the household. The higher the consumer to worker ratio, the harder and longer workers have to work to achieve the desired minimum level of

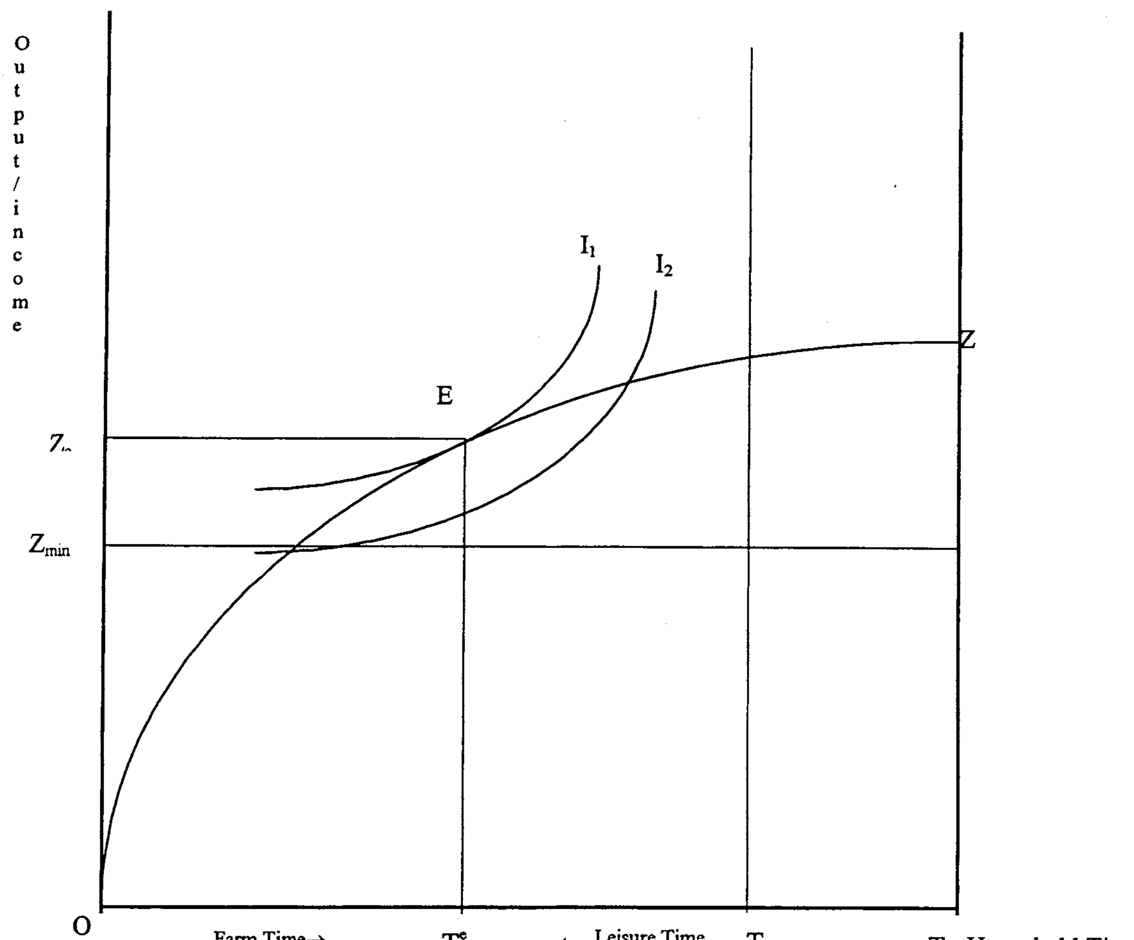
[31]For example age and sex.

output. Among households, members define both the minimum and maximum levels of output that they must produce. They also determine the relative weight attached to leisure versus income in the household utility function and thus the level of household subjective wage. Therefore, Chayanov's model assumes the household to maximise utility subject to three constraints: production function, minimum acceptable income levels and maximum number of working days available (Ellis 1993, p.112). Mathematically,

$$
(4.35)\qquad \begin{aligned} &\mathit{Max} && U = f(Z,T) \\ &\text{subject to} && Z = P_y f(T) \\ & && Z \geq Z_{\min} \\ & && T \leq T_{\max} \end{aligned}
$$

If production is binding, a solution will occur where the marginal rate of substitution of leisure for income equals the marginal value of product of labour. Graphically, the model is shown in Figure 4.3.

Figure 4.3 Graphical Representation of the Chayanovian Model



The graph shows the minimum subsistence output/income constraint which is depicted by the Z_{min} line. Total time determined by the number of workers in the household, which is either allocated to farm work or leisure, is shown by T_{max}. Farm work time is measured from left to right and leisure from right to left. Household production is represented by a production function, describing the response of output to varying levels of labour inputs. It displays the diminishing marginal returns to labour. It can also be interpreted as the household income curve. Unfortunately, flexible access to land cannot be captured by the production function in the above graph. Household consumption is represented by a set of indifference curves (I's), describing given amounts of total household utility provided by alternative combinations of Z and leisure. The slopes of these indifference curves give the household's subjective wage level. The equilibrium will be attained where the total value product is tangential to the indifference curves. The degree of subsistence does not have any influence on the slope of the income-leisure curve or on the equilibrium output and labour use in the household.

Comparing the original Chayanovian household theory with the new household economics, a household is viewed by both approaches as a single consumption or production unit engaged in non-market goods as well as market activities. For family labour, the new household economics assumes different members to have different relative time values in the market and non-market activities, whereas Chayanov assumes a single wage rate. Chayanov and the new household economics both recognise the relevance of demographic structure to production and consumption. The new household economics emphasises changes in the value over time of household members' time and the effect that it has on the pattern of demand for time-intensive versus goods-intensive goods (consumption shifts[32]). On the contrary, Chayanov concentrates on how the structure of the household affects its capacity to supply a household's consumption requirements (Low 1986, p.30). Furthermore, Chayanov discerns labour returns to be limited due to land and capital availability. Unlike the new household economics, the Chayanovian household theory cannot be applied in examining predictions on how households respond to exogenous variables which

[32]The new household economics assumes a zero time value for non-working members of the household since they do not contribute to production. However, these members affect the consumption pattern in the household.

affect production decisions but can be used for predictions concerning the impact of the demographic structure on consumption. To sum up, Chayanovian household theory has some relevance for examining the household economic behaviour in Sub-Sahara Africa.

4.4 Concluding Remarks

Neither the traditional consumption theory nor production theory *per se* can fully explain household behaviour in rural areas in Uganda. The farm household framework that integrates consumption and production behaviour explains such behaviour better. The framework has theoretical underpinnings from consumer and producer theories, and is a suitable paradigm for analysing the impact of changes in exogenous factors on household food security.

With some modifications, the new household economics and Chayanovian household theories can be used to understand the behaviours of rural households in Uganda. The agricultural household models applied so far have attributes derived from more than one theory. These farm household theories, in contrast with the traditional neoclassical economic theory, have emphasised the interdependence between utility maximisation and profit maximisation decisions which arise mainly as a consequence of the existence of endogenous prices of family labour and non-traded goods which are traded within the household. These endogenous shadow prices are dependent on farm production technology, household preferences and prices of traded consumption goods and outputs. It is these prices which are the main link between the production and consumption decisions.

One major benefit of these theories is that they treat the household as a unit of analysis. This is a departure from the traditional neoclassical consumption and production analysis where an individual or firm is considered. The new household economics treats household production as if it is by a firm. It further regards the head of the household as providing a role equivalent to the role of a manager in a firm, with the responsibilities of controlling and organising the household's productive resources. Because of the lack of a formal definition of a household, some researchers have been critical of the treatment of a household as a unit of production, especially in Africa. In examining whether the household is a unit of production, Crehan (1992) argues that it depends on who determines different household members' accessibility, control and organisation of productive resources. Some researchers, especially feminists such as Koopman (1991), have criticised the treatment of a household as a unit of analysis; however, they fail to suggest an alternative.

The household is assumed to have a single joint utility function where working members are assumed to pool their income, labour and fixed assets. Researchers (Koopman 1991; Katz 1994; and Alderman *et al.* 1995) have criticised the joint utility assumptions. Clearly, in terms of nutritional value derived from food consumed, all members would prefer to have more nutritious diets than less nutritious ones justifying joint preferences. The issue of pooling income by household members (Alderman *et al.* 1995) has received strong conjecture from empirical analyses. Whether the household pools income or not, this current study argues, is an empirical issue and area specific.

Both household theories discussed assume comparative advantage to play a role in household labour division. That is, one would employ her/his labour where the opportunity cost of her/his time is less. Unfortunately, comparative advantage fails in SSA countries in general and Uganda in particular, where gender division of labour is prevalent. Rural women in these countries participate more in non-remunerative activities than men not because that is where their comparative advantage lies but because of cultural, social and economic factors. Accordingly, the perfect substitutability of labour fails due to the gender division of labour. The lack of a labour market also implies that these households are faced with a subjective wage.

The household theories discussed above have an advantage over traditional neoclassical models in that they are able to take into account both the production and consumption decisions together. They recognise the importance of non-market activities, which predominate in semi-subsistence economies and the associated time allocation that is neglected in the traditional consumer and producer theories. Consideration of non-market activities and time allocation renders these theories suitable to examine the role of women in household food security. They further recognise the importance of the demographic structures and stress the vital role the household production theory plays in household behaviour.

However, none of these theories' assumptions can fully apply in the rural areas of Uganda. Assumptions have to be borrowed from both theories. The new household economics postulates that the marketed goods and services and time, do not yield utility to the household *per se* - it is their final product attributes which do. It is the final product attributes that enter the household utility function. Therefore, one is justified in arguing that food does *per se* not yield utility but its nutritional value does, assuming other characteristics to be constant. Household food security is commonly measured in terms of nutritional intake, which according to these theories yields utility and can enter the utility function. Unfortunately, new household economics theory in particular fails to give information on whether the Z-goods depend on the Z-good prices or the marketed good prices.

The semi-subsistence peasants assumed by the Chayanovian theory and the non-existence of labour markets have some relevance to rural Uganda's situation as previously discussed in Chapter 2. However, flexible access to cultivable land, as assumed by Chayanov, is not at all applicable to Uganda's rural areas given the existing land tenure system. Land is fixed in most cases, or even reducing in size due to rapid population growth and land degradation. In the case of rural women it is even worse, since most of them gain access to land through marriage, which access ceases on divorce or death. It further ignores the importance of domestic chores for absorbing a large proportion of women's time, resulting into low utility attached to additional income. This also applies to the new household economics, where time allocated to domestic chores is not separated from leisure. The next chapter discusses the data used in the empirical estimation.

5 The Data: Toward Model Development

In the preceding chapter the theoretical framework was discussed and suggested addressing household food security via household production theory. However, the available data from official sources especially from household budget surveys were inadequate for examining household food security in rural Uganda. Thus, fieldwork was carried out to gather data for the study. The data collection methods used and limitations of the data are presented in section one. The method used to transform the raw data into a more useable form is discussed. A brief descriptive statistical analysis of the data is the subject of section two. This section is important in its own way that it gives a feel for the data and at the same time facilitates the choice of the model. Tests were carried out to examine whether there were significant differences in the means for selected variables within and across districts. The figures in the parenthesis are the actual numbers of occurrence unless stated otherwise. Concluding remarks are presented in section three.

5.1 Data Collection Methodology, Problems and Transformation

5.1.1 Pre-testing the Questionnaire

The structured questionnaire was pre-tested with a pilot survey that was conducted on 20 randomly selected households in the villages of Nkambo, Senene and Kwata, in Muduma sub-county, Mawokota county in Mpigi district. The pilot survey was conducted for two days. This exercise assisted in modifying and improving the questionnaire and training the field research assistants.

The field research assistants had the right mix of intelligence and knowledge of how to deal with respondents in the rural setting. These assistants had been exposed to data collection exercises during their Bachelor of Statistics degree course training and grew up in the rural areas. Uganda as a country has over 30 ethnic groups speaking different languages. This is also true at the district level. Therefore, to overcome the language barrier problem, it was imperative to employ assistants who were also fluent in the local languages. Like in the actual surveys, editing of the questionnaire was carried out on the same day to minimise the incidence of erroneous recording.

5.1.2 Actual Surveys

The surveys were administered in three districts of Kiboga, Mbarara and Pallisa (see Appendices 2 - 4) from February to July 1996. These districts were purposively selected on the basis of their degree of food surplus. Kiboga district was selected as one of the districts with the most fertile soils and with high yields but prone to food deficits, Mbarara as a district less prone to food deficits and Pallisa as one of the districts with a high risk of food deficits since 1992 (see section 2.1).

The sampled households were all selected once in the main survey, with a household as the sampling unit. The study defines a household as a person or group of persons who live together under the same compound, have their meals together and have lived together under the same roof for at least six months prior to the survey - including babies born during this period.

Two counties in each district were purposively selected based on the crops grown in the area with the exception of Kiboga district. The multistage random sampling technique was employed in selecting the sub-counties, parishes and villages. In each county, two sub-counties were selected at random. In the selected sub-counties, two parishes were randomly selected. Furthermore, random sampling was employed in selecting three villages from each of the selected parishes. From the selected villages, random sampling was further employed in selecting 25 households from each parish. Therefore, the questionnaire was administered in 100 households in each district. The selection of each sampling unit was based on the list[33] of residents by village provided by the local councils. A summary of the sampled units from county level to village level is presented in Table 5.1.

To be able to monitor the changes in food consumption, two follow-up surveys were carried out on the same sampled households as in the main survey. These visits provided information on how women cope with changes/seasonality in the food security of their household members. The first follow-up was conducted from April to May and the second from June to July 1996. The structured questionnaires for each survey are as shown in Appendix 7. The collection of data was by direct interviews with the respondents.

---

[33] These lists are updated regularly by the council members.

Table 5.1 Summary of the Sampled Units

District	County	Sub-county	Parish	Villages
Kiboga	1. Kiboga*	Bukomero	1. Katera	Bukomero central, Kakumyu b, Kijonjoro a
			2. Mwezi	Mwezi a, Mwezi b, Rukuga
		Kiboga	1. Kagobe	Kagobe, Kyetume, Lwamonyole
			2. Kibiga	Kakooba, Karengera, Kibiga
Mbarara	1. Kashari	Rwanyamahembe	1. Mabira	Kachamba, Kitokye, Kyagaju
			2. Rwebishekye	Kaburishokye, Kikoma, Muko II
	2. Rwampara	Nyakajojo	1. Nyarubungo	Kashojwa, Katukuru, Nyarubungo
			2. Rwakishakizi	Kibingo, Mitsyamo,
Pallisa	1. Kibuku	Kibuku	1. Nalubumbe	Bukatikoko, Kanyolo, Namusita
			2. Rwatama	Kiryolo, Nanoko, Rwamata
	2. Pallisa	Pallisa	1. Akadot	Akadot, Kadoki, Okaribwok
			2. Kagoli	Akizim, Central Kagoli, Kaitabiri

*Kiboga district had only one county at the time of the survey, which was selected.

The main respondent was a woman[34], who was either the head of the household or the spouse to the head of the household. In polygamous households, one woman was selected at random as the main respondent. The husbands were only interviewed for the section marked 'for men only'.

The data collected in the main survey included household demographic characteristics for only those members who had lived in that particular household for at least six months prior to the survey. More detailed data were collected on the socio-economic characteristics of the woman respondent. The average daily time allocation was collected on both the woman respondent and her spouse, where applicable. Each gave her/his time allocation from the time one wakes up to when one goes to sleep. Data were also collected on property ownership between the main respondent and her spouse. Data on sources and amount of weekly income were collected on the main respondent and her spouse where applicable. Data were also collected on decision making within the household. Such data included who makes the decision, say, disposing of stocks, type of crops to be grown, type of food items to be consumed, disposal of cash income to name a few. Such data were important in selecting the household utility function.

[34]This was a step forward from the previous studies that have considered the main respondent as the head of the household, who in most cases is a male, despite their minority role in food production and consumption.

Data on household food and nonfood consumption were collected on a 30-day recall basis prior to the surveys. This flexible-recall system not only covered the frequently consumed food items but also those infrequently consumed, such as meat. Furthermore, this system was less expensive and less time-consuming on the part of the respondent as compared to the 24 hours recall system commonly used by nutritionists. The women respondents were requested to recall all the food actually eaten by the household as a whole. Memory loss over 30 days was assumed to be negligible given the routine consumption patterns in the rural areas.

Food quantities consumed referred to the amount that entered the cooking pot. Foods consumed away from home were ignored since it was impracticable to expect the respondents to report such information. The impact of the non-edible part and wastage during cooking and leftovers was assumed to be negligible. The respondents were requested to show the interviewers the unit of measure of each particular food just before placing it in the cooking pot. The quantities of food consumed were recorded in units such as tins, baskets, glasses and cans, which were household-specific measures. Kilogram equivalents of the household-specific measures were obtained by actual weighing of the food items for each village. It was not done for each household, as the local units did not vary much across households in the same village. Food items such as matooke, pineapples, chicken and cabbage were graded as average, medium and large. For each village, these grades were converted into their kilogram equivalents. For those households that consumed food from the market units such as bundles, tins, kilograms, glasses and spoons were recorded. For those foods reported in units other than kilograms, their kilogram equivalent was obtained by actual weighing of these food items in the nearest food markets. It was assumed that there was a small variation in the amount of food measured in bundles during the 30 days prior to the survey. The quantities of the food consumed with their respective prices were recorded.

Getting information on the prices of the consumed food from the market created no problems. However, prices of the food items consumed from own production were based on either the prevailing village price at the time of the survey or how much the respondents were willing to sell their food items. These prices were checked against prices in the nearest food markets. The prices per local unit measurement were respectively converted into price per kilogram at the data processing stage.

Data were also sought on the coping strategies taken by women in times of food shortages; number of meals during harvesting and planting periods; number of days on which the household members had only one meal; the health condition of the household members 30 days prior to the surveys; and shocks to household food security in terms of work, output, assets and income. This information was important as it gave insights on the severity of household food insecurity. Data collected on dietary and food security knowledge and awareness included factors determining the type of food items to be consumed, methods of food preparation, proportion of livestock/poultry/fruits consumed from own production by the household, reasons for selling foods, storage facilities, amount of food stored at the household and duration, and food preservation methods. The women respondents were also requested to give their own perception of household food security in general, and in particular what they thought the government should do to help those households at risk of food insecurity.

The data on consumption of nonfood items were collected for the 30 days prior to the survey. It was extremely difficult to get the quantities and instead only information on the amount spent for each item was recorded. Data on household food production were collected directly from the main respondent for the season prior to the survey. The food crops produced were categorised as major, minor and famine crops. Other data collected included the size of the holding[35], years of farming on the same holding, access to productive resources, and availability and accessibility of social infrastructure. Data were also collected on agricultural implements used on the farm and livestock and poultry ownership differentiated by gender.

The first follow-up survey requested the same data as in the main survey except for household food production and household demographic characteristics. The last follow-up requested the same data as in the main survey except for household demographic characteristics. However, in both follow-up surveys the respondents were requested to indicate whether there had been changes in the number of persons living in the household for the 30 days prior to the survey, but were living there at the time of the main survey.

---

[35]Size of the holding did not necessarily refer to area planted.

5.1.3 Data Limitations

- As discussed in Chapter 2, informal labour markets are prevalent in rural Uganda. This made getting rural wage rates/salaries difficult. Despite some households reporting use of hired labour in farming and/or in livestock, the method of payment and amount paid varied considerably across households. The method of payment was either on a contractual, payment in kind, daily, weekly or monthly basis. Seasonality in hiring labour was also prevalent. The respondents that reported to have used hired labour could only provide information on their sex but not on their education and ages. With such problems it was not easy to come up with a single measure of rural wage rates.

- The education variable was collected as the level of education attained (such as primary, secondary) instead of the number of years spent in school. This was an oversight as the former conceals a lot of very useful information.

- The continuous crops such as potatoes, cassava and matooke created problems in recording household production in the previous season.

- In the two follow-up surveys non-response[36] was recorded for some households. Such households included those where respondents were not found at home at the time of the survey, death of some respondents and couple separation due to marriage problems. Repeated visits within the survey period were made for those respondents not found at home on the first visit.

- Some food items such as amaranthus, maize on cob, fish, eggplant, sugarcane, pawpaw and mango, albeit consumed by some households, were not included in their daily dietary intake, as it was difficult to quantify them. Consumption of alcoholic beverages was also excluded, since not all members of the households derived utility from it.

- No provisions were made in the questionnaires to indicate whether there was a lactating or pregnant woman in the household. This was an oversight. The food requirements for a woman tend to be higher during breastfeeding or pregnancy.

[36]Non-response rate was below 6 percent during the follow-up surveys.

- Although consumption data were collected during all the three visits, the production data were for a single season. This hindered the introduction of dynamics in the agricultural household level discussed in Chapter 6 and the subsequent loss of the time dimension concept for household food security. Clearly, a household being food secure today does not guarantee its security tomorrow and this may affect household responses to changes in exogenous variables. However, a descriptive analysis of the seasonal dimension was attempted using consumption data as discussed in sections 5.2.3.6 and 5.2.3.7.

5.1.4 Data Transformation

a) Conversion of Food into Selected Nutritional Equivalent

The sample taken as a whole, the households consumed more than 50 different food items. Consequently, aggregation of some kind was inevitable. These food items were grouped as follows:

- Meat and related products[37], which included beef, pork, mutton, goat's meat, poultry, eggs and fresh milk.
- Cereals, which included millet, sorghum, maize flours and rice.
- Roots and tubers, which included dried cassava, fresh cassava and sweet potatoes.
- Matooke.
- Legumes, which included fresh beans, dried beans, groundnuts, simsim, soybeans and peas.
- Oils and fats, which included cooking oils, ghee and kimbo.
- Miscellaneous foods, which included pumpkin, passion fruit, cabbage, onion, tomatoes, pineapple, pumpkin and oranges.

Unlike previous studies that have used per capita nutritional intake, this study took into account the household age and sex composition. Given the heterogeneity of the household in terms of age and sex composition, weighted recommended daily intake per household was derived using the recommended daily intake by the *Uganda Nutri-Guide System* prepared by the Home Economics Department under MAAIF (undated). The individual recommended daily caloric intakes are given for the moderate activity

[37] Hereafter is referred to as meat group.

for 10 years old and above by sex. Let n denote the n^{th} nutritional value, r_{jg} the recommended daily intake for the g^{th} age group by j^{th} sex; and h_{jg} the number of household members falling in the g^{th} age group by j^{th} sex. Accordingly, the total recommended daily intake for the i^{th} household by j^{th} sex, was expressed as in Eq. 5.1.

$$(5.1) \quad R_{ij}^{n} = \sum r_{jg}.h_{jg}$$

The share of the recommended daily intake for the members in the g^{th} age group in the i^{th} household was expressed as in Eq. 5.2.

$$(5.2) \quad S_{ijg}^{n} = \frac{r_{jg}.h_{jg}}{R_{ij}^{n}}$$

The weighted n^{th} recommended daily intake for the i^{th} household for the j^{th} sex was expressed as in Eq. 5.3.

$$(5.3) \quad N_{ij}^{n} = \prod_{g} (r_{jg}.h_{jg})^{S_{ijg}^{n}}$$

Therefore, the weighted recommended daily intake for the i^{th} household was expressed as in Eq. 5.4.

$$(5.4) \quad N_{i}^{n} \;=\; \prod_{g} N_{ij}^{p}$$

where superscript p is the proportion of the total number of j^{th} sex in the total household size.

The next task was derivation of the n^{th} nutritional value from the reported food intake by the i^{th} household. The rural households reported consumption of a variety of food items either through own production, purchases and/or gifts/free collection[38]. The latter source was less common in the sampled districts, with less than 7 percent of the whole sample and is hereafter not included in the analysis. To facilitate the conversion process, all the food items that were reported in units other than kilograms were converted using the village-specific kilogram equivalents. Care was taken to control measurement errors while converting from local unit measures to kilograms and finally into the selected nutritional equivalents. The two food sources were aggregated for each food item and converted into their nutritional values using the *Uganda Nutri-*

[38] Free collection refers to sources such as from public waters (for example, fish) and forests (for example, wild foods).

Guide System. However, the nutritional equivalents of some food items such as mutton and pumpkin were not included, instead were converted using *The Composition of Foods Commonly Eaten in East Africa* by West *et al.* (1988).

Let x_{ij} denote quantity of the j^{th} food item consumed by the i^{th} household; d_j^n the n^{th} nutritional value per unit derived from the consumption of the j^{th} food item; and A_i^n the actual n^{th} nutritional daily food intake by the i^{th} household expressed as in Eq. 5.5.

$$(5.5) \quad A_i^n = \frac{\sum_j d_j^n x_{ij}}{30}$$

Eq. 5.5 converts the actual food intake to a daily basis, since the data on consumption were collected over a period of 30 days. In converting food quantities into their nutritional value, assumptions were made in addition to those mentioned above. First, the food losses during the preparation process up to the consumption stage were negligible. Second, no quality differences existed between different types of the same food item. Third, household daily food intake was the same over the 30-day period. Fourth, households had neither lactating nor pregnant mothers.

The weighted actual daily food intake of the n^{th} nutritional value for the i^{th} household was expressed as in Eq. 5.6.

$$(5.6) \quad DA_i^n = \left(\left(\frac{S_{ij}^n}{h_{ij}} \cdot \left(A_i^n \cdot p \right) \right)^{s_{ij}^n} \right)^p$$

Like the weighted recommended daily food intake, the weighted actual daily food intake took into account the heterogeneous nature of a household composition, in terms of age and sex.

A household is deemed to be food secure or have an adequate dietary intake, if Eq. 5.7 holds; otherwise it faces either chronic or transitory food insecurity. Transitory food insecurity occurs when a household experiences a decline in its access to enough food. If a household faces continuous inadequacies in its diet resulting from the lack of resources to produce or acquire food, then it is said to be chronically food insecure.

$$(5.7) \quad DA_i^n \geq N_i^n$$

b) Derivation of Food Group Prices

The task here is to derive the weighted prices for the corresponding food groups as discussed above. The common practice is to assume households to be faced with the same price for the same commodity. These prices are then weighted by the share of household expenditure (that is, household specific weights) in a particular food to the weighted group prices. Cautiously, Singh *et al.* (1986) assert that such an approach is bound to introduce spurious variations in prices and may suffer from the endogeneity problem. Strauss (1986) overcomes this problem by using regional average weights rather than household specific weights and Jacoby (1992) uses village level median prices.

By contrast, this study collected data on all foods consumed and produced by the households, derived the share of each food to overall food group expenditure, which were in turn used as weights to derive the weighted group price for that particular group as discussed below. The total food group expenditure for the g^{th} food group for the i^{th} household was expressed as in Eq. 5.8.

$$(5.8) \qquad Tx_i^g = \sum_j p_j^g . x_{ij}^g$$

where:

p_j^g = the price of the j^{th} food item in the g^{th} food group; and

x_{ij}^g = the quantity consumed of the j^{th} food item in the g^{th} food group by the i^{th} household.

The share (w_j^g) of the j^{th} food item in the g^{th} food group expenditure was derived as in Eq. 5.9.

$$(5.9) \quad w_j^g = \frac{p_j^g . x_{ij}^g}{Tx_i^g}$$

Thus, the weighted food price for the g^{th} food group for the i^{th} household was derived as in Eq. 5.10.

$$(5.10) \quad \overline{P}_i^g = \Pi(p_j^g)^{w_j^g}$$

c) Derivation of the Aggregate Food Output Price and Quantity

As with the consumption data, all output quantities were converted into their village-specific kilogram equivalents and the same was done on the prices per kilogram. Despite production of a variety of food crops by the rural household as a group, some households reported zero production of some food crops. To reduce the estimation difficulties encountered in such circumstances, food crops production was converted into a single food production category as discussed below. The total earnings for the i^{th} household's food output ($Gross_i$) were derived as:

$$(5.11) \quad Gross_i = \sum_k q_i^s \cdot p_i^s$$

where:

q_i^s = the s^{th} food quantity produced by the i^{th} household; and

p_i^s = the s^{th} food price faced by the i^{th} household.

The share of the s^{th} food output in the i^{th} household gross earnings were derived as in Eq. 5.12.

$$(5.12) \quad w_i^s = \frac{q_i^s \cdot p_i^s}{Gross_i}$$

Thus, the aggregated food output for the i^{th} household was derived as in Eq. 5.13.

$$(5.13) \quad \overline{Q}_i = \Pi(q_i^s)^{w_i^s}$$

Unlike the quantities of the food produced, the prices of these food items were aggregated into three to four groups according to the districts. For Mbarara district, food output prices were aggregated into four groups, namely, tubers (cassava and sweet potatoes), matooke, legumes (groundnuts, beans, soybeans, peas) and miscellaneous foods (Irish potatoes, maize, sorghum, millet). For Kiboga district, food output prices were aggregated into four groups, namely, legumes (groundnuts, beans, soybeans), matooke, tubers (cassava, sweet potatoes) and miscellaneous foods (Irish potatoes, maize, sorghum, millet, onions). For Pallisa district, tubers (cassava, sweet potatoes), legumes (groundnuts, beans, soybeans, simsim, peas) and cereal (maize, sorghum, millet). The weighted prices for the foods produced are discussed below. The share of the k^{th} food output in the q^{th} group was expressed as in Eq 5.14.

$$(5.14) \quad w_{ik}^q = \frac{q_{ik}^q \cdot p_{ik}^q}{Gross_q}$$

where:

q^q_{ik} = the k^{th} food quantity in the q^{th} group produced by the i^{th} household; and

p^q_{ik} = the k^{th} food price in the q^{th} group faced by the i^{th} household.

The weighted price for the q^{th} food group output for the i^{th} household was derived as in Eq. 5.15.

$$(5.15)\quad \overline{P}^q_i = \Pi(p^q_{ik})^{w^q_{ik}}$$

5.1.5 Data Processing

As discussed above, editing of the questionnaires was done on the same day of the interview, however assigning codes to open-ended questions was done after completion of each survey. Epi Info Version 5.01 software program was used for data entry. SPSS/PC Version 4.0 was used for the transformation of data and for descriptive data analysis. The actual model as discussed in Chapter 6 was estimated using the Shazam Econometrics Computer Program Version 8.0 package.

5.2 Descriptive Statistical Data Analysis

5.2.1 General Characteristics

5.2.1.1 Socio-economic Characteristics

The sample of 300 households had 2,170 members including children, making an average of 7.2 persons per household. Considering individual districts, Kiboga recorded, on average, 6.4 persons per household; Mbarara 7.4 persons per household; and Pallisa 7.9 persons per household. The average number of persons per household recorded by all districts was higher than the national figure of 5.4 as per the 1991 population census. Of the total household members in the sample, 50.1 percent were female and 49.9 percent male, figures consistent with the national demographic statistics that females outnumber males. At the district level, Kiboga recorded the highest percentage of females, followed by Pallisa, while Mbarara recorded the highest percentage of males followed by Pallisa. It follows that the Kiboga sample was female-dominated whereas the Mbarara sample was male-dominated.

The mean age of the main respondent was 37.7, 35.6 and 37.0 in Mbarara, Kiboga and Pallisa districts, respectively. A very high youth dependency ratio with 60.3 percent (1308) of the sample under 18 years, of which Kiboga, Mbarara and Pallisa recorded

32.6 percent, 33.3 percent and 34.0 percent, respectively was observed. This finding concurs with UNICEF (1994) that Uganda's population is getting younger. The high youth dependency ratio translates into a high consumer-worker ratio. This has implications for a woman's workload to meet the minimum consumption level of the household members.

Out of 969 economically active persons excluding the elderly, sick, students and below school-going age, 70.8 percent (686) reported farming as the main occupation, 16.0 percent (155) engaged in services and other related activities, 10.8 percent (105) were unpaid family workers and 2.4 percent (23) not stated. The percentage in farming was consistent with the estimates at the national level. Nearly 73.7 percent of the heads of the households reported farming as the main occupation and only 21 percent as services and other related activities. The majority of the respondents took on farming as their main occupation for several reasons. These include culture (25.5 percent), as last resort (41.2 percent), to earn income (6.3 percent), as the only alternative (17.5 percent) and due to a lack of capital to start up other business activities (9.4 percent). The majority regarded farming as an inferior activity. There was a misconception that agriculture was for uneducated people. This has implications for the government's efforts to boost agriculture, in particular food production.

The overall literacy rates did not differ much from those of a typical rural population. Out of 1751 people excluding children below school-going age, 21.9 percent (383) had no education, 63.8 percent (1117) had primary education and only 14.0 percent (246) secondary education or higher. Females were less educated than males at all education levels. Of those with no education, females accounted for 60.3 percent, 50.0 percent with primary education, 44.9 percent with secondary education and 36.8 with tertiary education, suggesting that the higher the educational level the lower the percentage of educated females. Some 54.7 percent of the total heads of households had primary education, only 16.7 percent with secondary education and 19.0 percent with no education. Considering only the male heads, some 56.3 percent had primary education, 29.6 percent at least secondary education and only 14.2 percent were illiterate. Considering only the female heads, about 38.3 percent were illiterate, 48.3 percent had primary education and only 13.4 percent had at least secondary education. More than half of the women respondents had primary education and 33.7 percent were illiterate.

Of the total sample, 80 percent of the households were male-headed and only 20 percent *de jure* female-headed. Of all the three districts, the Kiboga sample recorded the highest percentage of female-headed households. This is not surprising since many women in Kiboga were left widows as a result of the war that led the NRM government into power. Nationally, the percentage of female-headed households was 29 percent, based on the Uganda Population Census, 1991. The percentage of households headed by females from the survey findings did not vary much from those reported for other African countries. For instance, Mencher *et al.* (1986) reports that female-headed households accounted for 25 percent of the total households in developing countries and 30 percent by Jiggins (1989).

5.2.1.2 Property Ownership

More than 80 percent of the respondents in each district reported property ownership, either in the form of land, house, livestock, poultry and/or agricultural implements. However, co-ownership was reported, either with the husband, friend, relative or co-wives. In Mbarara, less than 30 percent of the respondents owned land or a house, which were acquired mainly through marriage. Less than 39 percent, 23 percent and 65 percent reported owning livestock, poultry and agricultural implements, respectively, which were acquired mainly through purchases. In Kiboga, less than 35 percent reported owning land and less than 30 percent a house, which was acquired mainly through inheritance, and more than 50 percent reported to own livestock and poultry, which were acquired through purchases. Only 2 percent of the respondents reported owning land or a house in Pallisa, a percentage lower than that reported for the other districts. About 19 percent owned livestock and 51 percent poultry. There were more respondents in Kiboga that owned property than in the other two districts. Co-ownership of land does cause the problems of using such property as collateral for formal loans and also its effective utilisation.

5.2.1.3 Sources of Income

On average, most women reported they had a source of income, with 56 percent, 73 percent and 85 percent in Kiboga, Mbarara and Pallisa, respectively. About 50 percent had control over their income. In all the districts, women reported spending their income mainly on children's education and household needs. The percentage that reported farming as a source of income was very much above other sources in Mbarara and Pallisa. A higher percentage of women in Pallisa derived their income from brewing and hiring out their labour than those in the other two districts. In Kiboga, women derived their incomes mainly from trading and handicraft. In all districts other minor sources of income included milk sales, services, remittances and fishing.

Most respondents reported irregularities in the flow of income. The market for buyers was very fragile, they claimed. On a weekly[39] basis, they earned Ug. Shs. 6,414.04, 15,250.97 and 5,353.51, on average, in Kiboga, Mbarara and Pallisa, respectively. The respondents in Mbarara earned a significantly higher income than those of either Kiboga (p-value = 0.063) or Pallisa (at p-value = 0.020). However, no significant differences in income earned were observed between respondents in Pallisa and Kiboga districts.

Only 2 percent of the households in Mbarara were not engaged in trading foods compared to 24 percent and 20 percent for Pallisa and Kiboga, respectively. Generally speaking, this finding confirms Bibangambah's (1983) assertion that food crops in developing countries were also cash crops[40]. This refutes the continued thinking of western economists that there is a clear demarcation between cash crops and food crops. Results further confirm that rural households in the sampled areas were semi-subsistence farmers. Food crops mainly traded in Mbarara included matooke, beans, millet and nuts; with 74 percent, 42 percent, 15 percent and 10 percent, respectively, of the households. Food crops mainly traded in Kiboga included matooke, beans, onions and nuts; with 42 percent, 30 percent, 19 percent and 10 percent, respectively, of the households. Food crops mainly traded in Pallisa included millet, soybeans, rice and groundnuts, with 28 percent, 26 percent, 15 percent and 13 percent, respectively, of the households. Of those involved in food sales, 72 percent, 67 percent and 39 percent in Kiboga, Mbarara and Pallisa, respectively, sold food as a surplus. On the contrary, 10 percent, 32 percent, and 60 percent in Kiboga, Mbarara and Pallisa, respectively, sold food out of their own subsistence to meet other pressing basic needs, especially in Pallisa. A small proportion of the households was reported to grow food crops mainly for sale in all districts.

[39]Income was reported on a weekly basis, since most of the households did not earn income beyond this period 30 days prior to the surveys.

[40]The concept of cash crops and food crops has vanished among the so-called 'subsistence' economies.

5.2.1.4 Household Decision-Making

Decision-making within the household has implications for the household welfare and its food security status. The available literature points to decision-making within the household to impact its level of participation in the development process. Decision-making is the basis for agricultural household models. Decision-making in many households is characterised by male dominance and in many instances women plan the income and men plan expenditures (UNICEF 1994, p.125).

However, the sampled areas in this research portrayed a different picture as far as household decision-making was concerned. The continued gender sensitisation by NGOs may have attributed to this. Decision-making in the female-headed households was entirely by women themselves; however, the picture was quite different in the male-headed households. Results in Table 5.2 suggest that joint decision-making in food sales, crops grown for sale and consumption, milk and disposal of farm output dominated individual decision-making. Considering individual decisions, husbands recorded higher percentages than their spouses in food sales, disposals of farm produce and type of crops grown for sale; with farm produce showing the largest difference.

On the contrary, women recorded higher percentages, with large differences in crops grown for home consumption and disposals of grains and fruits. The decisions on the number of full meals and snacks were entirely made by women. They made most decisions on food consumption quantities and diet composition with 95 percent and 68.2 percent, respectively. In most African countries and Uganda in particular, extended families are common. However, decisions have to be made on who should join and live in the household. As expected, husbands dominated decisions on the size of the family in the male-headed households.

All households grew food crops for own consumption and some for sale; however, decisions were made on the types of crops grown in either case. As expected, women in the female-headed households made most of the decisions concerning crops to be grown in either case. The picture was quite different for their counterparts in the male-headed households. Results suggest that decisions on types of crops to be grown for home consumption were made jointly by 43.5 percent, 41.4 percent by women and 14.6 percent by men alone. Decisions on crops grown for sale were made jointly by 47.5 percent, 27.4 percent by women and 24.7 percent by men. Overall, women dominated decision making in the food system cycle, ranging from the types of crops to grow up to the time when food was ready for human consumption. Individual decision making dominated incomes derived from employment and enterprises.

Table 5.2 Distribution of Decision-Making in Male-headed Households[a]

Decision made	Wife	Husband	Both	Other	Valid cases
	%	%	%	%	
Income from:					
a) Wife's employment	59.3	20.3	20.3	-	177
b) Husband's employment	2.8	72.4	24.9	-	181
c) Wife's enterprises	75.4	9.2	15.4	-	65
d) Husband's enterprises	8.6	77.6	13.8	-	58
e) Food sales	23.7	33.6	42.7	-	211
Food Consumption:					
a) Quantities of food consumed	95.0	1.3	3..3	0.4	239
b) Diet composition	68.2	9.2	22.2	0.4	239
c) Number of full meals	95.8	1.7	2.5	-	239
d) Number of snacks	94.3	1.9	3.8	-	239
e) Family size	11.7	49.8	38.1	0.4	239
Crops grown for:					
a) Sale	24.7	27.4	47.5	0.4	223
b) Home consumption	41.4	14.6	43.5	0.4	239
Disposal from Own Production:					
a) Milk	33.6	28.2	38.2	-	110
b) Farm produce	18.1	41.0	41.0	-	188
c) Meat (especially chicken)	32.5	24.6	43.0	-	114
d) Eggs	43.1	16.5	40.4	-	109
e) Fruits	48.9	12.8	38.3	-	141
f) Grains	48.1	19.0	32.9	-	210

Notes: [a]For all districts combined.

5.2.1.5 Time Allocation

Results in Table 5.3 suggest that men spent significantly more time on productive activities and leisure[41] than women in all districts. For all districts women spent significantly more time on domestic activities than men did, as expected. Comparisons across districts yielded interesting results. There were no significant differences in time allocated to productive activities by women between Kiboga and

[41] Leisure of women has to be interpreted cautiously, since most women may spend such time on handcraft.

Mbarara and by men across districts. However, significant differences were observed between Pallisa and the other two districts. Women in Pallisa, on average, spent less time on productive activities than those in either Kiboga (p-value = 0.000) or Mbarara (p-value = 0.000). These women further spent less time on domestic activities than those in Mbarara (p-value = 0.005), but more time than those of Kiboga (p-value = 0.020). No significant differences were observed on men's time spent on leisure across districts. However, significant differences were observed for women, with women in Pallisa spending less time on leisure activities than those in either Kiboga (p-value = 0.019) or Mbarara (p-value = 0.032).

Table 5.3 Average Daily Time Allocation (hours) – Main Survey

	Kiboga		Mbarara		Pallisa	
Activities	Women	Men	Women	Men	Women	Men
Domestic	6.82	3.29	6.01	3.00	6.37	2.89
Productive	5.02	8.72	5.29	8.97	4.67	6.30
Leisure	3.91	6.75	4.06	6.62	3.75	8.48

5.2.1.6 Household Health Status

The health status of members of a household directly and indirectly affects its food security status. A direct linkage is observed when a woman, who is the main producer and provider of food, is in poor health. A woman's poor health negatively affects not only her productivity in food production but also the overall household food accessibility, notably of children. Inability to get food from the garden, prepare it, collect fuel wood and fetch water may influence the types of food cooked, number of meals per day and possibility of feeding on leftovers. This may indirectly affect the other members' health status. The health status of the women and other members of the sampled households are discussed below.

The percentage of women who reported poor health during the 30 days prior to the surveys varied across districts. In Pallisa, 38.0 percent, 35.4 percent and 36.0 percent were in poor health prior to the main, first and second follow-up surveys, respectively. The corresponding figures for Mbarara were 52.0 percent, 34.7 percent and 38.8 percent; and Kiboga were 47.0 percent, 36.7 percent and 37.4 percent, respectively. A fall in the percentage of women reporting poor health was observed between the main and first follow-up surveys and a slight increase between the first and second follow-up surveys.

An indirect linkage is observed where any member's sickness drains the household disposable income, assets and/or draws a woman's time from other activities. In the sampled areas where households had an AIDS victim, notably a head of the household, the respondents reported excessive sale of food and to some extent other household assets to meet the health bill.

The percentage of women who reported poor health of other members of the household was higher than that of the women themselves, and also varied across the three surveys and districts. In Pallisa, 57.0 percent, 48.5 percent and 56.0 percent were in poor health prior to the main, first and second follow-up surveys, respectively. The corresponding figures for Kiboga were 74.0 percent, 57.8 percent and 57.1 percent; and for Mbarara were 59.0 percent, 78.9 percent and 50.0 percent, respectively. Similar patterns were observed between the percentage of women in poor health and that of other members of the households over the three surveys.

Considering only those women who reported poor health of a household member some observations do emerge. The poor health of a member of the household affected food production of 89.2 percent, 63.5 percent and 78.8 percent of the women in Kiboga prior to the main, first and second follow-up surveys, respectively. The corresponding figures for Mbarara were 84.7 percent, 60.0 percent and 80.0 percent; and for Pallisa 63.2 percent, 62.5 percent and 69.9 percent, respectively.

Health expenditures, on average, by survey and district are presented in Table 5.4. Unfortunately, the differences in health expenditure between the surveys could not be explained from the survey data. Using the main survey data, Pallisa households spent significantly less on health than the other two districts; however, no significant differences were observed between Kiboga and Mbarara. For the first follow-up, no significant differences were observed between households in Kiboga and those in the other two districts. On the contrary, households in Mbarara spent significantly more on health than those in Pallisa. Conversely, no significant differences on health expenditure were observed between all the three districts, using the second follow-up survey results.

Table 5.4 Average Health Expenditure (Ug. Shs.)

District	Main	First Follow-up	Second Follow-up
Kiboga	15,836	11,308	11,575
Mbarara	20,442	14,679	13,582
Pallisa	5,301	7,446	9,198

5.2.2 Farming Characteristics

5.2.2.1 Accessibility to Productive Resources

Overall, the percentage of women that had access to productive resources was relatively low as reported in Table 5.5.

Table 5.5 Distribution of Women's Accessibility to Productive Resources

Productive resource	Kiboga	Mbarara	Pallisa
	%	%	%
Hired labour	38	64	29
Improved seed	9	30	8
Credit facilities	10	16	1
Farming land	65	53	63
Extension services	15	31	18
Farming implements	48	39	77

More than 50 percent of the women in all districts had access to farming land, with Mbarara recording the lowest percentage. Some women, especially in Mbarara district, reported that much of the land was under livestock leaving them with little (and sometimes marginal) land for farming. This threatens their accessibility and consequently food production. Women in Mbarara had a higher access to productive resources, except farming implements and farming land, than in the other two districts. The accessibility to improved seeds was very low, confirming that most of the increases in production were derived from exploitative means. The low percentages for improved seeds and extension services were inherited from the slow recovery of the agricultural extension and research network as discussed in Chapter 2. The percentages reported were not very different from those reported elsewhere. In Mbarara and Pallisa districts, accessibility to credit facilities was the lowest. This was as expected since, as discussed above, most of these women lacked the collateral required to receive a loan from formal banking institutions.

5.2.2.2 Household Food Production

The food crops grown varied from district to district as presented in Table 5.6. The food crops mainly grown in Kiboga included cassava, matooke, sweet potatoes, maize, groundnuts and beans. These food crops were regarded as either main, minor or famine crops. A higher percentage of the households grew matooke, groundnuts and beans as main crops, and cassava and sweet potatoes as famine crops. In Mbarara crops mainly grown included cassava, matooke, sweet potatoes, groundnuts, beans and millet, the majority of which were grown as main crops except for cassava. In Pallisa, food mainly grown included sweet potatoes, beans, millet and soybeans; with beans grown as minor crops and millet as a main crop by most households.

The majority of households, irrespective of the head of the household and district, reported to have experienced a decline in crop yield prior to the main survey. Over 90 percent of the households expressed interest in expanding their operations. The reasons the respondents gave for a decline in the crop yield included inadequate knowledge on farming methods, unfavourable climatic conditions, land degradation, sickness, pests and rodents, and water logging. However, the most pressing problems were land depletion and changes in climatic conditions. Land fallowing was once a common practice for soil fertility management. However, it is no longer a common practice among farmers due mainly to population pressures. About 58.0 percent, 63.0 percent and 45.0 percent of the respondents in Kiboga, Mbarara and Pallisa, respectively, reported to have grown crops on the same land for over 10 years.

Women's knowledge of various techniques of farming and in particular in agriculture has implications for their productivity levels. For instance, if seeds are not well selected some may not germinate affecting the area planted; and those that germinate may yield below normal levels. Results in Table 5.7 suggest that despite many women in the whole sample displaying knowledge on seed selection techniques, as expected, some 14.0 percent (57) did not have such knowledge. Likewise, knowledge on storage techniques was very much above average. On the contrary, knowledge on animal husbandry was very low compared to the other two.

Table 5.6 Distribution of Food Crops Produced Prior the Main Survey by District by Type*

	Kiboga				Mbarara				Pallisa			
	Main crop	Minor crop	Famine	Valid cases	Main crop	Minor crop	Famine	Valid cases	Main crop	Minor crop	Famine	Valid cases
	%	%	%		%	%	%		%	%	%	
Cassava	3.4	1.7	94.9	59	5.0	8.3	86.7	60	4.3	4.3	91.5	47
Matooke	87.8	12.2	0.0	90	100.0	0.0	0.0	81	18.8	81.3	0.0	16
Sweet potatoes	28.8	20.0	51.3	80	54.1	19.7	26.2	61	82.9	2.9	14.3	72
Irish potatoes	21.4	78.6	0.0	14	-	-	-	-	-	-	-	-
Maize	36.4	63.6	0.0	55	70.0	30.0	0.0	40	84.8	15.2	0.0	46
Groundnuts	52.9	47.1	0.0	51	68.5	31.5	0.0	51	61.2	38.8	0.0	49
Beans	52.9	47.1	0.0	85	98.9	1.1	0.0	93	27.8	72.2	0.0	54
Onions	68.6	31.4	0.0	35	12.5	87.5	0.0	8	-	-	-	-
Millet	-	-	-	-	55.4	1.4	43.2	74	96.2	3.8	0.0	78
Sorghum	-	-	-	-	40.0	60.0	0.0	3	87.5	12.5	0.0	40
Cabbage	66.7	33.3	0.0	3	5.3	94.7	0.0	19	-	-	-	-
Peas	-	-	-	-	36.4	63.6	0.0	11	34.6	65.4	0.0	26
Soybeans	-	-	-	-	16.7	83.3	0.0	6	79.6	20.4	0.0	49
Simsim	-	-	-	-	-	-	-	-	0.0	100.0	0.0	8

Notes: *Type refers whether food crops were grown as main, minor or famine crops.

Table 5.7 Distribution of Knowledge on Selected Farming Techniques (%)

Knowledge on	Very much	Much	Fair	Not at all
Seed selection techniques	18.30 (15)	36.30 (109)	26.30 (79)	14.00 (57)
Husbandry techniques	10.00 (30)	22.30 (67)	36.70 (110)	31.00 (93)
Storage techniques	14.00 (12)	39.70 (119)	37.30 (112)	9.00 (27)

5.2.2.3 Post-Harvest Technologies

a) Preservation Methods

The methods of preserving foods were poor and varied greatly from district to district. This is consistent with the discussion in Chapter 2. Beans, groundnuts, sweet potatoes, cassava, maize comb, millet, soybeans and peas were sun dried in most areas without adding any chemicals. Some societies mix beans with soil, bee honey or ashes to prevent infestation. Preservation of onions was mostly by hanging them above the cooking place. Meat was preserved by cooking, smoking and at times drying. The only method of preserving milk was by boiling. Unlike the other two districts, preservation of roots and tubers, such as sweet potatoes, was a common practice among households in Pallisa. The poor preservation methods were not surprising given that 'farm to pot' methods dominated the sampled areas. This has implications for food security, especially during periods of food shortages.

b) Storage Facilities

The storage facilities used at the household levels varied from district to district, with the exception of granaries in Pallisa and Mbarara. For all districts combined, the facilities used included granaries, sacks, floors, basins and pots, and hanging with 44.5 percent (131), 68.4 percent (201), 26.5 percent (78), 9.9 percent (29) and 3.1 percent (9) of the total households reporting, respectively.

Generally speaking, less than half of the households prior to all the three surveys had food in their stores. In Kiboga, the foods mainly stored included beans, groundnuts, maize; beans, groundnuts and millet in the case of Mbarara; and millet in the case of Pallisa. Most of these households had kept such food between one and four months prior to the surveys. Problems with storage facilities were reported by 64.3 percent (193) of the total sample. Such problems included rodents and pests by 73.1 percent, inadequate storage facilities by 36.8 percent, lack of knowledge on the preservation methods by 17.6 percent and others by 10.9 percent, including leaking granary roof and thieves.

5.2.2.4 Household Farm Assets

a) Livestock and Poultry Assets

Of the total sample, 65.7 percent and 39.3 percent of the households reared livestock and poultry, respectively. These included cattle, goats, sheep, pigs, oxen, chicken, ducks and turkey. With the exception of cattle and chicken, other assets were of indigenous breed. Despite providing meat, milk and eggs, the consumption of these products from own reared livestock and poultry were very low. For instance, more than half of the households consumed less than 30 percent of the products from their own reared livestock and only 20.3 percent consumed more than 50.0 percent. Some 30.9 percent of the households consumed more than 50 percent of the products from their own reared poultry, 25.0 percent between 30 and 50 percent and some 44.0 percent less than 30 percent or not at all.

A higher percentage of women in Mbarara (57 percent) did not own either poultry or livestock, compared to only 20.0 percent and 37.0 percent in Kiboga and Pallisa, respectively. On average, men's assets valued Ug. Shs. 702,852, 2,289,764 and 437,957 in the case of Kiboga, Mbarara and Pallisa, respectively. The corresponding figures for women's assets were Ug. Shs. 116,621, 2,012,262 and 60,662, respectively. Livestock and poultry values were higher for men than for women, since the former owned high valued assets such as cross breed cattle, compared to the latter who owned low-valued assets such as chicken and goats.

b) Farm Equipment

The farm equipment owned by the sampled households included mainly the traditional hoe. Surprisingly a few households did not own this basic tool for land tillage; instead they reported borrowing the same from relatives and friends. Others included panga, forks, slashers, axes, spraying pipes, oxen, banana sickles and wheelbarrows.

5.2.3 Household Food Consumption

5.2.3.1 Household Food Sources

The households derived their food mainly from their own production and purchases. Generally, the household depended heavily on the market for oils and fats, fish, meat, and miscellaneous foods. Root and tubers, matooke, cereals, legumes, vegetables and fruits were mainly derived from own production. Within each food group, some interesting features were observed for the whole sample. For instance, a higher percentage of households depended on the market for maize flour, groundnuts, rice, onions, chicken and fresh milk. Consumption of beef and fresh milk dominated the meat group; dried beans and groundnuts dominated the legumes group; and onions and cabbages dominated the vegetables group. The percentage of the households that consumed fish and fruit was relatively low.

5.2.3.2 Household Food Expenditures

Household food expenditure results using the main survey data are reported in Table 5.8. A similar pattern in total household expenditure and household food expenditure was observed. For Mbarara and Kiboga, most households spent between Ug. Shs. 50,000 and 100,000 per month on food. More than 60 percent of the households in Pallisa spent between Ug. Shs. 5,000 and 50,000 per month on food. The households in Kiboga, on average, spent Ug. Shs. 80,380 on food alone compared to Ug. Shs. 37,345 on other nonfood expenditures, including health and education.

The corresponding figures for Mbarara were Ug. Shs. 86,251 and 50,006; and for Pallisa were Ug. Shs. 38,385 and 7,564, respectively. Generally, the households in Pallisa spent less on all categories of household expenditures than in the other districts. However, this has to be interpreted with caution. For instance, households in Pallisa simply may not have had sufficient exchange of entitlements to purchase basic needs such as food, education and health.

The percentage of household expenditure spent on food is among the household food insecurity indicators used by most economists following Engel's law. Roughly, a threshold of two thirds of household total expenditure allocated to food has been used as a rule of thumb in determining household food security status for developing countries (Poleman 1981, p. 25), with a household spending above this threshold signalling food insecurity. The previous studies (such as Alderman and Garcia 1993) have used a threshold ranging from 60.0 to 70.0 percent. Results in Table 5.8 show that, on average, most households were food insecure in all districts, with a higher percentage in Pallisa district.

Table 5.8 Distribution of Monthly Expenditure by District – Main Survey

Expenditure group	Kiboga	Mbarara	Pallisa
	%	%	%
Total household expenditure (Ug. Shs.)			
5,000 - 50,000	8	9	65
50,000 – 100,000	36	28	31
100,000 – 150,000	34	27	3
150,000+	22	36	1
Food expenditure (Ug. Shs.)			
3,000 - 50,000	15	22	75
50,000 – 100,000	62	48	23
100,000 – 150,000	19	23	1
150,000+	4	7	1
Nonfood expenditure (Ug. Shs.)			
0	3	1	0
100 - 5,000	6	4	9
5,000 – 50,000	67	60	58
50,000 – 100,000	16	23	31
100,000+	8	12	2
Food expenditure as % of total expenditure			
Less than 30	0	4	1
30 – 50	11	14	3
50 – 70	36	32	12
70+	53	50	84
Average	72	68	85

5.2.3.3 Intra-household Food Distribution

Intra-household food distribution is skewed toward male-adults especially husbands in some societies in Africa. This is different from the situation in most Asian countries, where it is skewed towards males including male-child (see, for example Carloni 1981, Quisumbing *et al.* 1995). Although husbands in Uganda were served with special meals in the past, the survey findings indicated that the practice was vanishing. For all districts combined, a fair distribution of food among the household members was practised by 64.3 percent of the women, 20.7 percent reported the distribution to depend on the circumstances, unequal distribution prevailed for 10.3 percent and 4.7 percent deliberately refused to respond. They claimed the question was very sensitive. The influence of education and the NGO's effort to raise women's status in the society have been partly attributed as a cause of gradual changes. Most women were aware that the quantity and quality of foods consumed by children greatly affects their growth, which in future affects their productivity.

It was, though, still the case on a small-scale that it is a taboo for a woman to eat, for instance, fish in the Bahima tribe of Mbarara; eggs, chicken, sheep, pork and grasshoppers to name a few foods in Buganda culture. These are protein-rich foods, which were consumed by men alone. The revolution of culture has partly brought about changes in those foods that used to be not eaten by women and girls. Against these findings, the study assumes equal food distribution among the household members according to body and growth requirements. In other words, intra-household food distribution appeared to be optimal from the point of view of the households.

5.2.3.4 Energy Used for Cooking

Fuel wood energy was commonly used for cooking by 98.7 percent (296) of households surveyed. This was consistent with the percentages reported in literature elsewhere in Africa. Charcoal was used by only 5 percent (15) of the households and paraffin by only one household. Paraffin was mainly used for lighting. A higher percentage of the respondents reported the availability of fuel wood to have been poor in Kiboga (73.3 percent) and Mbarara (54.7 percent). In these two districts, less than 5.0 percent of the respondents reported the availability of fuel wood to have been good. On the contrary, more households in Pallisa (43.4 percent) reported the availability of fuel to have been good.

The quality of fuel wood used for cooking has deteriorated over time. Some households reported use of reeds and maize straws, once used for mulching, for cooking. The implications of this are twofold. First, it negatively affected women's time. Women claimed that, with poor quality of fuel wood, they had to stay around all the time while cooking. Increasing deforestation partly attributed to the deteriorating quality of fuel wood. Second, this affected soil fertility restoration in the long run, as discussed in Chapter 2, because use of fertilisers was not a common practice.

5.2.3.5 Household Coping Strategies

To maintain their food security status, households need to have a stable food supply. Due to unforeseen circumstances they sometimes face food shortages either in the long- or short-run. Accordingly, women have devised several strategies to cope with these shortages without government assistance. Such strategies have been used in food security literature (such as Maxwell, D 1996) as indicators of the intensity of the food insecurity problem and also provide insights into the vulnerability of a household to food insecurity. In Kiboga district 38.5 percent experienced food shortages prior to the first follow-up survey compared to only 13.0 percent prior to the second follow-up. The corresponding figures for Mbarara were 40.0 percent compared to 27.0 percent; and for Pallisa 50.0 percent compared to 32.0 percent, respectively. It is noted that fewer households experienced food shortages prior to the second follow-up survey.

Respondents indicated several strategies that they adopt to cope with transitory food shortages. During the main survey, respondents were requested to indicate the broader strategies they would adopt in times of transitory food shortages. Buying food from savings and/or income earned from sources other than food was a common practice in Mbarara district, only ranked second in Kiboga and third in Pallisa. Skipping a meal and borrowing money from relatives and friends to buy food were equally common practices in Pallisa; and the former in Kiboga. Other strategies included food exchange where, for instance, a household with beans could exchange them with another household for a tin of cassava; working for others for food; and begging food from friends and relatives, especially in Kiboga and Pallisa.

On the contrary, the follow-ups concentrated on the specific strategies actually adopted by only those households that experienced transitory food shortages. The strategies were similar to those discussed above but with different degrees of prevalence. Working for others was a common practice for Kiboga households in both follow-up surveys, food exchange ranked second. In Mbarara, dependency on remittances from husbands ranked first and working for others second in the second follow-up, while working for others ranked first and buying food second in the first follow-up survey. In Pallisa, borrowing money ranked first and skipping meals and working for others ranked second in the second follow-up and in the first follow-up skipping meals ranked first and working for others second.

Results above suggest that skipping a meal was a common practice, especially in Pallisa. More than 70 percent of the households in Kiboga and Mbarara had at least two meals daily prior to all three surveys. The corresponding figures for Pallisa were 63 percent prior to the main survey but fell below 40 percent prior to the first and second follow-up surveys. Results in Table 5.9 show the distribution of those households that experienced skipping a meal prior to the survey time. Pallisa recorded the highest number of such households as expected. Some observations emerged from Table 5.9 that were worth noting. First, no systematic pattern between the survey times was observed within the district, except for Pallisa, where the majority had one meal for at most seven out of thirty days. In Kiboga and Mbarara, a slightly higher percentage had one meal for at most seven days prior to the main and second follow-up surveys, and for more than fifteen days prior to the first follow-up survey. Generally speaking, the above coping strategies were short term.

Table 5.9 Distribution of Households Skipping a Meal by Number of Days (%)

	Kiboga			Mbarara			Pallisa		
No. Days	Main	Follow 1	Follow 2	Main	Follow 1	Follow 2	Main	Follow 1	Follow 2
1 - 7	60.0	33.3	71.4	62.5	44.4	50.0	91.9	96.7	93.5
8 - 14	15.0	23.8	14.3	20.8	0.0	25.0	2.7	3.3	3.2
15^+	25.0	42.9	14.3	16.7	55.6	25.0	5.4	0.0	3.2
Valid cases	20	21	7	24	9	8	37	61	62

Notes: Follow 1 and 2 stand for first and second follow-up surveys, respectively.

The drought of 1991 - 1992 affected many rural areas in the country including the so-called food surplus districts. This was quite striking for rural households, as they have to start planning on a longer-term basis. Nearly 70 percent of the households in the sampled areas reported to have started adopting long-term strategies to minimise food shortages in the future. Some 52.0 percent of the households reported to have increased growing a variety of crops and started food crop diversification. Growing a variety of crops was seen as a way of minimising food yield risks. Food crop diversification was mainly through shifting from less to more drought resistant crops, such as cassava and sweet potatoes, especially in Kiboga and Mbarara districts. However, some respondents reported that their efforts to grow drought-resistant crops such as cassava were subverted by the cassava mosaic disease.

Secondly, some 33.2 percent of the households reported to have started practising proper food planning, such as prompt planting, weeding, harvesting, and improving food preservation methods and storage facilities. The households that used not to preserve food and practise proper storage methods reported to have started. Finally, nearly 26 percent reported limiting food sales to only excess, stocking foods during harvesting and savings. Fourth, some 13.5 percent reported increasing their efforts to meet the minimum consumption levels, through putting in more hours and investing their meagre incomes in food production.

The approach of Ramider *et al.* (1990) was used to get information on women's perceptions of their household food security in terms of low income, poor harvest and domestic workload. Results are presented in Table 5.10 and refer to cases where all of these three factors applied. For instance, the response 'never' indicated cases when any of the questions in column one did not apply due to inadequate income, poor harvest and domestic workload. Only 6.0 percent of women respondents in Pallisa never worried about running out of food to serve their households, compared to 20.0 percent and 30.0 percent in Kiboga and Mbarara, respectively. Only 16.0 percent of the respondents in Pallisa did not report any member of a household going to bed hungry, compared to 65.0 and 82.0 percent in Kiboga and Mbarara, respectively. Some 52.0 percent of the respondents in Mbarara perceived that their households were not suffering from any dietary inadequacies as compared to 33.0 percent in Kiboga and only 8.0 percent in Pallisa.

Table 5.10 Women's Perception of their Household Food Security

	Never			Sometimes			Often		
	Kiboga	Mbarara	Pallisa	Kiboga	Mbarara	Pallisa	Kiboga	Mbarara	Pallisa
Ever worry about food shortages	20	33	6	5	19	21	1	1	2
Any household member ever go to bed hungry	65	82	16	1	2	20	0	0	0
Household dietary inadequacies	33	52	8	4	13	15	1	1	1
Household members ever skip meals	51	70	12	3	4	8	0	0	0
Her own dietary inadequacies	36	57	4	9	11	19	0	1	3

On the other hand, more respondents in Mbarara sometimes perceived that their households were getting inadequate dietary intake than those of Kiboga (4.0 percent) and less than those in Pallisa (15.0 percent). About 57.0 percent of the respondents in Mbarara never perceived themselves as getting an inadequate diet as compared to some 36.0 percent in Kiboga and only 4.0 percent in Pallisa. More respondents in Pallisa sometimes perceived themselves as getting inadequate diet than in the other two districts

5.2.3.6 Household Dietary Intake Characteristics

a) Across Food Groups and District

The staples such as matooke, cereals and tubers made up the main dish of the rural households. Legumes, meat, fish, and vegetables were eaten as side dishes. This partly explains the higher contribution of staples to the daily dietary intake. Statistically significant differences were observed in the percentage distribution of each food group to overall daily dietary intakes between districts during the same survey (Appendix 6). The sources of calories, protein and iron from the groups varied across the sampled districts considerably. The households of Pallisa derived a significantly higher proportion of their daily dietary intakes from tubers than those of either Mbarara or Kiboga except during the second follow-up survey. Despite the matooke food group being the poorest in terms of calories, protein and iron per kilogram, it was the major source of calories to the households in Mbarara district (30 percent) compared to only 8 percent in Pallisa. While the cereal group is richer in nutrients per kilogram than either tubers or the matooke group, it ranked second in Pallisa, third in Mbarara and fourth in Kiboga. Households of Pallisa derived a significantly higher proportion of their dietary intake from cereal than those of the other two districts for all three surveys. The proportion of caloric intake derived from meat was comparable to the findings of Bender and Smith (1997, p.15) for African countries. Overall, the households derived over 60 percent of their caloric intake from starchy staples, a finding within the range of 60-70 percent reported by Poleman (1981, p.29) for most Asian and Africa countries.

Further, results in Appendix 6 suggest that the proportion of protein intake derived from legumes were well above that from the other five food groups. Households of Kiboga derived a significantly higher percentage of protein intakes from legumes than either those of Mbarara or Pallisa. Generally, the proportions of protein and iron intakes derived from meat were significantly higher in Mbarara and Kiboga than those of Pallisa. Additionally, meat contributes a small percentage to the overall iron intake. Overall, the starchy staples contributed over 30 percent to protein intake and over 40 percent to iron intake with a higher percentage by households in Pallisa. This reinforces the role of starchy staples in the overall household dietary intakes. The percentage distribution of dietary sources in the sampled districts were comparable to the findings of MoPED (1995 1996b) and Ssekiboobo and Kakande (1994).

There is, however, some statistically significant seasonal dimension to the dietary composition, for all districts[42]. The percentage of dietary intake derived from cereal was significantly lower during the second follow-up survey than that in either the main or first follow-up surveys in the case of Kiboga and Mbarara; whereas a significantly higher contribution was observed for the households of Pallisa during the second follow-up survey. The percentage of caloric intake derived from matooke was significantly different across surveys in the case of Mbarara. A significantly lower contribution of matooke in the second follow-up than the first follow-up survey was observed. The overall contribution of tubers to dietary intakes varied significantly across surveys except for Kiboga and Mbarara between the main and first follow-up surveys. Additionally, a significantly lower contribution of legumes to dietary intake between the second survey and the other two surveys, in the case of Mbarara is observed. The variations in the contribution of each food group across the surveys may be indicative of the seasonal variations in the farming systems.

b) Within Food Group Distribution

The within food group distribution of sources of calories, protein and iron varied considerably across districts (Table 5.11), using data from the main survey. Despite being relatively expensive, beef dominated the protein and iron intakes within the meat group. Sweet potatoes contributed the highest proportion in the roots and tubers food group in all districts and for all food security proxies, with Pallisa and Kiboga recording over 60 percent. Despite the overall richness in calories, protein and iron found in dried cassava, the contribution was only 3 percent in Kiboga compared to over 20 percent in the other two districts.

Groundnuts and dried beans contributed a larger proportion in the legumes food group for all food security proxies and in all districts, with dried beans dominating. While groundnuts and soybeans are almost twice as rich in calories per kilogram as the other foods within the same group, the contribution of soybeans was less than 3 percent in Kiboga and Mbarara as compared to over 18 percent in Pallisa. For the cereal group maize flour dominated in Kiboga and millet in the other two districts. Despite millet being richer in protein per kilogram than rice, its proportion was lower in Kiboga than that of rice regardless of the latter being more expensive. Rice recorded a low

[42] Results not presented here but available on request.

contribution to dietary intake among the foods within the same group among households of Pallisa, despite being among the largest rice growing districts in the country. This is due to the fact that rice is mainly grown as a cash crop. The distribution of sources of dietary intakes within food groups reflects the traditional consumption patterns in the rural areas, which in turn echoes the local farming systems and cultural food preferences.

Table 5.11 Within Food Group Distribution of Sources of Calories, Protein, and Iron by District

	Kiboga			Mbarara			Pallisa		
Food	Calories	Protein	Iron	Calories	Protein	Iron	Calories	Protein	Iron
	%	%	%	%	%	%	%	%	%
Meat									
Beef	33	45	61	38	52	80	39	46	66
Pork	8	9	8	0	0	0	5	6	8
Goat's meat	4	5	7	1	2	6	5	5	7
Mutton	0	0	0	0	0	0	2	1	2
Chicken	11	13	12	2	3	4	13	14	16
Eggs	6	6	12	3	3	10	1	1	1
Milk	37	23	0	56	40	0	35	27	
Roots & tubers									
Dried cassava	3	3	3	26	24	23	29	26	26
Fresh cassava	29	22	27	27	23	27	7	6	7
Sweet potatoes	61	63	61	41	44	42	64	68	67
Irish potatoes	7	12	9	6	10	8	0	0	0
Legumes									
Groundnuts	40	36	16	25	23	11	34	28	15
Fresh beans	8	10	11	13	15	15	1	1	1
Dried beans	50	50	70	58	58	71	36	33	49
Peas	0	0	0	2	2	2	12	12	12
Soybeans	2	3	3	1	2	1	18	25	23
Cereal									
Millet	17	19	24	65	65	72	42	43	48
Maize flour	48	51	52	23	23	19	24	25	20
Sorghum	2	3	3	5	5	5	25	25	26
Rice	32	28	22	8	7	4	9	8	5

c) Distribution According to Headship

Studies cited in section 3.4.11 reported mixed results regarding the issue of headship. Some studies have repeatedly argued that female-headed households are more disadvantaged in all aspects than male-headed households. This prompted examining whether or not headship was an important factor in the sampled households. Table

5.12 displays the distribution of dietary sources by headship using data from the main survey. It is evident that female-headed households in Mbarara were significantly more secure in terms of calories and protein than male-headed households. There were no significant differences in the other two districts.

Table 5.12 Dietary Intake as Percentage of RDI and Distribution of Dietary Intake by Source

	Kiboga			Mbarara			Pallisa		
	MHH	FHH	Prob	MHH	FHH	Prob	MHH	FHH	Prob
Calories as % RDI	100.5	101.8	0.899	92.2	115.6	0.038*	68.3	75.2	0.548
Protein as % RDI	162.6	155.0	0.679	146.1	187.5	0.027*	76.0	101.5	0.144
Iron as % RDI	159.7	154.7	0.800	147.1	171.8	0.168	95.3	108.5	0.459
% calories by source									
Matooke	23.0	29.8	0.055#	30.2	29.2	0.801	2.8	0.2	0.236
Tubers	25.0	24.7	0.922	12.2	10.3	0.469	44.4	65.1	0.007*
Cereal	14.1	11.5	0.277	24.9	26.6	0.671	24.9	20.3	0.404
Meat	6.9	3.7	0.002*	11.5	9.1	0.431	2.7	1.1	0.299
Legumes	24.8	26.2	0.586	17.5	21.4	0.132	24.2	13.2	0.075#
Oils	5.0	2.8	0.022*	2.0	2.1	0.944			
Others	1.3	1.5	0.431	1.6	1.3	0.603	0.0	0.2	0.278
% protein by source									
Matooke	11.8	16.3	0.036*	15.6	14.0	0.542	1.7	0.2	0.342
Tubers	7.8	8.6	0.568	3.7	3.5	0.830	17.5	33.1	0.005*
Cereal	12.5	11.6	0.693	23.4	24.1	0.848	25.7	24.9	0.897
Meat	19.8	11.4	0.000*	23.2	16.5	0.112	7.5	5.1	0.445
Legumes	46.5	50.4	0.271	32.8	40.3	0.061*	47.5	36.6	0.210
Others	1.6	1.7	0.698	1.3	1.5	0.508	0.1	0.0	0.305
% iron by source									
Matooke	15.5	19.5	0.169	19.7	16.8	0.338	1.9	0.1	0.307
Tubers	19.4	19.0	0.892	9.4	7.7	0.403	34.2	53.8	0.009*
Cereal	10.4	8.8	0.443	25.6	24.8	0.842	24.4	21.5	0.604
Meat	7.9	4.3	0.001*	7.2	3.7	0.33*	2.4	1.2	0.438
Legumes	42.8	44.0	0.752	34.1	43.1	0.034*	36.8	23.3	0.075#
Others	3.9	4.2	0.658	3.9	3.7	0.886	0.3	0.0	0.241

Notes: *significant at prob<0.01 and #significant at prob<0.08.
MHH – male-headed households and FHH is female-headed households.

In Kiboga, female-headed households derived a significantly higher percentage of their caloric and protein intakes from matooke than male-headed households. The percentage of dietary intake derived from meat was significantly higher in male-headed households than in female-headed households. This was also true for oils. In Pallisa, female-headed households derived a significantly higher percentage of their dietary intake from tubers than male-headed households. This was also true for protein and iron intakes. The proportion of calorie intake derived from legumes was significantly higher for the male-headed households than female-headed households. On the contrary, Mbarara recorded no such significant differences between the distribution of sources of calories.

A significant difference between female-headed and male-headed households in the proportion of protein intake derived from meat consumption was noted. In Mbarara, female-headed households derived a significantly higher percentage of protein and iron intakes from legumes than male-headed households. Overall, these findings at this point indicate no systematic pattern regarding distribution of dietary sources by headship.

5.2.3.7 Dietary Adequacy

In terms of dietary adequacy (as expressed in Eq. 5.7), the percentage of households that were food insecure varied considerably across the surveys and districts. Comparably, households of Pallisa were significantly more food insecure than those of the other two districts. However, no significant differences were observed between Mbarara and Kiboga. The percentage of households that were food insecure in all calories, protein and iron combined were relatively more in Pallisa district than the other two districts over the three surveys (Table 5.13, last column). Overall, the

Table 5.13 Distribution of Food Insecure Households

District/survey	Calories	Protein	Iron	All
	%	%	%	%
Kiboga				
Main	56.0	28.0	31.0	21.0
First follow-up	86.8	53.8	14.3	14.3
Second follow-up	54.4	41.1	5.6	5.6
Mbarara				
Main	63.0	18.0	23.0	13.0
First follow-up	76.5	28.2	3.5	3.5
Second follow-up	91.6	68.4	24.2	24.2
Pallisa				
Main	86.0	59.0	57.0	49.0
First follow-up	90.0	82.0	43.0	43.0
Second follow-up	79.8	71.7	26.3	26.3

findings disagree with the tendency that caloric sufficiency implies sufficiency in other nutrients. They are, however, consistent with the results of studies that push for the concept of household food security to be broadened to include micronutrients

(ACC/SCN, 1992; Delisle *et al.*, 1991). In terms of headship, female-headed households in Mbarara were significantly more secure in terms of calories and protein than male-headed households (Table 5.12).

For all districts, the average daily caloric intakes for all surveys (Table 5.14) were lower than the national average caloric intake reported by the MoPED (1996b) of about 2,400 kcal. These figures were also lower than 2,419 kcal (UNDP 1994) recommended for all SSA countries and only higher than the critical minimum of 2,200 kcal suggested by WHO in the case of Kiboga prior to the main survey. The average protein intakes were above the recommended level of 57.7 gm by FAO (1973) for Kiboga and Mbarara prior to the main survey. The average protein intake for Pallisa district was lower than the national figure of 50 gm reported by the MoPED (1995, 1996b). The differences in average daily intake do not necessarily provide information on the households whose food security was at risk.

Households at Risk of Food Insecurity

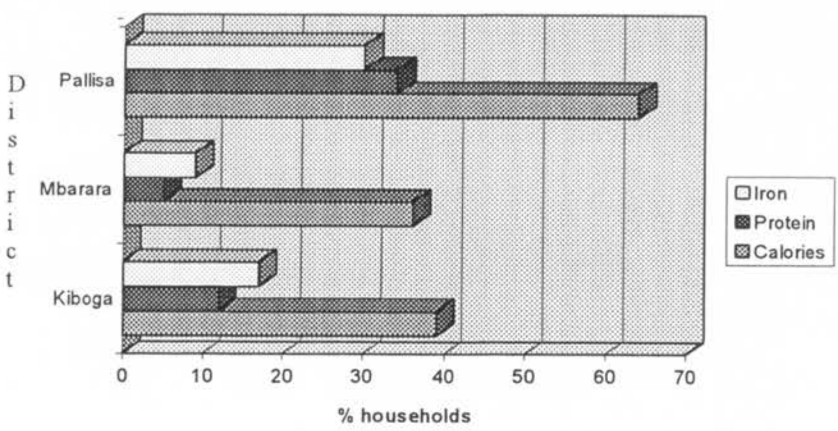
Researchers have applied different cut-off points of the recommended daily dietary intake to examine households at risk of food insecurity. For instance, Rogers (1996) and Alderman and Garcia (1993) use a cut-off point of 75 percent and Delisle *et al.* (1991) employ a cut-off point of 60 percent for calories and 75 percent for protein. This study employs a cut-off point of 75 percent with the results presented in Table 5.14. Figure 5.1 depicts the households at risk of becoming food insecure by district using data from the main survey. More than 60 percent of the households in Pallisa consumed less than 1,720 kcal prior to all surveys. In Kiboga, less than 40 percent of the households consumed not more than 1,664 kcal of calories prior to the main and second follow-up surveys, as compared to nearly 62 percent prior to the first follow-up. On the contrary, less than 40 percent of the households consumed not more than 1,734 kcal of calories prior to the main and first follow-up surveys, as compared to 72.6 percent in the second follow-up survey, in the case of Mbarara.

Some 29.8 percent of the households in Kiboga consumed less than 29.86 gm of protein prior to the first follow-up survey, as compared to only 14 percent and 21.4 percent prior to the main and second follow-up surveys, respectively. About 41.3 percent of the households in Mbarara consumed less than 31.33 gm prior to the second follow-up survey compared to 5 percent and 9 percent prior to the main and first follow-up surveys, respectively. Nearly 68 percent of the households in Pallisa consumed less than 31.06 gm of protein prior to the first follow-up survey as compared to only 36 and 44.4 percent prior to the main and second follow-up surveys, respectively.

Table 5.14 Distribution of Average Daily Dietary Intake by District and Survey

District/survey	Calories		Protein		Iron		Valid cases
	Mean	Households at risk	Mean	Households at risk	Mean	Households at risk	
	Kcal	%	Gm	%	Mg	%	
Kiboga							
Main survey	2,221	39.0	66.27	14.0	18.62	17.0	100
First follow-up	1,560	61.9	41.09	29.8	23.76	6.0	91
Second follow-up	2,189	36.9	48.53	21.4	32.97	1.2	90
Mbarara							
Main survey	2,196	36.0	64.87	5.0	17.69	9.0	100
First follow-up	1,845	39.0	53.02	9.0	27.58	2.0	85
Second follow-up	1,438	72.6	40.0	41.3	18.67	9.5	95
Pallisa							
Main survey	1,519	64.0	39.81	36.0	12.73	30.0	100
First follow-up	1,242	79.0	26.48	68.0	18.32	26.0	100
Second follow-up	1,594	65.7	38.52	44.4	23.82	15.2	99

Figure 5.1 Households at Risk of Food Insecurity by District - Main Survey



Nearly 17 percent of the households in Kiboga consumed less than 8.87 mg of iron as compared to only 6 and 1.2 percent prior to the first and second follow-ups, respectively. Only 2 percent of the households in Mbarara consumed less than 8.81 mg of iron prior to the first follow-up survey, compared to 9 and 9.5 percent prior to the main and second follow-up surveys, respectively. Results in Table 5.14 suggest that Pallisa had more households at risk of iron insecurity than those in the other two districts, with more than 20 percent of the households consuming less than 8.99 mg of iron prior to the main and first follow-up surveys. Generally speaking, Pallisa districts had the highest proportion of households at risk of food insecurity compared to the other two districts. However, for individual districts, households were more prone to caloric insecurity than either protein or iron insecurity.

Table 5.15 presents a comparison of households at risk of food insecurity with those at no such risk by district using data from the main survey. The households with larger family size were more likely to be at risk of becoming caloric insecure in all districts; protein insecure in the case of Pallisa and iron insecure in the case of Pallisa and Mbarara. If we take total expenditure on food as a measure of income, households with lower incomes were more likely to be at risk of becoming food insecure. The households with older women were more likely to be protein and iron insecure in the case of Pallisa district. Additionally, households with more children were more likely to be at risk of becoming caloric insecure in the case of Mbarara and Kiboga. No such significant differences were noted in terms of time spent on productive activities and women's income.

Table 5.15 Comparison of Households at Risk and Those at no Risk of Food Insecurity Using Selected Variables.

	Kiboga			Mbarara			Pallisa		
	No Risk	At Risk	Prob	No Risk	At Risk	Prob	No Risk	At Risk	Prob
Caloric Security									
Household size	5.4	7.8	0.000*	6.5	8.8	0.001*	6.9	8.5	0.062#
Food expenditure	67,531	46,051	0.000*	72,395	54,473	0.017*	49,873	24,458	0.000*
Productive time	4.7	5.3	0.211	5.12	5.4	0.495	4.6	4.7	0.750
Woman's income	3,541	3,341	0.891	14,011	6,016	0.196	5,966	3,001	0.252
Woman's age	35.6	35.6	0.990	38.2	36.9	0.659	35.3	37.9	0.279
Prop. of children	53.6	63.4	0.005*	51.5	59.6	0.064#	47.6	48.7	0.790
Protein security									
Household size	6.3	7.2	0.312	7.4	7.2	0.916	7.1	9.6	0.007*
Food expenditure	62,685	33,263	0.000*	68,041	26,090	0.011*	37,036	26,952	0.095#
Productive time	4.9	5.5	0.401	5.2	6.2	0.327	4.6	4.8	0.521
Woman's income	3,704	1,702	0.360	11,509	4,000	0.583	4,800	2,649	0.413
Woman's age	35.1	39.5	0.270	37.2	47.8	0.102#	35.5	39.8	0.081#
Prop. of children	56.5	63.8	0.176	54.2	58.3	0.672	46.6	51.6	0.228
Iron security									
Household size	6.4	6.5	0.909	7.0	10.7	0.002*	7.0	10.0	0.001*
Food expenditure	64,214	34,447	0.000*	64,954	75,950	0.387	37,330	24,922	0.046*
Productive time	4.9	5.4	0.391	5.2	6.0	0.287	4.6	4.7	0.765
Woman's income	3,713	2,246	0.438	11,190	10,555	0.951	4,737	2,508	0.412
Woman's age	36.4	31.8	0.185	37.3	41.9	0.355	34.5	42.6	0.001#
Prop. of children	56.2	63.6	0.124	53.5	63.4	0.176	49.3	45.9	0.419

Notes : *significant at prob <0.01 and #significant at prob < 0.08.

Time is a very important dimension of the concept of household food security. Clearly, a household's food security today does not guarantee tomorrow's security. Accordingly, to examine the time dimension effect only those households that participated in all the three surveys were considered, that is, 84, 80 and 99 in the case of Kiboga, Mbarara and Pallisa, respectively, using a cut-off point of 75.0 percent of the recommended daily dietary intake. Some 34.4 percent of these households in Pallisa experienced caloric insecurity in all surveys compared to only 15.5 and 20.0 percent in Kiboga and Mbarara, respectively. In Mbarara, no households suffered protein and iron insecurity prior to all the surveys. Nearly 16 percent of the households in Pallisa experienced protein insecurity as compared to only 3.6 percent in Kiboga prior to all surveys. On the other hand, some 27.4 percent (54.8 percent) of the households in Kiboga were caloric (protein) secure prior to all the surveys as compared to 18.8 percent (52.2 percent) and 4.0 percent (19.2 percent) in Mbarara and Pallisa, respectively. More than 70 percent of the households in Mbarara and Kiboga were iron secure prior to all the surveys as compared to only 48.5 percent in Pallisa. These findings further point to Pallisa as more prone to food insecurity than either Kiboga or Mbarara. The percentage of food insecurity households would definitely increase with increases in the threshold level.

5.3 Concluding Remarks

The methodology used to gather data for this study has been discussed and problems associated with the data were spelt out. Some observations emerged from the descriptive statistical data analysis that are worth noting. There was striking evidence that households in the sampled areas were both consumption and production units, hence supporting the application of household production theory. Results showed that rural households were semi-subsistence farmers, the non-existence of a labour market and that decisions within the household were mostly jointly made. The analysis has confirmed the incidence of household food insecurity among the rural households that has long been overshadowed by national food security, and consequently taken for granted by the government. The severity of household food insecurity and dietary sources varied greatly from district to district. This analysis will facilitate the choice of the model in the next chapter.

6 Model, Procedures and Techniques

In Chapter 3, different approaches to investigating rural household behaviour in relation to food were discussed. Details of their strengths and weaknesses were also discussed and only a summary is repeated here. Separable agricultural household models dominated such analyses. In general, researchers assumed production and consumption decisions to be separable. More specifically, they ignored the prevalence of market failures, existence of imperfect substitution between the work of husbands and wives and, more so, the explicit incorporation of the crucial role women play in rural household welfare. In this chapter an empirical nonseparable agricultural household model that captures the simultaneity that exists between production and consumption decisions among the rural households in Uganda while appealing to the theory presented in Chapter 4 is presented.

6.1 Theoretical Model

Most of the previous studies with the exception of such studies as de Janvry *et al.* (1992) and Jacoby (1991, 1992) have incorporated time allocation in the agricultural household without differentiation by gender. Such studies not only ignore the gender division of labour in an African setting but also make a woman's time allocation invisible in influencing household food production, consumption or both. This study postulates each household to allocate its total time $T=(T^m,T^w)$ among the productive activities $F=(F^m,F^w)$, domestic activities $H=(H^m,H^w)$ and leisure $L=(L^m,L^w)$; where superscripts m and w refer to the male and female who is either the head or spouse to the head of the household, respectively. Time allocated to different farm activities[44], is assumed to be fixed in the short run. Thus, time constraints for the husband and wife are expressed as in Eqs. 6.1 and 6.2, respectively. The labour inputs of the wife and the husband are hypothesised to be imperfect substitutes.

$$(6.1)\quad T^m \le F^m + H^m + L^m$$

$$(6.2)\quad T^w \le F^w + H^w + L^w$$

The following assumptions are made on time allocation within a household: off-farm and hired labour, and onfarm labour provided by children and other adult members are constant.

[44] Farm activities such as land preparation, sowing, weeding and harvesting.

Rural households in Uganda are semi-subsistence farmers as discussed in Chapter 2 and empirically demonstrated in Chapter 5. They grow a variety of food crops, partly for their own consumption and partly for markets. Each household is postulated to produce s outputs $Q = (q^1, q^2, ..., q^s)$, at prices $P_q = (p_q^1, p_q^2, ..., p_q^s)$; and these outputs are jointly produced with family labour inputs F^w, F^m at shadow wage rates w^w, w^m, respectively, and t other farm inputs $E = (e^1, e^2, ..., e^t)$ at $P_e = (p_e^1, p_e^2, ..., p_e^t)$. Contrary to the traditional production theory, the literature indicates that effective access to productive resources by rural women in developing countries influences household production, consequently affecting the household's command over food. Land degradation, availability of storage facilities, knowledge of food preservation methods and availability of markets for farm produce are also factors that affect household production. Accordingly, let $N = (N^1, N^2, ..., N^f)$ denote the vector of the non-conventional factors of production. The multi-production function for the i^{th} household by gender is then expressed as in Eq. 6.3.

(6.3) $Q_i^d = f(F^d, E, N)$ for d = w, m

It is assumed in Eq. 6.3 that wives and husbands operate different farms. However, in Uganda and in particular the sampled areas, superscript *d* on the dependent variable is dropped as some enterprises are worked on fully by women or jointly as discussed in Chapter 5. Furthermore, the farm inputs are allocatable neither by gender nor by crop. Household production is assumed to be riskless.

The household is postulated to maximise profit from its farm operations in the short run. The 'profit' comes partly from the sale of its food surplus. However, in Uganda this should be interpreted cautiously, as some rural households sell part of their subsistence food as discussed in Chapters 2 and 5. The household short-run profit function is expressed as in Eq. 6.4 and is assumed to satisfy the usual profit function assumptions. *f(.)* is as defined in Eq. 6.3 and the rest of the variables are as defined before.

(6.4) $\underset{q \succ 0}{Max}\ P_q f(.) - w^w F^w - w^m F^m - P_e E = \pi_i (P_q, w^w, w^m, P_e; N)$

As previously discussed in Chapter 5 (section 5.1.4), rural households consume a variety of food items derived mainly from own production and purchases. Each household is postulated to consume r food items from own production $X=(x^1,x^2,...,x^r)$, which can be purchased at $P_x=(p_x^1,p_x^2,...,p_x^r)$; s purchased food items $Z=(z^1,z^2,...,z^s)$ at price $P_z=(p_z^1,p_z^2,...,p_z^s)$; and t nonfood items $Y=(y^1,y^2,...,y^t)$ at price $P_y=(p_y^1,p_y^2,...,p_y^t)$. In addition to consumption of food items, the household is said to derive utility from leisure, L. Appealing to the new household economics and Chayanovian household theories, this study takes into account the demographic factors that influence household consumption decisions. This caters for the differences in the consumption patterns across households. These factors enter the utility function as separate arguments (Pollak and Wales 1980, 1981, 1992). Let $C=(C^1,C^2,...,C^k)$ denote the vector of the household socio-demographic characteristics. Thus, a rural household is said to jointly maximise utility as expressed in Eq. 6.5 subject to time and income constraints expressed in Eqs. 6.6 and 6.7, respectively. S^w, S^m denote the nonfarm incomes earned by wife and husband, respectively.

(6.5) $$\underset{x \succ 0}{Max}\, U_i(X,Y,Z,L^m,L^w;C)$$

subject to

(6.6) $$F^d+H^d+L^d \leq T^d, \qquad T^m+T^w \leq T$$

(6.7) $$P_xX+P_zZ+P_yY+w^wL^w+w^mL^m \leq \pi_i(P_q,w^w,w^m,P_e;N)+S^w+S^m$$

The joint utility maximisation within the household has been among the basis under which the agricultural household models have come under criticism. In the sampled area, joint utility maximisation is justifiable based on the decision-making process that takes place within the household. Although some studies (for example, UNICEF 1994) have portrayed the male head as dominant in the household decision-making process, the sampled area portrays the contrary (see section 5.2.1.4). In the male-headed households, joint decisions in food sales, crops grown for sale and home consumption, milk and disposal of farm outputs dominated individual decisions; whereas decisions on the number of meals and snacks were entirely made by women. Individually, women's decision-making dominated the food system cycle, ranging from the type of crops grown to the time when food is prepared for consumption. Furthermore, intra-household food distribution was fair in most households as previously discussed in section 5.2.3.3.

The household profit is introduced in the income constraint in Eq. 6.7, a point of departure from the traditional consumption theory. The price vectors P_q and P_x may overlap since the households consume much of their produce. Under the local nonsatiation assumption, utility maximising consumption bundles must meet the income constraint in Eq. 6.7 with equality. Given the duality that exists between the direct and indirect utility function, the household is postulated to maximise a joint indirect utility function that gives the maximum utility achievable at given prices and income as expressed in Eq. 6.8.

$$V_i(P_x, P_y, P_z, w^w, w^m, M; C) = Max(X, Z, Y, T^m - F^m - H^m, T^w - F^w - H^w; C)$$

(6.8) subject to

$$P_x X + P_y Y + P_z Z + w^w L^w + w^m L^m - \pi_i(.) - S^w = S^m$$

where *V(.)* is an indirect utility function and said to satisfy the usual assumptions; $M = \pi_i(.) + S^w + S^m$ is the household full income; and the rest of the variables are as defined before.

Due to some data problems, some compromises in the transition from the above theoretical model to the estimated model were made. Accordingly, the study proceeds taking into account the labour markets and very low application of other farm inputs, especially improved seeds and fertilisers, in rural Uganda. Imperfections in the labour markets pose a major problem in the empirical estimation of an agricultural household model as presented in Eq. 6.8, especially in this case where rural women do not work for a wage. As discussed in Chapter 2 and 4, imperfections in the rural labour markets are prevalent in Uganda. Researchers have employed different methods to impute a value for labour (shadow wage), especially for those individuals who are self-employed including onfarm employment or household members who do not work for a wage. The first category of these studies assumed wage rates to be exogenous to the households. Some researchers have applied an *ad hoc* method of imputing the wage rate. Assuming the male participates in the labour market but not the female, then a male equivalent scale is assumed for the female rate. This male equivalent scale is then multiplied through the male wage rate to derive the female wage rate. For households not hiring labour for use on the farm, Zindi (1997) used the prevailing wage in the nearest geographic area to impute a wage. Studies such as Rosenzweig (1980) assumed a perfect labour market. To compute the shadow wage rate for the self-employed or non-participants in the labour markets, they use information for participants in the labour market corrected for sample selection, a method advanced by Heckman (1974).

The second category of these studies has assumed the shadow wage rate to be determined within the households. Some studies (such as Gronau 1977; Jacoby 1993; Skoufias 1993, 1994; Lambert and Magnac 1994) have used the marginal productivity of labour derived via the agricultural production technology as proxies for wages. In contrast, Newman and Gertler (1994) follow a primal approach that does not require the estimation of marginal returns. They use the optimal condition that the marginal rate of substitution of household consumption for leisure equals the marginal returns to labour to derive the shadow price for labour at the equilibrium level. Coyle (1994, p.54) follows a dual approach by assuming a household maximises an indirect utility function and profit function conditional on the optimal choice of family labour. He does not directly derive the shadow wage rate, but instead derives the first order condition for an optimal choice of family labour (see Coyle, 1994, pp. 52-55). This current study subsequently adopts Coyle's approach.

While other farm inputs used in food production were incorporated in Eq. 6.8, application of inputs such as fertilisers and improved seeds was negligible over the sampled households. Exasperating as this is, the fact is that very few households applied such farm inputs. All this renders P_e redundant.

This study assumes a separable indirect utility function for food, which implies a two-stage budgeting hypothesis, which was discussed in detail in section 4.1.3. At stage one, households determine their broad expenditures on the following broad categories, namely, food, health, education, and other nonfood items. At stage two, group expenditures are allocated among the items in each broad group. At this stage the household is postulated to maximise a group utility function. Therefore, for the discussion that follows it is assumed that the household maximises an indirect food group utility function on condition that all household full income is spent on food. A translog functional form is assumed for the conditional profit function, $\tilde{\pi}(.)$ as expressed in Eq. 6.10. Let the functional form for the conditional indirect utility function, $\tilde{V}(.)$, be expressed as in Eq. 6.9 (see Varian, 1992, p.128). These functional forms are less restrictive. The socio-demographic characteristics are assumed to enter the indirect utility function by the scaling method discussed in Chapter 3.

$$(6.9)\quad \tilde{V}(.) = \left[M^{1-\phi} + \frac{\phi - 1}{(1+\beta)(1+\sigma)} \prod (e^{\alpha} C^{\varphi} N^{\eta} F^{d\lambda} (P_x^{1+\beta} P_z^{1+\sigma}) \right]^{\frac{1}{1-\phi}}$$

$$(6.10)\quad In\tilde{\pi}_i(.) = \varsigma_0 + \sum_j^s \varsigma_j Inp_q^j + \sum_k \gamma_0 InC^k + \sum_d \delta_0 InF^d + \sum_f \rho_0 InN^f + \frac{1}{2}\sum_j^s \sum_k^s \iota_{jk} Inp_q^j Inp_q^k + \frac{1}{2}\sum_s^f \sum_t^f \rho_{st} InN^s InN^t + \frac{1}{2}\sum_s^d \sum_t^d \delta_{st} InF^s InF^t + \frac{1}{2}\sum_s^k \sum_t^k \gamma_{st} InC^s InC^t + \sum_j^s \sum_f \omega_{jf} Inp_q^j InN^f + \sum_j^s \sum_k \varpi_{jk} Inp_q^j InC^k + \sum_j^s \sum_d \theta_{jd} Inp_q^j InF^d$$

The first order condition for an optimal choice of $F^{d\lambda}$ is expressed as Eq. 6.10a, and the conditional household food demand equations are specified using Roy's theorem as expressed in Eq. 6.10b and food production equations using Hotelling's Lemma as expressed in Eq. 6.10c.

$$(6.10a)\quad \frac{\partial \tilde{V}(.)}{\partial F^{d\lambda}} + \frac{\partial \tilde{V}(.)}{\partial M} \bullet \frac{\partial \tilde{\pi}(.)}{\partial F^{d\lambda}} = 0$$

$$(6.10b)\quad x^r = -\frac{\partial \tilde{V}(.)/\partial P_x}{\partial \tilde{V}(.)/\partial M} \qquad z^s = -\frac{\partial \tilde{V}(.)/\partial P_z}{\partial \tilde{V}(.)/\partial M}$$

$$(6.10c)\quad q_s = \frac{\partial \tilde{\pi}(.)}{\partial q_s}$$

The demand equations in Eq. 6.10b are highly nonlinear and to avoid this, these equations are transformed by taking natural logarithms on both sides as expressed in Eq. 6.9. The i^{th} household output equations are as expressed in Eq. 6.13. After carrying out the necessary manipulations on the first-order conditions for the optimal choice of family labour by gender, the expression for labour supply is given in Eq. 6.14.

$$(6.11)\quad Inx_i^r = \alpha_{ir} + \sum_r \beta_{ir}^x Inp_{ix}^r + \sum_s \sigma_{is}^x Inp_{iz}^s + \phi_{ix} InM_i + \sum_k \varphi_{ikr} InC_i^k + \sum_f \eta_{ifr} InN_i^f + \sum_d \lambda_{idr} InF_i^d$$

$$(6.12)\ Inz_i^s = \alpha_{is} + \sum_r \beta_{ir}^z Inp_{ix}^r + \sum_s \sigma_{is}^z Inp_{iz}^s + \phi_{iz} InM_i + \sum_k \varphi_{iks} InC_i^k + \sum_f \eta_{ifs} InN_i^f + \sum_d \lambda_{ids} InF_i^d$$

$$(6.13)\ Inq_i^s = \varsigma_i + \sum_s \iota_{is} Inp_q^s + \sum_f \omega_{if} InN^f + \sum_k \varpi_{ik} InC^k + \sum_d \theta_{id} InF^d$$

$$(6.14)\ InF_i^d = \widetilde{\delta}_{oi} + \sum_j \widetilde{\delta}_{ij} InP_j + \sum_f \widetilde{\mu}_{if} InN^f + \sum_k \widetilde{\kappa}_{ik} InC^k$$

Eqs. 6.11 to 6.13 are said to satisfy the usual consumer and producer assumptions. Modelling the household production and consumption decisions in a nonseparable manner is obvious from Eqs. 6.11 to 6.13. For instance, the food demand equations are jointly affected by the variables on the production and consumption side of the model, which are expressed in terms of the quantities demanded by the i^{th} household. As discussed in section 3.5.2, some researchers (such as Strauss 1984, 1986) have employed such equations or expressed them in share forms to derive the price and income elasticities that are later used to derive the caloric-income and price elasticities indirectly. This approach is not adopted here as it may fail to capture household food security and it is reported by researchers such as Behrman (1995) to bias the elasticities upwards. To circumvent these problems, the study employs a direct approach. The subsequent sections demonstrate how Eqs. 6.11 and 6.12 are translated into a form that directly captures household food security.

The various definitions of household food security which were discussed in section 3.1 all agree on the characteristics of household food security as secure access to adequate food at all time. Thus, for a household to be food secure, its food intake must be greater than or equal to the recommended intake requirements. Dietary intake as in household food security is measured in this study in terms of calories, protein and iron. Iron is chosen among the micronutrients, as high deficiencies are reported in Uganda (see Republic of Uganda 1996).

Since this study's main emphasis is on overall household food security, it necessitated aggregating each food derived from own production and purchases and thereafter derive their overall nutritional values in terms of calories, protein and iron as discussed in Chapter 5. Thus, Eqs. 6.11 and 6.12 are added together to allow the derivation of nutritional equivalents from all foods consumed from different sources. Let $x_{ij} = (x_i^r + z_i^s)$ for $j = r + s$ denote the quantity of the j^{th} food item consumed by the i^{th} household for all sources combined; $p_{ij} = (P_x, P_z)$ food prices; d_j^n the n^{th} nutritional value (n = *calories, protein, iron*) per unit derived from the consumption of the j^{th} food item; and then A_i^n the reported daily n^{th} nutritional food intake by the i^{th} household expressed as in Eq. 6.15.

$$(6.15)\quad A_i^n = \sum_j d_j^n x_{ij}$$

The demand expressions in Eqs. 6.11 and 6.12 (ignoring the *In* for simplicity) are substituted for x_{ij} into Eq. 6.15 to derive:

$$(6.16)\quad A_i^n = \alpha_{ij} + \sum_j \widetilde{\beta}_{ij} p_{ij} + \phi_i M_i + \sum_k^{k-1} \varphi_{ik} C_i^k + \sum_f \eta_{if} N^f + \sum_d \lambda_{id} F_i^d + \sum_s \gamma_{is} h_{is}$$

The expression in Eq. 6.16 predicts the impact of a change in the exogenous variables on household food intake, in terms of calories, protein and iron. The i^{th} household composition is included by sex as h_s, for s=(f = female and m = male). On the other hand, the recommended food requirements are given at an individual level but can easily be translated into a household level (see section 5.1.4). Assume the recommended daily n^{th} food intake (R_i^n) weighted by sex for the i^{th} household be expressed as in Eq. 6.17.

$$(6.17)\quad R_i^n = \sum_s \omega_{is} \cdot r_s^n h_{is}, \quad \text{for } s = \text{m, f}$$

where ω_s is the proportion of the s^{th} sex and r_s^n the corresponding recommended n^{th} daily intake weighted by age for the i^{th} household. Assume $\omega_s r_s^n = \gamma_s$ (from Eqs. 6.16 and 6.17), that is, the sex impact on both the recommended and actual n^{th} food intake is the same. Then Eq. 6.17 for the i^{th} household can be re-expressed as in Eq. 6.18:

$$(6.18)\quad G_i^n \equiv A_i^n - R_i^n = \alpha_{ij} + \sum_j \widetilde{\beta}_{ij} p_{ij} + \phi_i M_i + \sum_k \varphi_{ik} C_i^k + \sum_f \eta_{if} N^f + \sum_d \lambda_{id} F_i^d$$

Re-introducing *In*, G_i^n measures the n^{th} actual daily food intake as a proportion of the recommended daily intake for the i^{th} household; and $\alpha, \widetilde{\beta}, \phi, \varphi, \eta$ and λ are parameters to be estimated and the rest of the variables are as defined before. The lower the proportion of the actual daily intake to recommended daily intake the more food insecure the household is deemed. The price variables in Eq. 6.18 are the price of the food item but not the price per nutrient, since government policies directly affect the former.

6.2 Procedures

The rural households covered in the survey as a group reported consumption of over 50 different food items such that aggregation of items was inevitable (see section 5.1.4). Some degree of aggregation was required to limit the parameters to be estimated to a manageable number. Assuming weak separability, the food items consumed were therefore aggregated into 7 groups: meat, cereals, oils, tubers, legumes, matooke and miscellaneous foods (see section 5.1.4). For each food group a weighted group price is derived on the items reported to have been consumed by the household.

On the production side, household food production was aggregated into a single product category. Output prices were aggregated into three to five groups according to district. Aggregation on both the consumption and production side facilitated the estimation of a complete agricultural household model. Derivation of the weighted prices and nutritional intake were discussed in section 5.1.4.

6.2.1 Empirical Model

In the light of the above discussion, the system of equations estimated using a nonseparable agricultural household model is as expressed in Eqs. 6.19 - 6.21. Since the model is estimated using econometric techniques, disturbance terms were added to the equations. The disturbances are additive and assumed to be normally distributed with mean zero and constant covariance matrix, that is (o,Ω).

$$(6.19)\quad In\,G_i^n = \alpha_n + \sum_g \widetilde{\beta}_{ng} In\,\overline{p}_i^g + \phi_n InM_i + \sum_k \varphi_{ink} C_i^k + \sum_f \eta_{\inf} N_i^f + \sum_d \lambda_{ind} F_i^d + \varepsilon_{ni}$$

$$(6.20)\quad In\overline{q}_i = \overline{\varsigma}_i + \sum_q \widetilde{\iota}_{iq} In\,\overline{p}_i^q + \sum_f \omega_{if} InN^f + \sum_k \varpi_{ik} InC^k + \sum_d \theta_{id} InF^d + \nu_i$$

$$(6.21)\quad InF_i^d = \widetilde{\delta}_i + \sum_j \widetilde{\delta}_{ij} In\,\overline{p}_{ij}^s + \sum_f \widetilde{\mu}_{if} N_i^f + \sum_k \widetilde{\kappa}_{ik} C_i^k + \tau_i$$

where:

G_i^n = i^{th} overall household food security (%) in the n^{th} food intake for n = calories, protein and iron, for all food sources combined;

$\bar{p}_i^g$ = g^{th} weighted group food price (Ug.Shs/kg) (g = *Pmeat, Pcereal, Poils, Ptubers, Plegumes, Pmatooke and Pmiscellaneous*) consumed by the i^{th} household;

$\bar{p}_i^q$ = q^{th} weighted group output price (Ug.Shs/kg) (q = *matookep, tubersp, cerealp, legumesp*) for the i^{th} household;

$\bar{q}_i$ = aggregate output (kg) for the i^{th} household;

M_i = real full income (Ug.Shs) for the i^{th} household;

N^f = vector of productive resources *(f=credit, extension services, farming land, farming equipment, improved seeds and labour)*;

C^k = vector for socio-demographic variables (k = $Size_i$, Cw_i, *Educ1, Educ2, Market*, $Share_i$, $Hwom_i$, $Hmem_i$, $Head_i$, Age_i, $Type_i$);

$Size_i$ = head count as a proxy for household size for the i^{th} household;

Cw_i = consumer:worker ratio as a proxy for the i^{th} household life cycle;

Educ1 = 1 if a woman respondent never attended school
= 0 else;

Educ2 = 1 if a woman respondent had primary education
= 0 else;

Educ3 = 1 if a woman respondent education higher than primary
= 0 else;

Market = distance to the nearest produce market in kilometres;

$Share_i$ = percentage share of a woman's assets value in total i^{th} household asset value;

$Hwom_i$ = 1 if a woman had been sick during the 30 days prior to the survey in the i^{th} household
= 0 else;

$Hmem_i$ = 1 if other members of the household had been sick during the 30 days prior to the survey in the i^{th} household,
= 0 else;

$Head_i$ = 1 if i^{th} household is headed by a male
= 0 otherwise;

Age_i = woman's age in completed years in the i^{th} household;

$Type_i$ = 1 if the i^{th} household derives much of its consumption from own production
= 0 otherwise;

F_i^d = number of man-hours spent daily on productive activities by d (= m w) in the i^{th} household; and

$\varepsilon_i, v_i, \tau_i$ = disturbance terms to take account of the excluded variables and assumed to be normally distributed.

It is obvious from the model above that variables are either discrete or continuous. The discrete variables include education, head of the household, household type, health status of the women and other household members, and accessibility to productive resources. The system of equations in Eqs. 6.19 - 6.21 was estimated by district given differences in the distribution of the sources in calories, protein and iron intake as discussed in section 5.2.3.6.

6.2.2 Description of the Explanatory Variables Included

a) Prices and Household Income

Most food demand studies that have used cross-sectional data have excluded food prices; the major problem being lack of enough variability in the prices. However, the food prices used in this study have variations. Within each district, price variations in individual food items consumed and produced by the sampled households were observed. These variations made it possible to estimate the effects of prices on household food security. To estimate a complete nonseparable agricultural household model, some degree of aggregation across food items was inevitable as discussed above. Thus, weighted food group prices were employed as presented in Chapter 5.

Unlike conventional consumption theory, the household production theory postulates a household to maximise utility subject to household full income. According to Becker (1965), household full income comprises its net money income from all sources plus the opportunity cost of household time not spent in the labour market. However, as discussed above and in Chapter 5, non-existence of a formal rural labour market in Uganda made getting rural wage rates difficult. Therefore, the full income considered by this study differs slightly from Becker's. It comprises earnings from farming plus income from sources other than farming. Earnings from farming were derived by multiplying quantities produced by output prices. It is hypothesised that an increase in household full income leads to improvements in overall household food security.

b) Women-Specific Variables

In most SSA countries, and in particular Uganda, women play a crucial role in the three pillars of household food security. Consequently, examining women's entitlements can capture a household's command over food. The factors considered as a measure of a woman's entitlements include her share in the total household assets, education, health status, time spent on productive activities and access to productive resources, including land, credit, extension services and hired labour.

Studies on food security have continued to ignore the role household assets play in times of food scarcity. The households, and in particular women, can dispose of some of their assets to cater for food shortages. To derive asset values, the quantities of the assets were multiplied by their respective values that prevailed at the time of the survey. Then the percentage share of the value of women's assets in the total household assets was derived. A positive relationship is hypothesised between a woman's share in household assets and household food security.

A positive relation is also hypothesised to exist between a woman's education level and household food security. The study recorded education in level terms, that is, no education, primary, and secondary or higher.

Women's health status cannot be ignored in examining household food security. Their health has direct consequences on household food security through food production and consumption. A woman's poor health is hypothesised to inversely affect food production and consumption. Besides woman's health, the health status of other members of the household inversely affects woman's time and reduces household income, negatively affecting household food accessibility. If a woman reported poor health a score of one was assigned, otherwise zero was assigned.

A woman's labour time allocation affects her household food security. The sign on time allocation variable cannot be determined *a priori*. Time allocation included time allocated to productive activities, domestic activities and sleeping. Leisure time was derived as a residual. The time spent on productive activities included time in the garden in the case of the women. Domestic activities include activities such as fetching water, child care, food preparation, collecting firewood to name a few. Time was measured in hours.

A woman's access to productive resources was hypothesised to inversely affect the household's command over food. The productive resources included credit facilities, extension services, farming land, farming equipment, improved seeds and hired labour.

c) Other Socio-demographic Variables

Household size measures economies of scale in consumption, that is, to maintain the same consumption levels, large families need to spend less on highly priced foods, though richer in terms of particular nutrients. Some studies have assumed constant economies of scale by incorporating income as per capita income. This study included household size and income as separate variables. Head count was used as a proxy for household size.

The consumer:worker ratio was used as a proxy for the household members' life cycle. The higher the ratio the more mouths to feed than productive hands. This puts pressure on women's time, consequently affecting household food security.

Distance to the nearest produce market was used as a proxy for physical access. This has implications for both net food sellers and buyers. For either case, the sign of the coefficient cannot be determined *a priori*.

Most studies have incorporated the age of the head of the household, who is usually a male head. This study instead incorporated on both sides of the model the age of the woman. Data on age were recorded as the number of completed years at the time of the survey.

Household type, as argued by Phillips and Taylor (1990), plays a crucial role in assessing household food security. Those households which derived more than 65 percent of their food consumption from own production were regarded as 'net food producers', otherwise as 'net food buyers'. This was derived as a percentage of total food value from own production divided by total food value from all sources. Thus, those households with more than 65 percent were assigned 1 as net food sellers, and the others were assigned zero as net buyers.

6.3 Techniques

The nonseparability behaviour assumed to exist between household production and consumption decisions leads the error terms ε_i, ν_i and τ_i to be contemporaneously correlated. Consequently, estimating the parameters using OLS and 2SLS will lead to inefficient results. Zellner's seemingly unrelated regression techniques would have been an alternative but some explanatory variables are endogenous to the system. Thus, to consistently estimate the parameters, Eqs. 6.19 to 6.21 are estimated as a system using the 3SLS method. It yields efficient estimates as long as the variance-covariance matrix of the error terms is not diagonal (Griffiths *et al.* 1993; Judge *et al.* 1985). However, efficiency will be threatened in circumstances where errors are heteroscedastic and ignored. To test the null hypothesis of a diagonal variance-covariance matrix, the Lagrange Multiplier (LM) statistic suggested by Breusch and Pagan (1980) was employed. It is defined as in Eq. 6.22.

$$(6.22)\quad \lambda_{LM} = N\sum_{i=2}\sum_{j=1}\left(\hat{\sigma}_{ij} \big/ \hat{\sigma}_{ii}\hat{\sigma}_{jj}\right)^2$$

where $\hat{\sigma}_{ij} = \hat{e}_i\hat{e}_j \big/ N$. The total number of observations (N) appears in the denominator instead of total number of observations less the number of explanatory variables included in the equations. This takes into account the above system equations, Eqs. 6.19-6.21, where the number of variables included in each equation is not the same. Although this leads $\hat{\sigma}_{ij}$ to be a biased estimator, it is asymptotically consistent (Judge *et al.* 1985, p.321). Under the null hypothesis of a diagonal variance-covariance matrix, the LM statistic follows an asymptotic $\chi^2_{(N(N-1)/2)}$ distribution. The *Shazam Econometrics Computer Program Version. 8.0* (White 1997) was used to estimate Eqs. 6.19 - 6.21 as a system of equations.

6.3.1 Testing for Heteroscedasticity

Since this study uses cross-sectional data the problem of heteroscedasticity is inevitable. The presence of heteroscedasticity in the error terms affects the efficiency of the parameter estimates but does not affect the consistency. Consequently, incorrect inferences are drawn when testing statistical hypotheses if heteroscedasticity is ignored. To the knowledge of the researcher there is hardly any research carried out to indicate how such diagnostic tests are carried out on a system using cross-sectional data. Instead, such tests are carried out on a single-equation basis (see Duncan 1983; Beggs 1985). Therefore, this study tested for heteroscedasticity equation by equation using the B-P-G test statistic. Under the null hypothesis of homoscedasticity, the B-P-G test statistic is postulated to follow a χ^2 distribution with *N-K-1* degrees of freedom, where N is the total number of observations and K is the number of explanatory variables in an equation. If the B-P-G test statistic was greater than the critical χ^2 value at a given level of significance, then the null hypothesis of homoscedastic errors was rejected. Once rejected, the original form was transformed according to the form of heteroscedasticity.

This study employed a weighted least squares method (see Ramanathan 1997, p.426) to correct for heteroscedasticity. All variables in the equation affected were divided through by the estimated residual from the original equation. The equation was re-estimated with the transformed variables without an intercept. The B-P-G test statistic was applied on the transformed equation to check for any more prevalence of heteroscedasticity. If the null hypothesis was rejected, the transformed variables were further transformed using the estimated residual values from the previously transformed equation. This process continued until the null hypothesis of homoscedastic errors was accepted. The conventional $\bar{R}^2$ ceases as a measure of goodness of fit since it gives the proportion of explained variation in the transformed dependent variable, not in the original units.

6.3.2 Testing for Multicollinearity

Although the presence of multicollinearity among explanatory variables does not violate regression assumptions, it does affect the size, standard errors and signs of the parameter estimates (see Fomby *et al.* 1984, p.284; Green 1997, p.279). The presence of multicollinearity reduces the usefulness of the parameter estimates for policy making purposes. There are various tests suggested in econometrics textbooks for detecting multicollinearity among explanatory variables but unfortunately they are only suggestive; they fail to provide a way forward to solving the problem once detected. Despite the weaknesses of the simple correlation analysis (see, for example, Fomby *et al.* 1984, p.294) it was used to detect pair-wise correlations among the explanatory variables. In addition to simple correlation analysis, auxiliary regressions were run to detect multicollinearity among the explanatory variables. When the r^2 of a particular explanatory variable on all other variables was higher than the $\overline{R}^2$ of the equation, then that variable was investigated further.

6.3.3 Testing for Separability

Much of the literature on agricultural household models has concentrated on labour decisions. Lopez (1984, 1986) provides the first explicit test of nonseparation using standard non-nested hypothesis techniques to compare separable and nonseparable models. Benjamin (1992) points out that Lopez's technique is sensitive to misspecification tests and it is also difficult to decipher the rejection of separation. Searching for a potential nonseparable technology to Peruvian peasant farmers, Jacoby (1992) employs a sequential testing procedure. His results reveal that female and male labour are nonseparable in animal traction and land. Benjamin (1992) develops an empirical model to test the proposition that household labour demand is not dependent on household structure using household data from rural Java. The null hypothesis that family labour allocation decisions are independent of household structure was not rejected. This study subsequently adopts Benjamin's approach.

6.3.4 Goodness-Of-Fit

Goodness-of-fit of parameter estimates indicates how well the estimated equation fits the data. $\overline{R}^2$ has dominated as a measure of goodness-of-fit in empirical work, especially when single equations are estimated. However, the conventional $\overline{R}^2$ cannot be used where equations are estimated as a system (Greene 1997; Berndt 1991, p.468; Judge *et al.* 1985, p.478; Kmenta 1986). In a single equation context, the F-test statistic that corresponds to the null hypothesis that all slopes of parameter estimates are simultaneously equal to zero is related to the conventional $\overline{R}^2$ measure. This translated into a system of equations and, using McElroy's test $\widetilde{R}^2$, a test statistic under the null hypothesis that all slope parameter estimates in all equations in the system are simultaneously equal to zero is expressed in Eq. 6.23 (see Greene 1997, p.679).

(6.23) $\text{Likelihood ratio test} = N\ln(1-\widetilde{R}^2)$

This test statistic is postulated to follow a χ^2 distribution with degrees of freedom equal to the number of independent slope parameter estimates in the system of equations. Therefore, this LR test statistic was employed to test the goodness of fit for the system equations.

6.3.5 Treatment of Zero Observations

The major problem of using cross-sectional data in food demand and supply studies is the occurrence of zero consumption/production of some food items, and hence zero prices. Treatment of such zero prices has varied considerably from one study to another (see section 3.5.3). On the consumption side, the bias introduced by zero prices was minimised by aggregation across food items. The number of households faced with zero prices on the consumption side was very small. However, on the production side a relatively large number of the households did not produce some of the crops even after some degree of aggregation, especially for Pallisa district. This is as expected since the survey covered a single growing season. Ignoring this problem may lead to biased estimates. To solve this problem, average prices were computed for those households with non-zero production and then used for those households that reported zero production of the same crop.

For the female-headed households, zero values appeared for husband-specific variables. This also can lead to biased estimates. However, inclusion of the headship dummy variable in the model minimises the bias. This is following Battese (1997).

6.4 Concluding Remarks

In light of the above discussion, a nonseparable agricultural household model that treats household consumption and production decisions simultaneously is suggested. This is a departure from the previous studies carried out elsewhere in Africa that have unrealistically assumed separability for rural households. This model takes into account the non-existence of formal labour markets and imperfect substitutability of work of wives and husbands in rural Uganda. It is within this nonseparable framework that the impacts of the changes in the exogenous variables on household food security are examined. Among the explanatory variables are the women-specific variables meant to facilitate examination of their crucial role in ensuring household food security. The dependent variables on the consumption side of the model are explicitly expressed in a way that measures household food security directly using three proxies, calories, protein and iron. Since the household is taken as the unit of analysis, it was important to convert the recommended intake and the reported actual intakes to reflect this unit of analysis. The heterogeneity of the households in terms of age and sex composition was taken into consideration during the conversion process.

To empirically apply the nonseparable agricultural household model suggested above, comprehensive primary data were collected covering data on variables relevant for examining household food security in rural Uganda (see Chapter 5). The empirical results are presented in the next chapter.

7 Empirical Results and Discussion

The nonseparable agricultural household model as specified in the preceding chapter was estimated using the procedures and method of estimation described. The assessment criteria for the parameter estimates were based on economic theory, statistical performance and the researcher's knowledge of the rural household food consumption and production behaviours.

The organisation of the chapter is as follows. In section one a discussion of the parameter estimates of the consumption side of the nonseparable agricultural household model is presented. A discussion of the results of the production side of the nonseparable agricultural household model is the subject of section two. This is followed by a discussion of the diagnostic tests carried out on the system of equations and equations individually in section three. The chapter ends with some conclusions and general observations on the results.

7.1 Estimated Results for the Consumption Side

Household food security elasticities are important in understanding and providing guidance to policymakers in food policy formulation and developing food intervention program. They provide empirical information on the effects of changes in exogenous factors on households' command over food. Signs and magnitudes of elasticities are useful in monitoring the direction and size of changes in households' entitlements on its food security. As previously discussed, such estimates are non-existent in Uganda. Up to the present day, the government employs *ad hoc* measures in addressing household consumption and production, which indirectly affect household food security. Without such estimates realisation of effective planning may not be forthcoming.

Given the heterogeneous nature of the sampled households (see Chapter 5), the agricultural household model was estimated by district. This will provide estimates useful to policymakers on the direction and extent of the exogenous effects for each district. The parameter estimates of the consumption side of the household model are presented in Tables 7.1, 7.2 and 7.3 for Kiboga, Mbarara and Pallisa, respectively. The parameter estimates in these tables are elasticities. Hypotheses testing involved not only testing for significance of individual coefficients but also testing for equality of the coefficients across the models of household food security proxies. The first seven variables in each of these tables are the weighted food group prices as described in section 6.2.1.

Table 7.1 Results on the Consumption Side of the Nonseparable Agricultural Household Model - Kiboga

	Calories as % RDI		Protein as % RDI		Iron as % RDI	
Variable	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
*ln*Pmeat	0.06	2.36*	0.11	2.82*	0.07	2.06*
*ln*Pcereal	0.01	0.31	-0.01	-0.45	-0.02	-0.66
*ln*Poils	0.02	2.45*				
*ln*Ptubers	-0.00	-0.04	0.03	0.68	0.02	0.49
*ln*Plegumes	0.09	1.18	0.27	2.35*	0.01	0.08
*ln*Pmatooke	-0.08	-2.33*	-0.11	-2.13*	-0.10	-2.10*
*ln*Pmiscellaneous	0.06	1.90*	0.10	2.02*	0.07	1.60
*ln*Income	0.62	9.03#	0.45	4.73#	0.70	6.64#
*ln*Size	-0.80	-8.64#	-0.61	-4.37#	-0.78	-5.92#
Educ2	0.04	0.32	0.08	0.49	-0.15	-0.87
Educ3	0.02	0.19	0.10	0.52	-0.16	-0.88
Hwom	-0.09	-1.51#	-0.20	-2.18#	-0.09	-1.01
*ln*Fwom	-0.45	-2.20*	-0.93	-3.10*	-0.37	-1.22
*ln*Fman	0.19	2.11*	0.48	3.78*	0.06	0.44
Type	-0.16	-2.60*	-0.20	-2.29*	-0.29	-3.04*
Head	-0.32	-1.64	-0.90	-3.17*	-0.03	-0.11
*ln*Share	0.02	1.29#	0.05	2.19#	0.05	2.01#
Constant	2.38	4.63*	2.73	3.48*	2.86	3.90*
$\bar{R}^2$	0.58		0.07		0.49	

Notes: #Significant at 90% level of significance for a one tailed t-test or better level.
*Significant at 90% level of significance for a two tailed t-test or better level.
*ln*income is the logarithm of the full income.

Table 7.2 Results on the Consumption Side of the Nonseparable Agricultural Household Model – Mbarara

	Calories as % RDI		Protein as % RDI		Iron as % RDI	
Variable	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
*ln*Pmeat	-0.00	-0.23	0.00	0.07	0.03	1.36
*ln*Pcereal	-0.04	-1.19	0.03	0.74	0.00	0.07
*ln*Poils	0.00	0.48	-	-	-	-
*ln*Ptubers	0.03	1.61	-0.00	-0.12	0.08	3.36*
*ln*Plegumes	-0.00	-0.03	0.00	0.07	-0.06	-1.13
*ln*Pmatooke	-0.10	-3.74*	-0.13	-4.58*	-0.09	-2.35*
*ln*Pmiscellaneous	-0.03	-1.05	-0.02	-0.69	-0.04	-1.10
*ln*Income	0.64	11.82#	0.56	8.87#	0.40	4.95#
*ln*Size	-0.84	-11.66#	-0.74	-8.96#	-0.65	-6.19#
*ln*Share	0.00	0.24	0.01	0.64	-0.00	-0.06
Educ2	0.13	1.83#	0.17	2.14#	0.14	1.34
Educ3	0.13	1.60#	0.11	1.10	0.07	0.53
*ln*Age	-0.32	-3.58#	-0.35	-3.38#	-0.20	-1.50#
Head	-0.41	-3.57*	-0.42	-3.21*	-0.37	-2.16*
Hmem	-0.14	-2.50#	-0.14	-2.22#	-0.11	-1.33*
*ln*Fwom	-0.48	-4.11*	-0.43	-3.17*	-0.70	-3.96*
*ln*Fman	0.11	2.17*	0.10	1.66*	0.04	0.53
Type	-0.07	-1.21	-0.11	-1.64	-0.01	-0.12
*ln*Cw	-	-	-	-	-0.08	-2.16*
Constant	5.52	8.87*	6.07	8.55*	6.63	7.00*
$\bar{R}^2$	0.66		0.59		0.36	

Notes: #Significant at 90% level of significance for a one tailed t-test or better level.
*Significant at 90% level of significance for a two tailed t-test or better level.

Table 7.3 Results on the Consumption Side of the Nonseparable Agricultural Household Model – Pallisa

	Calories as % RDI		Protein as % RDI		Iron as % RDI	
Variable	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
*ln*Pmeat	0.07	1.69*	0.03	0.37	0.10	1.65*
*ln*Pcereal	0.01	0.44	0.03	0.91	-0.01	-0.43
*ln*Poils	-0.18	-1.80*	-	-	-	-
*ln*Ptubers	-0.05	-1.16	-0.23	-3.38*	-0.06	-1.00
*ln*Plegumes	0.00	0.06	0.08	1.62	0.02	0.46
*ln*Pmatooke	-0.06	-0.23	0.20	0.54	-0.23	-0.70
*ln*Pmiscellaneous	0.14	1.61	0.07	0.49	0.18	1.55
*ln*Income	0.46	11.47$^{\#}$	0.36	6.18$^{\#}$	0.36	6.73$^{\#}$
*ln*Size	-0.44	-5.46$^{\#}$	-0.41	-3.26$^{\#}$	-0.43	-3.87$^{\#}$
Educ2	0.08	1.41$^{\#}$	0.15	1.68$^{\#}$	0.07	0.92
Educ3	-0.01	-0.09	0.26	1.26$^{\#}$	-0.05	-0.28
*ln*Age	-0.27	-2.81$^{\#}$	-0.36	-2.34$^{\#}$	-0.14	-1.04
Head	-0.47	-2.54*	-0.80	-2.85*	-0.55	-2.23*
Hwom	-0.21	-2.73$^{\#}$	-0.23	-1.98$^{\#}$	-0.19	-1.79$^{\#}$
*ln*Fwom	-0.58	-1.31	-0.91	-1.36	-0.62	-1.04
*ln*Fman	0.29	3.34*	0.59	4.48*	0.45	3.82*
Type	-0.07	-1.18	-0.08	-1.00	-0.01	-0.06
*ln*Cw	-	-	-0.10	-2.25$^{\#}$	-0.04	-1.08
Constant	5.18	3.49*	5.15	2.55*	4.57	2.59*
$\bar{R}^2$	0.67		0.27		0.37	

Notes: $^{\#}$Significant at 90% level of significance for a one tailed t-test or better level.
*Significant at 90% level of significance for a two tailed t-test or better level.

7.1.1 Effects of Real Income

The real income parameter was used instead of nominal income, by deflating the latter by the Stone price index. In all districts and for all proxies of household food security, real income was positive and statistically significant, but inelastic. In Kiboga, a one percent increase in real income of the rural households led to improvements in daily caloric security by 0.62 percent, protein by 0.45 percent and iron by 0.70 percent. Testing the equality of the income elasticity across the models, a significantly lower response in daily protein security than in either iron or caloric security is noted. As their income increases, rural households in Kiboga consume more foods richer in iron than either calories or protein. The caloric-income elasticity was significantly higher than the protein-income elasticity.

In Mbarara, a one percent increase in real income led to improvements of daily caloric security by 0.64 percent, protein by 0.56 percent and iron by 0.40 percent. Results indicate a significantly higher response in daily caloric security than the other two proxies. The high incidence of households that were caloric insecure partly explains this finding. That is to say, increasing their income improves their daily caloric intake more than either iron or protein intakes. This induces them to consume more foods richer in calories than either protein or iron. The impact of income was significantly higher for protein security than iron security. These households were more responsive to changes in real income than those in the other two districts, except for iron security.

In Pallisa, a one percent increase in real income of the rural households led to improvements in daily caloric security by 0.46 percent, protein by 0.36 percent and iron by 0.36 percent. Households in Pallisa recorded the least food security improvements from changes in real income. A one percent increase in real income led to a significantly higher improvement in daily caloric security than the other two proxies of food security. As their incomes increase, rural households in Pallisa consume more foods richer in calories than either protein or iron. The high response in caloric security could be partly explained by the high incidence of households that were caloric insecure.

There are possible explanations for the positive sign on the income variable. Since most of these households depend heavily on their own production, increases in their full income may induce them to invest more in activities that improve their overall productivity. The improvements in productivity will not only increase food availability, but will also lead them to have a surplus for sale. Re-investing the income derived from food sales may enhance their productivity, leading to improvements in food accessibility. The income may also be used to purchase those foods that the household derives mainly from the market, such as meat.

The magnitude of income elasticities derived was sizeable for all proxies of household food security in all three districts. Under the traditional consumption theory, when consumption of a food item has not reached satiation level, the income elasticity of the food item will be far from zero. Using this analogy in demand for nutrients, the results show that these rural households' food security is still below the satiation levels. However, this has to be interpreted cautiously across districts.

Despite the income elasticities being sizeable, how do they compare with those derived in other developing countries? The nutrient-income elasticities have varied considerably across studies and from country to country. The caloric-income elasticities derived in this study are in the range reported in previous studies carried out elsewhere in developing countries (such studies as cited by Strauss and Thomas 1995, p.1894; Teklu 1996; Bouis and Haddad 1992, pp.336-337; Behrman and Deolalikar 1987; Wolfe and Behrman 1983). However, this has to be interpreted cautiously. The variations in nutrient-income elasticities are due to methodological differences such as: choice of the dependent variable, proxy for household income, the data collection methods and the estimation procedures (Wolfe and Behrman 1983; Behrman 1995); the level of food items aggregation (Strauss 1986, p.137; Deaton 1988); measurement errors (Alderman and Garcia 1993); omission of food prices in such estimations; and separability of household food consumption and production decisions. All in all, these explanations point to the non-systematic considerations in data, modelling and estimation issues that have characterised food demand analysis. Since this study estimated caloric-, protein- and iron-income elasticities directly, the level of food aggregation does not appear to be a potential cause for high income elasticities.

The overall findings show iron, as a proxy for micronutrients, was as responsive to income changes as daily caloric and protein security. This is consistent with the observations by Behrman (1995) that micronutrients are also income-responsive. Overall, raising income of the rural households is a significant determinant in improving their household food security, *ceteris paribus*. This concurs with the position of the proponents of raising income as a way of getting rural households out of food insecurity (such the World Bank 1988; Srinivasan 1985; MoPED 1996b). However, this poses the issue of how to initiate policies designed to improve incomes of rural households.

What implications do these elasticities have on those households whose food security is at risk? As discussed in Chapter 5, the number of households at risk of food insecurity varied across the three proxies within each district. For the households at risk of food insecurity to have at least 75.0 percent of the recommended daily dietary intakes, their incomes have to improve considerably. Those at risk of caloric insecurity require a monthly increase in nominal income of Ug. Shs.29,747.50, Ug. Shs. 25,768.60 and Ug. Shs. 34,073.30 to reach 1,728 kcal, 1,665 kcal and 1,720 kcal for Mbarara, Kiboga and Pallisa, respectively, *ceteris paribus*. That is, their incomes have to increase from the existing levels by 41.5 percent, 45.0 percent and 121.3 percent, respectively. The households at risk of protein insecurity require a monthly increase in nominal incomes of Ug. Shs. 18,096.00, Ug. Shs. 17,049.60 and Ug. Shs. 35,278.40 to reach 25.98 gm, 23.10 gm and 21.40 gm for Mbarara, Kiboga and Pallisa respectively. That is, their incomes have to increase from the current levels by 44.4 percent, 42.3 percent, and 117.9 percent, respectively. Those at risk of iron insecurity require a monthly increase in nominal income of Ug. Shs. 159,100.00, Ug. Shs. 16,909.00 and Ug. Shs. 24,253.60 to reach 7.09 mg, 6.87 mg and 6.93 mg for Mbarara, Kiboga and Pallisa, respectively. That is, their incomes have to increase from the existing levels by 62.5 percent, 36.9 percent and 87.2 percent, respectively. In other words, to move these households already at risk to not at risk of becoming food insecure requires raising the level of income. Concomitantly, moving these households to higher income levels will possibly take time.

7.1.2 Effects of Household Size

As discussed in the previous chapter, the study incorporated household size as a separate variable in the model. In all three districts, the effect of household size was negative and statistically significant for all the three proxies of household food security. The negative sign is consistent with the findings of Wolfe and Behrman (1983) but contrary to the findings of Rogers (1996).

In Kiboga, a 15.6 percent increase in household size led to a fall in daily caloric security by 12.4 percent, protein by 9.5 percent and iron by 12.2 percent. The response was significantly higher in daily caloric security than the other two proxies. The size variable had a significantly higher impact on iron security than protein security. Using the sample mean levels, increasing household size by one person reduced caloric intake by 278 kcal, protein by 6.04 gm and iron by 2.27 mg. This increases the number of households at risk of food insecurity by 6 percent, 4 percent and 4 percent in terms of calories, protein and iron, respectively.

In Mbarara, a 13.5 percent increase in household size led to a fall in daily caloric security by 11.3 percent, protein by 10.0 percent, iron by 8.8 percent. Like Kiboga, daily caloric security was significantly more responsive to household size than the other proxies. Using the sample mean levels, increasing household size by one person reduces caloric intake by 249 kcal, protein by 6.36 gm and iron by 1.56 mg. This increases the number of households at risk of food insecurity by 13 percent, 3 percent and 5 percent in terms of calories, protein and iron, respectively. Such an outcome has serious implications for Mbarara, which has a high incidence of caloric-insecure households.

In Pallisa, a 12.6 percent increase in household size led to a fall in daily caloric intake by 5.5 percent, protein by 5.1 percent and iron by 5.4 percent. Like the other two districts the impact of household size was slightly higher for caloric security than for either protein or iron security. Using the sample mean levels, increasing household size by one person leads caloric intake to decline by 87 kcal, protein by 2.09 gm and iron by 0.68 mg. This increases the number of households at risk of food insecurity by 4 percent, 4 percent and 3 percent in terms of calories, protein and iron respectively. It is observed that the households of Pallisa experienced the lowest decline, in absolute terms, for all the three proxies of food security.

In all the districts, the impact of household size was not uniform across household food security proxies. In Kiboga and Pallisa, the impact of household size was slightly higher for iron security than protein security. The reverse was true for Mbarara households. Household size had the highest impact on caloric and iron security in Kiboga and on caloric and protein security in Mbarara.

Given that these rural households derive much of their consumption from own production, the larger the household size the higher the food production, consequently improving overall household food accessibility. However, the overall results for all three districts suggest the contrary. There are possible explanations for this finding. First, the high youth dependency ratios in the sampled areas could have partly contributed to this finding. Second, the increase in household size, *ceteris paribus*, may have led to re-allocation of household food budget away from nutritionally richer food to less richer ones. The extent of re-allocation depends on the life cycle of the household members. Even if such re-allocations do not take place, an increase in household size, if not followed by a proportionate increase in the available food, will result in reduced intakes per person.

The sign and magnitude of the household size elasticity is important since it reflects the extent of returns to scale in consumption with respect to size (Behrman and Deolalikar 1987; Wolfe and Behrman 1983). The results in Tables 7.1-7.3 suggest the presence of returns to scale in consumption. Overall, the household size was more responsive, in absolute terms, than income; an indication of decreasing returns to scale, except for caloric security for Pallisa households. This implies that doubling income and household size does not improve household food security, except for calories in Pallisa, *ceteris paribus*. The explanation could be that as long as these households continue living below the poverty line, an increase in income might not improve their food security due to other pressing basic needs, such as health and education. The returns to scale in consumption were slightly higher in Mbarara than in the other two districts.

7.1.3 Effects of Food Prices

Studies using cross-sectional data have continued to ignore the impact of food prices on dietary intake. These studies either assumed such prices to have no impact on rural household food consumption or such data on price were unavailable (for example, Kyereme and Thorbecke 1991). Teklu (1996) cites some studies carried out in Africa that incorporated food prices. This study explicitly includes food prices in the model as discussed in the previous chapter. It derives results from a model that treats household production and consumption decisions simultaneously, such that signs on coefficients of some food group prices may differ from the expected ones as postulated by the traditional consumption theory. Consequently, interpretation of the same will differ. It is evident from Tables 7.1-7.3 that the effect of prices on the three proxies of food security was not uniform. It varied from district to district and across the proxies of household food security. Some prices were positively and others negatively related to the household food security proxies.

To test the significance of the food group prices on household food security, the study employed a two tailed t-test value at 90 percent level of significance. At this level of significance, less than half of food price coefficients were significant in Mbarara and Pallisa, as compared to more than half in Kiboga. The proportion of significant food price variables increases with the use of a one tailed t-test. However, the validity of using a one tailed t-test is impractical in such circumstances without a *priori* knowledge on the sign of the parameter estimates. In view of this, a two tailed t-test value was employed. The elasticity of household food security proxies with respect to prices of food was inelastic, with none of the estimated price elasticities greater than 0.30. The food price elasticities were well below the income elasticities.

Matooke

In Kiboga district, the price of matooke was consistently negative and statistically significant for all proxies of household food security. A one percent increase in the price of matooke led to a 0.08 percent, 0.11 percent and 0.10 percent fall in calories, protein and iron intakes, respectively. Using the sample mean levels if the price of matooke was to double, caloric intake would decline by 168 kcal, protein by 6.69 gm and iron by 1.77 mg, consequently increasing the number of households at risk of food insecurity by about 3, 4 and 3 percent, respectively.

Despite maintaining the same sign, the matooke price was not significant in the case of Pallisa. This finding is as expected, since matooke was regarded as a foreign food item in this part of the country.

In Mbarara, the matooke price was negative and statistically significant for daily caloric and protein security. A one percent increase in the price of matooke led to 0.10 percent, 0.13 percent and 0.09 percent fall in calories, protein and iron security, respectively. Protein security indicated a significantly higher responsiveness to matooke price than caloric security, despite being a poor source of protein. The price of matooke was more elastic than the other food prices included in the model. Using the mean values, if the price of matooke was to double, the household caloric intake would fall by 211 kcal, protein by 8.49 gm, and iron by 1.59 mg, *ceteris paribus*. This would increase the number of households at risk of food insecurity by 11 percent, 6 percent and 5 percent in terms of caloric, protein and iron intakes, respectively.

A possible explanation for the negative sign of the matooke price variable in Mbarara and Kiboga is that a rise in the price of matooke may have increased its sale at the expense of household food consumption, especially by the poorest of the poor. This is as expected since matooke plays a key role in household dietary intake as reported in

Chapter 5 and at the same time is a source of income. For instance, nearly 74 percent and 42 percent of the households reported deriving their sources of income from the sale of matooke in Mbarara and Kiboga, respectively.

Meat

Generally speaking, meat is taken as a side dish in Uganda. In all districts, almost all households depended on the market for the supply of meat. However, at a more disaggregated level, households in Mbarara derived much of their milk intake from own production. The price of meat was not statistically significant in the case of Mbarara households, although with a somewhat high t-ratio for iron security. The insignificance in the calories and protein equations may be explained by the excess supply of milk, which is one of the food items in this group, within the district.

In Kiboga, the impact of changes in meat price was consistently positive and statistically significant. A one percent increase in the price of meat improved food security by 0.06 percent, 0.11 percent and 0.07 in terms of calories, protein and iron intakes, respectively. The protein-price responsiveness was significantly above caloric-price responsiveness. Using the sample mean levels, if the price of meat doubles, household food security improves by about 132 kcal, 6.88 gm and 1.34 mg, in terms of calories, protein and iron, respectively, *ceteris paribus*. This would reduce the number of caloric, protein and iron insecure households by 5 percent, 3 percent and 3 percent, respectively.

Like Kiboga, increases in meat prices in Pallisa improved food security in terms of calories and iron by 0.07 percent and 0.10 percent, respectively. These households were more responsive to changes in the price of meat than households in Kiboga district. Using the sample mean levels, if the price of meat doubles, the caloric intake increases by about 117 kcal and protein by about 1.26 gm, *ceteris paribus*. This reduces the number of caloric and iron insecure households by 4 percent and 3 percent, respectively.

Regardless of the significance status, both iron and protein security were more responsive to changes in meat prices than caloric security. Overall, a rise in the price of meat discouraged its consumption, and the subsequent substitution toward more nutritionally richer (in terms of calories, protein and iron), but less expensive food items (such as legumes), improved household food security. In other words, a price increase in meat resulted in a sufficiently large increase in demand for other relatively richer foods. The increase was large enough to offset the direct decrease in calories, protein and iron resulting from a reduction in meat consumption. This reflects a strong cross-price substitution effect between meat and other foods consumed by the rural households. The positive sign on the price of meat in the caloric security is consistent with the findings of Strauss (1986, p.138) in Sierra Leone for the fish and animal products food group.

Oils

The oils food group included ghee and other cooking oils, where the former was basically home made from raw milk. In Pallisa, this food group referred to cooking oils, in general, excluding ghee. In all districts, households depended on the market for cooking oils.

The changes in oil prices had a significant and positive effect in Kiboga. A rise in the price of oils led caloric security to improve by 0.02 percent. A rise in the price of oils may have resulted in the substitution of oils consumed by other foods richer in calories but less expensive.

In contrast, an increase in the price of oils in Pallisa led caloric security to fall by 0.18 percent. The oil price was slightly more elastic than that of other food prices. This is surprising given the low contribution of oils to overall caloric intake. However, this has to be interpreted with caution. The oils are used to add flavour to food. The high price of oils may lead to households abandoning consumption of some foods, such as beans, in the urban areas but not in the rural areas. Thus, explanation of a negative sign for rural households is very difficult to justify.

In Mbarara district, households consumed more ghee than any other cooking oils. Most households rearing cattle were able to make their ghee, consequently making its exchange among households limited. The poor packaging of the ghee also limits its market in urban areas. This partly explains the insignificant price of the oils in the caloric security equation.

Miscellaneous Foods

This group includes onions, cabbages, pumpkins, passionfruit and pineapple. The price of the miscellaneous food group was insignificant in Mbarara, although it maintained a negative sign across household food security proxies.

In Kiboga, the price of the miscellaneous foods was positive and statistically significant for all proxies. Using the sample mean levels, doubling the price of the miscellaneous foods improves caloric intake by 130 kcal, protein by 6.11 gm and iron by 1.29 mg. This reduces the number of households at risk of caloric, protein and iron insecurity by 5, 3 and 3 percent respectively. A possible explanation for the positive sign is as follows. The food items included in this group were a source of income, especially onions, to the households. Therefore, the positive sign may have been attributed to the profit effect in the full income.

The impact of the price of the miscellaneous foods on household food security proxies was positive. The caloric and iron securities had somewhat high t-ratios, albeit insignificant. The iron-price elasticity was more elastic than the caloric-price elasticity. Using the sample mean levels, doubling the price of the miscellaneous foods improves caloric intake by 217 kcal and iron intake by 2.30 mg. Consequently reducing the number of households at risk of caloric and iron insecurities by 9 percent and 7 percent, respectively. The same explanation for Kiboga households above holds true for Pallisa households. It is evident from the results in Tables 7.1 and 7.3 that the impact of a price increase on caloric security was slightly higher than that of Kiboga. Results further suggest that changes in the price of the miscellaneous food group had a higher impact on iron security than the other food prices. The impact was also slightly higher in caloric security excluding the price of oils.

Cereals

The price of cereals was not significant in all three districts for all the proxies of household food security. It is evident from Tables 7.1-7.3 that signs on the price of cereals alternated across the three proxies of household food security within individual districts. Surprisingly, these findings were contrary to the expectations. For instance, among the food items included in the cereals group, millet contributed the highest proportion to the dietary intake and also was regarded as a source of income in Pallisa and Mbarara (see Chapter 5). Thus, one would expect the households to be responsive to changes in prices. This could partly be attributed to millet being a labour-intensive crop such that in the short run changes in prices had not effect.

Legumes

In Kiboga, the coefficients of the price of legumes were consistently positive but only statistically significant for protein security. The positive elasticities can be attributed to the profit effect through the full income. An increase in the price of legumes resulted in an improvement in daily protein intake by 0.27 percent. The responsiveness of the price of legumes was well above that of other food prices. The higher responsiveness of the price of legumes can be explained on grounds that it was not only the main source of protein and iron, but also a source of income. Among the food items included in this group, beans contributed the highest proportion, followed by groundnuts, and were also a source of income. Using the sample mean levels, if the price of legumes doubles protein security improves by 18.40 gm, *ceteris paribus*. This reduces the number of protein insecure households by 7 percent.

In Pallisa, the sign on the coefficients of the price of legumes were consistently positive, and the coefficients showed a somewhat high t-ratio in the case of protein although insignificant. Using the sample mean levels, if the price of legumes was to double, household protein intakes would increase by 3.39 gm. The above explanation for a positive sign in the case of Kiboga holds true for the households in Pallisa. The positive price elasticity for legumes is consistent with Bezuneh *et al.* (1988) finding for the millet and sorghum group in Kenya.

There was no systematic direction in the sign on the coefficients of the price of legumes in the case of Mbarara. It is further observed that the price of legumes did not explain household food security. This is contrary to the expectations given the role legumes played in daily dietary intakes and source of income to the households in the district.

Tubers

In Mbarara and Pallisa districts, consistency in the sign of the coefficients on the price of tubers was observed across household food security proxies, except for protein in Mbarara. In Kiboga, the price of tubers was found not only to be insignificant, but also no systematic pattern on the sign was observed.

The price of tubers was positively related to caloric and iron security in Mbarara and statistically different from zero. In other words, an increase in the price of tubers significantly improved household food security in terms of calories and iron. A slightly higher response was observed for iron security. The profit effect may be partly attributed to the positive elasticity. Using the sample mean levels, doubling the price of tubers improves household caloric and iron security by about 57 kcal and 1.45 mg, respectively, *ceteris paribus*. This reduces the number of caloric and iron insecure households by 3 and 2 percent, respectively.

The results also suggest that the price of tubers negatively affected household food security proxies in Pallisa, although it was only significantly different from zero in the case of protein security. A one percent increase in the price of tubers reduced household food security in terms of protein by 0.23 percent. It was surprising to note the insignificance of the price of tubers in the case of caloric security. The negative sign was as expected since tubers were the main source of dietary intake and among the major sources of income. The negative sign could be an indication that tubers are traded not as surplus, consequently reducing household food security. Using the sample mean levels, doubling the price of tubers reduces household protein security declines by 9.56 gm, *ceteris paribus*.

Results above show that the significance of individual food prices varied across household food security proxies within and across districts. The insignificance of some individual prices was not necessarily due to multicollinearity among the variables. This could partly be attributed to the aggregation of food items, omission of some variables such as a proxy for cultural preferences and tastes proxy, and also due to the fact that these households derive much of their consumption from own production. Overall, households in Kiboga were more responsive to individual food prices than those in the other two districts. The higher responsiveness observed could partly be attributed to its proximity to Kampala, the capital city. One can argue that farmers are to some extent better informed about food markets in the city.

A joint test on all the prices would be very useful in this case when some individual price coefficients are insignificant and would also help in testing the nonseparability assumption. This was carried out using the Wald χ^2 test statistic and the results are presented in Table 7.4. A joint test on all prices was statistically significant for caloric

Table 7.4 Joint Test for all Food Prices on Household Food Security Proxies

District	Calories as % RDI	Protein as % RDI	Iron as % RDI
	Wald χ^2 p-value	Wald χ^2 p-value	Wald χ^2 p-value
Kiboga	0.14	0.01[b]	0.70
Mbarara	0.03[c]	0.08[d]	0.43
Pallisa	0.83	0.68	1.00

Notes: [b]Significant at 0.03 level; [c]significant at 0.05 level and [d]significant at 0.10 level.

and protein security in Mbarara; and for only protein security in Kiboga. It is worth noting that although Mbarara recorded the highest number of insignificant coefficients on individual prices, it performed best in terms of a joint test. However, a joint test on all prices was not statistically significant for Pallisa for all three household food security proxies.

How do these price elasticities compare with earlier studies? Like income elasticities, there are considerable variations in the food price elasticities estimated for food demand studies. Such variations are attributed to treatment of zero expenditures (Heien and Wessells 1990; Teklu 1996), survey design, specification and estimation procedures (Teklu 1996), and level of food aggregation. Most studies on food demand are silent on how they treated zero expenditures. The presence of zero expenditures biases parameter estimates upwards, especially if the number is large. It also leads to underestimation of the $\overline{R}^2$ (Heien and Wessells 1990). As Teklu (1996) asserts, such variations hinder drawing plausible generalisations on the numerical value of food price elasticities. However, not only are generalisations made impossible but also comparison of such estimates. The nutrient price elasticities are no exception (see for example, Behrman,1995, pp.19-20). Notwithstanding these shortcomings, the range of the food group price elasticities in this study does not differ much from those reported by Strauss (1984, 1986, p.138) in Sierra Leone, when profits are allowed to vary. They are lower than the price elasticities reported by Bezuneh *et al.* (1988) for Kenya, as expected, since these were food quantity-price elasticities.

7.1.4 Effects of Age of a Woman

In all districts, age of a woman had a consistently negative impact on the proxies of household food security, except in Kiboga, where it was omitted as it was showing high correlations with other variables in the model.

In Mbarara and Pallisa, the impact of the age of a woman was consistently negative and statistically significant, except for iron in Pallisa. In Mbarara, a 2.7 percent increase in the age of a woman resulted in a fall in caloric security by 0.86 percent, protein by 0.93 percent and iron by 0.55 percent. In Pallisa, a 2.7 percent increase in the age of the woman resulted in a fall in daily caloric security by 0.72 percent and protein by 0.96 percent. Overall, protein security was more age elastic than the other two proxies of household food security in Mbarara and Pallisa. The age of the woman indicated a higher response than all food prices and women-specific variables other than time, in absolute terms. It is noted that holding other factors constant, an increase in the age of a woman by one year could have serious implications for household food security.

The possible explanation of the negative sign on age is twofold. First, as a woman gets older, the food security of her household members may deteriorate as her productivity declines both on the farm and in the household. Second, most of the elderly women respondents had no education. In part, this could have negatively influenced their knowledge on nutrients derived from various foods. This leads some to argue that the older a woman, the less knowledge she had on the nutritional value derived from different foods. However, this should not rule out circumstances where elderly women may have more nutritional knowledge through experience than younger ones.

7.1.5 Effects of Education of a Woman

Studies related to food consumption modelling in developing countries, such as Hardaker *et al.* (1985), have continued to incorporate the education of the head of the household, who in most cases is a male. They omit education of women, the key players in household food consumption, leading to misspecification errors. This study included education of a woman as a dummy variable with three levels, depicting increasing levels of literacy: no education, primary education, and secondary education or higher. A positive relationship was hypothesised between household food security and level education by this study.

Overall, primary education was positively related to all proxies of household food security. Surprising to note was the insignificance of primary and secondary education of women in Kiboga, and with no systematic pattern on sign across the three proxies.

However, in the case of caloric and protein security, the sign was positive for both primary and secondary education.

In Pallisa, primary education of the woman was statistically associated with improvements in her household members' caloric security by 0.08 percent and protein by 0.15 percent. The impact of primary education was higher than most of the food prices. A household with a woman having primary education will consume about 127 kcal of calories and 6.21 gm of protein, more than a household with a woman with no education. This would reduce the number of caloric and protein insecure households by 4 percent and 6 percent, respectively.

In Mbarara, primary education was statistically associated with improvements of caloric security by 0.13 percent, iron by 0.14 percent and protein by 0.17 percent. It is evident from these results that protein security was more responsive to primary education than the other two proxies. It is worth noting that primary education had a slightly higher impact than the health status of other household members, except for caloric security. The household with a woman with primary education will consume about 277 kcal of calories, 10.71 gm of protein and 2.48 mg of iron more than a household with a woman with no education, *ceteris paribus*. This would reduce the number of caloric, protein and iron insecure households by 12 percent, 2 percent and 4 percent, respectively.

Secondary education or higher was consistently positive in Pallisa and Mbarara, but only statistically significant in the latter for caloric security and protein security in the former. In Mbarara, the responsiveness was slightly higher for protein. A household in Mbarara with a woman having secondary education will consume about 295 kcal calories more than a household with a woman with no secondary education, thereby reducing the number of caloric insecure households by 14 percent. A corresponding increase in protein intake by 14.58 gm in Pallisa would be realised.

Regardless of the significant status of the education variables, with primary education a woman is to some extent informed on the importance of adequate dietary intakes. That is, knowledge associated with primary education can substantially improve nutritional education and hence improve household food security. These findings support the current government's emphasis on primary education. Results in Tables 7.1-7.3 show that the impact of education varied across proxies of household food security and from district to district.

Despite using levels to measure the education of women in rural Uganda, the magnitudes of the elasticities are comparable with those studies carried out elsewhere in developing countries (such as Alderman and Garcia 1993 for rural Pakistan). However, they are higher than those of Behrman and Wolfe (1984) for Nicaragua. The impact of education of women on household food security was slightly lower than that of the income and household size variables. This was contrary to Behrman and Wolfe's (1984) study in Nicaragua, where they found women's education to have a higher influence on dietary intake than income or household size.

The overall low significance of the education variables is partly attributed to the proxy measure of education used. As pointed out in Chapter 5, this was an oversight in the data collection exercise. Those studies (such as Wolfe and Behrman 1983; Behrman and Wolfe 1984) that have found education of women to be highly significant have employed years of schooling. Others (such as Kyereme and Thorbecke 1991 and Alderman and Garcia 1993) have employed education levels and reported low significance levels.

7.1.6 Effects of Health Status

In the case of Mbarara, health of a woman was omitted from the model as it showed a high correlation with the variable for the health of other household members. The poor health of either a woman or other members of the household affected household food security. The parameter estimates were statistically significant at 90 percent level of significance or higher using a one tailed t-test.

The impact of poor health of a woman was consistently negative but only significant in caloric and protein security for the households of Kiboga district. A woman's poor health resulted in a fall in protein security by 0.20 percent and caloric security by 0.09 percent. Assuming other factors are constant, these a household with a sickly woman will consume about 12.75 gm of protein and 206 kcal of calories, respectively, less than that with a woman in good health. This would increase the number of caloric and protein insecure households by 3 percent and 11 percent, respectively. The impact of poor health of a woman was slightly higher than that of food prices, except for legumes price in the protein security equation.

The impact of poor health of a woman on food security was negative and statistically different from zero in the case of Pallisa district. A woman's poor health resulted in a fall in caloric security by 0.21 percent, protein by 0.23 percent and iron by 0.19 percent. Thus, a household with a sickly woman would consume about 334 kcal, 9.51 gm and 2.38 mg of caloric, protein and iron intake, respectively, less than that with a woman in good health. This would increase the number of calories, protein and iron insecure households by 16 percent, 25 percent and 16 percent, respectively.

The possible explanation for a negative sign on health status is as follows. Since a woman is responsible for collecting food from the field and preparing it, fetching water and collecting firewood to name a few tasks, when sick she may not be able to perform all these tasks. This may result in members having one meal per day or eating less. In the long run, a woman's poor health may affect her productivity not only in the household but also on the farm. This results in less food available and hence threatens food accessibility.

In Mbarara, the impact of poor health of members of the household other than a woman resulted in a fall in caloric security by 0.14 percent, protein by 0.14 percent and iron by 0.11 percent. At the sample mean levels, a household with sickly members other than a woman will consume about 312 kcal, 9.12 gm and 2.02 mg of calories, protein and iron, respectively, less than households with members in good health. Consequently, this increases the number of insecure households by 13, 7 and 9 percent, respectively. There are specific explanations for this response in Mbarara. First, in some households with AIDS victims, notably a head of the household, the respondents reported excessive sale of food and other household assets to meet the medical bill. This obviously affects household food accessibility. Second, since women care for the sick, the time they spend nursing impacts on the time they have for other activities, consequently affecting food security.

7.1.7 Effects of Time Spent on Productive Activities

The effect of time allocated to productive activities by women was consistently negative and statistically significant for all districts. In Kiboga, a one percent increase in time allocated to productive activities resulted in a fall in caloric security by 0.45 percent, protein by 0.93 percent and iron by 0.34 percent. The corresponding figures for Mbarara were 0.48 percent, 0.43 percent and 0.70 percent; and in Pallisa 0.58, 0.91 and 0.62, respectively.

The main source of protein and iron are beans, which are time- and fuel energy-consuming foods due to the method of preparation. Groundnuts that rank second to beans do not consume much fuel energy but are time-consuming in terms of the processing methods. In other words, so long as constraints remain on women's time, protein and iron security will continue to be affected more than caloric intake. This has more serious implications for households of Pallisa than those of the other two districts, as it recorded more protein- and iron-insecure households. Results further suggest that caloric-time was more elastic in the case of Pallisa, protein-time in Kiboga and iron-time in Mbarara.

The negative sign on the time variable is consistent with the 'zero sum game' discussed by McGuire and Popkin (1990). Spending more time on productive activities reduced the amount of time women had for domestic activities. For instance, as reported in Chapter 5, the quality of fuel wood used for cooking has deteriorated over time requiring a woman to remain around all the time while cooking. With more time spent on productive activities, she may not be able to do this. This may result in a reduction in the number of meals and a decline in the overall household hygienic conditions, consequently reducing food intake.

It was surprising to note the positive and significant responses of time allocated to productive activities by the husbands. More time on productive activities spent by husbands led to improvements in household food security in all districts, except for iron, which was negative in the cases of Kiboga and Mbarara.

Time spent on productive activities by women was more responsive, in absolute terms, than some variables included in the model, including husbands' time. Results in Table 7.5 suggest that the impact of the time a woman spent on productive activities was significantly higher than that of a man in all districts, except for iron security in Kiboga. In part, this finding suggests imperfect substitution of the labour of women and men. This contradicts the previous food demand studies that included time without differentiating it by sex. The results confirm the relevance of time allocation of a rural woman in household food security. They are also consistent with those of Senauber *et al.* (1986) in Sri Lanka.

Table 7.5 Test on the Significance of the Equality between Time Elasticities of Women and Men

District	Calories as % RDI	Protein as % RDI	Iron as % RDI
	Wald χ^2 p-value	Wald χ^2 p-value	Wald χ^2 p-value
Kiboga	0.01[a]	0.00[a]	0.23
Mbarara	0.00[a]	0.00[a]	0.00[a]
Pallisa	0.06[c]	0.03[c]	0.09[d]

Notes: [a]Significant at 0.01 level, [c]significant at 0.05 level and [d]significant at 0.10 level.

Generally speaking, the discussion of the results in sections 7.1.4 – 7.1.7 concentrated mainly on individual women-specific variables and how they related to the three proxies of food security. Their individual significance varied considerably across these proxies. As in the case of food prices, this prompted carrying out a joint test for all women-specific variables. The results are as presented in Table 7.6. In Mbarara and Kiboga, the joint test was highly significant for all proxies of household food security. On the contrary, a joint test was only statistically significant in the case of caloric security in Pallisa. Despite some insignificance in Pallisa, the overall results confirm the crucial role of women in ensuring household food security.

Table 7.6 Joint Test for all Women-specific Variables on Household Food Security

District	Calories as % RDI	Protein as % RDI	Iron as % RDI
	Wald χ^2 p-value	Wald χ^2 p-value	Wald χ^2 p-value
Kiboga	0.03[c]	0.01[a]	0.02[b]
Mbarara	0.01[c]	0.04[c]	0.03[c]
Pallisa	0.06[d]	0.17	0.19

Notes: [a]Significant at 0.01 level, [b]significant at 0.03 level, [c]significant at 0.05 level and [d]significant at 0.10 level.

7.1.8 Effects of Household Type

There is not enough evidence to reject the null hypothesis that household type influenced household food security. This is consistent with the Phillip and Taylor (1990) argument that household type is an important factor in examining household food security. In all districts, it was consistently negative for all household food security proxies, but significant only in Kiboga district. The household type variable was somewhat significant at 90 percent level of significance in terms of protein and caloric security in Mbarara.

In Kiboga, a household being a net food producer resulted in a significant fall in caloric security by 0.16, protein by 0.2 and iron by 0.3 percent. The impact was slightly higher for iron security. At the sample mean levels, if the household was a net food producer its food security will decline by 365 kcal, 12.61 gm and 5.46 mg in terms of caloric, protein and iron intakes, respectively. This would increase the number of caloric, protein and iron insecure households by 8, 11 and 18 percent, respectively.

The negative sign was contrary to expectations. As discussed in the previous chapters, these rural households were semi-subsistence farmers, of whom some sell food not in surplus to meet their other pressing basic needs. Thus, as long as these rural households continue living under poverty and with no other source of income, they will continue to sell the little food they have, consequently exacerbating their food insecurity.

7.1.9 Effects of the Head of the Household

As discussed in previous chapters, headship has dominated as a yardstick by donor agencies and NGOs to target assistance to women. However, the relevance of such a yardstick has received criticism from some researchers such as Peters (1995). To examine the impact of headship on household food security in rural Uganda, a discrete variable was included directly in the model. Its effect yielded mixed results across the districts. The signs were consistently negative for all proxies in all districts, except for iron in Kiboga.

In Mbarara, headship significantly affected all household food security proxies, with a higher impact on protein intakes. Assuming other factors remained constant, a household in Mbarara with a male head will consume about 903 kcal, 26.68 gm and 6.58 mg of calories, protein and iron, respectively, less than that with a female head. The negative sign is not surprising since respondents in male-headed households reported an increasing chunk of land being allocated to cattle keeping, leaving less land, which is at times marginal land. This effect is exacerbated by the low application of agricultural inputs by these households. It may lead to less food available from the farm, consequently affecting household food security. However, the magnitude of the elasticity seems to be relatively high.

The headship variable was negative but only significantly different from zero in caloric and protein securities in the case of Kiboga. At the sample mean levels, this would imply that a household with a male head would consume 724 kcal and 57.18 gm of calories and protein, respectively, less than a household with a female head.

Like the other two districts, the impact of headship was significantly higher on protein security than iron security in Pallisa. At the sample mean levels, this would imply that a household with a male head would consume 733 kcal, 32.79 gm and 7.05 mg of calories, protein and iron, respectively, less than a household with a female head.

This finding disagrees with those previous studies carried out elsewhere in Africa and donor agencies that suggested preferential treatment of female-headed households. The possible explanations for the negative sign are as follows. First, the women in the male-headed households may have had little say on which foods and how much could be sold. As reported in Chapter 5, women's decisions dominated on the type of food crops to be grown for sale but husbands' decisions dominated on the disposal of the same. Second, these women may have had little say on their own labour allocations. Third, they had little say on the size and composition of the household apart from their own children, as reported in Chapter 5. They further had no control over their in-laws' labour. Consequently, uncontrolled increases in household size exacerbated a woman's workload.

In summary, the above discussion has concentrated on the discussion of the results on the consumption side of the nonseparable agricultural household model. Despite the low significance of some variables, some important observations emerge from the empirical estimation. First, the impact of the exogenous factors on the three proxies of food security varied considerably from district to district. This was also true within the district, suggesting that a single policy cannot be used to improve rural household food security. The findings imply that, instead, a mix of policies is appropriate.

Second, results have indicated that not only did purchasing power variables influence food security, but also the socio-economic characteristics, especially of women. The impact of most of the women-specific variables was found to be slightly higher than other variables. A joint test on all women-specific variables further confirmed the crucial role women play in household food security.

Third, despite rural households deriving much of their consumption from their own production, the food security proxies indicated responsiveness to changes in food group prices. The positive elasticities on some food prices, except for the meat group, are indicative of the effect of the profit in full income. Households in Kiboga district were more responsive to changes in food prices than the households in the other two districts.

Fourth, iron security as a proxy for micronutrients and protein security, was found to be responsive to changes in exogenous variables, as was caloric security. This is consistent with the renewed emphasis on household food security that broadened the concept to include micronutrients.

Fifth, the low significance of some of the variables included in the model was observed. For the food prices variables, this could be partly attributed to the level of food aggregation. The omission of some relevant factors such as culture may have also contributed to the low significance of some parameter estimates. Food consumption behaviours, as discussed in Chapter 2, are affected by cultural practices that vary across localities and were difficult to quantify.

Overall, in Kiboga caloric and iron security were more affected by household size and protein than by time a woman spent on productive activities. In Mbarara, size had the highest impact on caloric and protein securities and time spent on productive activities by a woman on iron security. Unlike the other two districts, time spent on productive activities by a woman in Mbarara had the highest impact on all proxies of household food security.

7.2 Estimated Results on the Production Side

This section presents empirical results on household food production and labour supply. Household food production was estimated conditional on the amount of family labour differentiated by gender used on productive activities. Modelling a multicrop food production function for the rural households was impractical despite observations that they produced a variety of food crops. The prevalence of zero production for some crops by some households and the need to maintain tractability of a complete agricultural household model hindered the practical estimation of a separate production function for each food crop. Instead, food production was aggregated into a single production function. Additionally, it was impractical to collect input data by crop. Results of the production side of the nonseparable agricultural household model are presented in Table 7.7. The composition of food group prices on the production side was different from that on the consumption side as discussed in section 5.1.4. These prices appear as the first four rows.

Table 7.7 Results on the Production Side of the Nonseparable Agricultural Household Model

	Kiboga		Mbarara		Pallisa	
Variable	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
*ln*cerealp	-0.06	-0.81	0.05	2.29*	0.15	2.45*
*ln*legumesp	-0.04	-0.98	-0.04	-1.08	0.03	0.75
*ln*tubersp	0.02	0.54	-0.02	-0.59	0.03	0.53
*ln*matookep	0.07	1.04	0.48	17.31*	-	-
Extension service	0.38	1.47#	-	-	-0.30	-1.64#
Hired labour	0.27	1.34#	0.51	1.10	-	-
Improved seed	-	-	0.52	1.23	0.32	1.01
Credit facilities	-0.53	-1.88#	-0.09	-0.17	-	-
Farming land	0.31	1.80#	-0.10	-0.25	-0.28	-1.71#
Farming equipment	-	-	0.09	0.20	-	-
Educ2	0.17	0.57	0.95	2.15*	0.73	4.19#
Educ3	0.06	0.17	0.65	1.13	0.61	1.63*
*ln*Age	-	-	-0.50	-2.95#	0.67	2.66#
Hmem	-	-	-0.30	-0.79	-0.04	-0.27
*ln*Fwom	0.30	0.86	0.11	2.24*	1.16	1.49
*ln*Fman	0.03	0.12	0.14	2.85*	0.41	1.29
Head	-0.15	-0.29	-0.24	-0.61	-0.24	-0.39
*ln*Size	0.68	3.48	0.90	7.12*	-	-
*ln*Cw	-	-	- -		-0.11	-0.94
*ln*Market	-	-	-0.17	-2.56*	-	-
Constant[a]	3.27	4.17*	4.18	4.70*	-1.15	-0.68
$\bar{R}^2$	0.36		0.27		0.37	

Notes: *Significant at 90% level of significance or better using a two-tailed t-test.
#Significant at 90% level of significance or better using a one tailed t-test.
[a] Estimate for the constant in case of Mbarara is not the true constant. It is a variable estimate for the corrected heteroscedastic output equation.

7.2.1 Effects of Food Prices

Generally most food prices were not statistically different from zero. The level of aggregation of food prices may have partly affected their significance. Contrary to expectations, the impact of some food prices on overall household food production was negative. In Kiboga and Mbarara districts, the price of matooke was consistently positive but only statistically significant in the latter. A one percent increase in the price of matooke led to increases in household food production by 0.07 percent and 0.48 percent for Kiboga and Mbarara, respectively. Household production was more price elastic in the latter than in the former. It is observed that an increase in the price of matooke increased overall household food production. The increase in price of matooke increases their income that may in turn be used to improve production of matooke and other crops produced by the household.

In Mbarara and Pallisa districts, the price of cereals was consistently positive and statistically significant. A one percent increase in the price of cereals increased the overall household production by 0.15 and 0.05 percent in Pallisa and Mbarara, respectively. It is observed that an increase in the price of cereals increased the overall household food production. The response was slightly higher in Pallisa. In Kiboga and Mbarara districts, the price of tubers was consistently positive but not significantly different from zero. The price of legumes was negative and not statistically different from zero in the case of Mbarara.

Results in Table 7.8 suggest that even a joint test on all prices for Kiboga was not statistically significant. However, a joint test on all prices in the other two districts was statistically different from zero. That is, all prices combined affected household food production in Mbarara and Pallisa, further confirming the relevance of prices on production.

Table 7.8 Joint Test for Food Price Variables on Household Food Production

District	Wald χ^2 p-value
Kiboga	0.93
Mbarara	0.00^a
Pallisa	0.03^c

Notes: [a]Significant at 0.01 level, [c]significant at 0.05 level.

It is evident from the results that the impact of food prices on overall household food production varied considerably from district to district. Matooke price in Mbarara district not only affected household food production but also household food consumption, as discussed above. This is indicative of the nonseparable nature of household consumption and production in terms of matooke. On the contrary, the price of cereals affected food production but not consumption in Pallisa; and the price of legumes affected household food consumption but not production in Kiboga.

7.2.2 Effects of Access to Productive Resources

A woman's access to productive resources was hypothesised to improve food production. However, contrary to expectation, it is evident in Table 7.7 that some resources negatively affected household food production. The perverse negative sign on some productive resources was observed even after correcting for econometric problems. In Kiboga district, a woman's access to hired labour, extension services and farming land positively affected overall household food production, with a slightly higher response for the extension services. However, a woman's access to credit facilities was negatively related to household food production.

In Mbarara district, the elasticity of household food production with respect to a woman's access to productive resources was positively related to household food production but insignificant for hired labour, improved seeds and farming equipment. The t-ratio on the improved seeds was somewhat high. On the contrary, a woman's access to credit facilities and farming land were negatively related to overall household food production and statistically insignificant.

In Pallisa, the elasticities of household food production with respect to a woman's access to extension services and farming land were negative and significantly different from zero. The coefficient on improved seeds was positive but insignificant. A woman having access to extension services reduces household production by 0.30 percent and farming land by 0.28 percent. Household food production was slightly more responsive to a woman's access to extension services than farming land. The negative sign on farming land could partly be that these women had access to marginal land.

The impact of a woman's access to productive resources varied considerably from district to district. In Mbarara and Pallisa districts, accessibility to improved seeds positively affected household food production. The negative sign on credit facilities in Kiboga and Mbarara could partly be attributed to the fact that formal credit was tied to non-food crops. Whereas access to farming land increased household production in Kiboga, it led to a decline in the case of Pallisa. The impact of productive resources was slightly higher than food prices in Kiboga and Pallisa. The same was also true for Mbarara households for some productive resources.

7.2.3 Effects of Education

Theoretically, education is postulated to enhance the production capacity of an individual. Primary and secondary education of a woman was consistently insignificant in Kiboga and positive and statistically significant in Mbarara and Pallisa. It is noted that education of a woman significantly affected overall household food production, implying that education of a woman improves her food production efficiency in Mbarara and Pallisa. Educated women have a capability to process and apply the information passed on to them, such as better farming methods and seed selection. Overall, the primary education of the woman had a higher impact on household food production than any other variables in the case of Mbarara.

7.2.4 Effects of Time Spent on Productive Activities

Results in Table 7.7 suggest that time spent on productive activities by women was positive and significantly affected household food production, except in Kiboga. A one percent increase in the time spent on productive activities increased household food production by 0.11 and 1.16 percent Mbarara and Pallisa, respectively. The response was slightly higher, in absolute terms, in Pallisa. The time spent on productive activities had a higher impact than the other variables in the case of Pallisa. The time a woman spent on productive activities affected both household production and consumption.

The effect of time the husband spent on productive activities was highly significant and positive in Mbarara and Pallisa. A one percent increase in time a man spent on productive resources led to increases in food production by 0.14 and 0.41 percent for Mbarara and Pallisa, respectively. However, the impact of time spent on productive activities by men was higher than that of women. The effect of husband's time spent on productive activities was not statistically significant for Kiboga.

7.2.5 Effects of Other Variables

The age of a woman significantly influenced overall household food production in Mbarara and Pallisa. However, the impact was negative in the latter and positive in the former. A one percent increase in the age of a woman led to household food production to increase by 0.67 percent in Pallisa, and to a fall by 0.50 percent in Mbarara. The negative sign in the case of Mbarara suggests that as a woman grows older her productivity on the farm declines. This is contrary to the case of Pallisa households. The result in Pallisa could partly be related to the fact that young women tend to look at farming as an inferior activity, consequently leaving it to the older generation of women.

Results also suggest that household size significantly affected household food production in Kiboga and Mbarara, with a slightly higher impact in the latter. It is worth noting that household size affected not only household food security but also household food production. Despite increases in household size increasing food production, the increases in production did not match the increases in consumption, thus justifying the negative sign on the size coefficient for all the proxies of household food security.

Headship and poor health status negatively affected household food production in all districts, although all coefficients were statistically insignificant. The sign is consistent with the findings on the consumption side of the nonseparable agricultural household model above. It is observed that distance to the nearest market for agricultural produce negatively affected household food production. The farther the market, the less food would be produced. In Pallisa, the consumer:worker ratio negatively affected household food production, although statistically insignificant. The impact of education of a woman was not consistent across the districts. While in Pallisa and Mbarara it positively affected overall household food production, it was insignificant in the case of Kiboga.

Despite the insignificance of some individual women-specific variables, results in Table 7.9 suggest a statistically significant joint test for all districts. These findings are consistent with those in Table 7.7, confirming that women-specific variables do influence both household production and consumption.

Table 7.9 Joint Test for all Women-Specific Variables on Household Food Production

District	Wald χ^2 p-value
Kiboga	0.10[d]
Mbarara	0.03[c]
Pallisa	0.00[a]

Notes: [a]Significant at 0.01 level, [c]significant at 0.05 level and [d]significant at 0.10 level.

In summary, the overall household food production was influenced by cereal and matooke prices. These prices were significantly different from zero although they were inelastic. The range of the price elasticities on the production side did not vary much from that derived on the consumption side of the household model. Results on accessibility to productive resources were consistent with the literature on women, which suggest that a woman's access to production resources influenced overall household food production. However, the impact varied not only between each productive resource but also from district to district. This finding contradicts previous studies (such as Mwaka 1990) that assumed the impact to be the same. It is evident from these results that policies to address women's access to productive resources have to take into consideration these variations. It is observed that the time women spent on productive activities not only affected household production but also household food security, as discussed in the previous section. This is in conformity with the literature that a woman's time is crucial in both household food consumption and production.

7.3 Estimates of Women Labour Supply

Women labour supply was estimated as a nonseparable function as discussed in the previous chapter. It incorporated variables on both the consumption and production sides of the agricultural household model. The elasticities of women labour supply with respect to various exogenous variables are reported in Table 7.10. The number of significant variables varied from district to district. More than 50 percent of the variables were found to be significant for Kiboga and Mbarara and only less than 50 percent for Pallisa.

7.3.1 Effects of Food Prices

Overall, food group prices were not important factors in explaining women labour supply in any of the three districts. The discussion that follows concentrates on only the significant price variables. In Kiboga, the elasticity of women labour supply with respect to the price of legumes was positive and statistically significant, at 0.28. That is, an increase in the price of legumes increased a woman's labour supply. Given that

Table 7.10 Results of the Nonseparable Agricultural Household Model for Women Family Labor Supply

	Kiboga		Mbarara		Pallisa	
Variable	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
*ln*Pmeat	0.03	1.20	-0.02	-1.11	-0.02	-0.48
*ln*Pcereal	0.01	0.27	-0.10	-2.48*	0.00	0.20
*ln*Poils	-	-	0.02	1.35	0.03	0.23
*ln*Ptubers	0.00	0.11	0.03	1.30	0.03	0.96
*ln*Plegumes	0.28	6.13*	-0.02	-0.51	-0.04	-1.91*
*ln*Pmatooke	0.01	0.43	-0.03	-1.16	0.25	1.45
*ln*Pmiscellaneous	-0.02	-0.68	0.04	1.24	0.05	0.90
Extension service	0.29	3.54#	-	-	-0.02	-0.28
Hired labour	-0.03	-0.46	-0.05	-0.65	0.08	1.71#
Improved seeds	-	-	0.00	-0.00	0.03	0.43
Credit facilities	-0.02	-0.29	-0.10	-1.16	-	-
Farming land	-0.00	-0.08	-0.11	-1.65#	-	-
Farming equipment	-	-	0.17	2.32#	-	-
Educ2	0.34	3.42#	0.16	1.83#	0.00	0.10
Educ3	0.28	2.36#	0.20	1.82#	0.10	1.03
*ln*Age	-	-	-0.23	-2.10#	-0.06	-0.82
Hwom	-0.10	-1.64#	-	-	-0.09	-1.92#
Hmem	-	-	-0.15	-2.11#	-	-
Head	-0.13	-1.69*	-0.29	-3.05*	-0.05	-0.69
*ln*Size	0.14	1.78*	-	-	0.11	2.63*
*ln*Cw	-	-	-0.07	-1.53#	-0.01	-0.41
Constant	-0.57	-1.18	3.30	4.93*	0.24	0.20
$\overline{R}^2$	0.45		0.28		0.24	

Notes: *Significant at 90% level of significant or better using a two-tailed t-test.
#Significant at 90% level of significant or better using a one tailed t-test.

legumes were a major source of income to these rural households, an increase in price induced women to increase their labour supply. Using the sample mean levels, an increase in the price of legumes would increase a woman's labour supply by almost eight hours a week. However, the price of legumes in Pallisa was negative and statistically significant from zero. A one percent increase in the price of legumes reduced women labour supply by 0.04 percent. Using the sample mean levels, an increase in the price of legumes would decrease a woman's labour supply by almost one hour a week. Generally speaking, woman labour supply was more responsive to changes in the price of legumes in Kiboga than Pallisa, in absolute terms.

The price of the cereals was negative and statistically significant in Mbarara district. An increase in the price of cereals reduced the time a woman spent on productive activities. Using the sample mean levels, an increase in the price of cereals would reduce woman labour supply by almost three hours a week. The price of cereals was positive but not statistically different from zero.

In Mbarara the price of meat, oils, miscellaneous food and tubers showed somewhat high t-ratios although insignificant at the 90 percent level using a two-tailed t-test. The price of oils, tubers and miscellaneous food groups positively affected women labour supply.

A joint test on all food prices was carried out and results are presented in Table 7.11. There was a statistically significant impact in the case of Kiboga, which was consistent with the findings for protein security in Table 7.4. However, the joint test results in Table 7.11 contradict the findings reported in Table 7.8.

Table 7.11 Joint Test for Food Prices Variables on a Women Labour Supply

District	Wald χ^2 p-value
Kiboga	0.00[a]
Mbarara	0.31
Pallisa	0.15

Notes: [a]Significant at 0.01 level.

There are a number of general observations that emerge from the effects of the prices of foods on the time spent on productive activities by rural women. First, the level of food aggregation may have affected the overall significance of the price. Second, the price of cereals in Mbarara, and the price of legumes in Kiboga and Pallisa, not only affected women labour supply but also overall household food security. This could imply that household food consumption decisions and woman labour decisions are nonseparable in the case of legumes in Kiboga and Pallisa.

7.3.2 Effects of Access to Productive Resources

There was no systematic pattern of the impact of a woman's accessibility to productive resources on her labour supply. The significance of individual resources varied considerably from district to district.

In Kiboga, only the extension services variable was positive and statistically different from zero. Using the sample mean levels, a woman with access to extension services would supply about nine hours a week more than a woman without access to the same, *ceteris paribus*. As in the case of household food production, access to credit facilities negatively affected a woman's labour supply although not statistically different from zero. It is observed that accessibility to hired labour and farming land negatively affected women labour supply, albeit statistically insignificant. It is evident from Tables 7.7 and 7.10 that access to extension services affected not only household food production but also women labour supply.

Access to farming land and farming equipment significantly explained women labour supply in Mbarara. Using the sample mean levels, a woman with access to farming land would supply about four hours a week less than a woman without access to the same. Similarly, a woman with access to farming equipment would supply about five hours a week more than a woman without access to the same. In absolute terms, access to farming equipment had a slightly higher impact on a woman's labour supply than access to farming land. The access to credit facilities variable was negative but statistically insignificant, albeit with a somewhat high t-ratio. A woman's access to hired labour and improved seeds insignificantly affected her labour supply. It is worth noting the consistency in sign on accessibility to productive resources, except for hired labour and improved seeds between women labour supply and household food production.

It is noted that access to hired labour significantly explained a woman's labour supply in Pallisa. Using sample mean levels, a woman with access to hired labour would supply about eight hours more than her counterpart without access to the same. While access to improved seeds positively affected women labour supply, access to extension services negatively affected the same. However, both effects were not statistically different from zero.

7.3.3 Effects of Health Status

In all districts, the health variable displayed a negative sign as expected. The poor health of a woman in Kiboga and Pallisa, and health of the other household members in Mbarara, significantly reduced the time a woman spent on productive activities. Using the sample mean levels, a sick woman would supply three hours less than a woman in good health in both Pallisa and Kiboga. On the other hand, illness of other members of a household would lead a woman to supply five hours a week less than a woman whose other household members are healthy. The reduction in hours a week was slightly higher in Mbarara. The slightly lower reduction in women labour supply with respect to her own poor health could partly be attributed to the fact that women have to continue with their routine irrespective of their poor health. This is contrary to expectations. As Obbo (1995) points out, these rural women postpone taking care of their pains. This also applies to pregnant women, who perform agricultural work until the eleventh hour. Most of them resume work shortly after delivery because they have to feed their families, especially children. Overall, the health variables significantly reduced not only women labour supply but also household food security and production, as discussed above.

7.3.4 Effects of Other Variables

Headship was consistently negative in all three districts, but only statistically significant in the case of Mbarara and Kiboga. That is, a household with a male head negatively influenced the time women spent on productive activities. Using the sample mean values, a woman in a male-headed household would supply about nine hours a week less than her counterpart in a female-headed household, *ceteris paribus*, in Mbarara. The corresponding figure for Kiboga was four hours less. The impact of headship was slightly higher in Mbarara.

In all districts, a woman's education was consistently positive and statistically significant, except for Pallisa. Using the sample mean levels, a woman in Kiboga with primary education and secondary education would supply ten hours a week and eight hours a week more than one with no such education, respectively. Primary education had a slightly higher impact than secondary education. Using the sample mean levels, a woman in Mbarara with primary education and secondary education would supply five hours a week more than one with no such education in both cases. While primary education, in general, was more responsive than any other variables in Kiboga, it ranked second after the age of the woman in Mbarara.

The elasticity of women labour supply with respect to age of woman was negative and only significant in the case of Mbarara, suggesting that as a woman grows older time devoted to productive activities declines as expected. Using the sample mean levels, an increase in a woman's age would reduce her labour supply by almost seven hours a week.

In Kiboga and Pallisa, household size affected women labour supply with a higher impact in the former. Using the sample mean levels, an increase in household size would lead a woman to spend an additional four hours and three hours a week, respectively. The consumer:worker ratio in Mbarara showed a somewhat high t-ratios though statistically insignificant. Since a woman is responsible for child-care and looking after the elderly in the household, an increase in their number reduces her time spent on productive resources.

Results on the joint test on women-specific variables in the women labour supply are reported in Table 7.12. In case of Mbarara and Pallisa a joint test was not statistically significant. On the contrary, a joint test was statistically significant in the case of Kiboga.

Table 7.12 Joint Test on Women-Specific Variables on Women Labour Supply

District	Wald χ^2 p-value
Kiboga	0.00[a]
Mbarara	0.92
Pallisa	0.74

Notes: [a]Significant at 0.01 level

In summary, the impact of exogenous variables on a woman's labour supply varied considerably from district to district. For instance, a woman's access to extension services had a higher impact on her labour supply than any other variable in the case of Kiboga. In Mbarara, headship was more responsive than any other variables included in the model. Primary education showed a higher response than the health variable in Kiboga and Mbarara. Furthermore, nonseparability of women labour supply and household production showed up in different variables across the districts, for instance, cereal and matooke price in Mbarara and extension services in Kiboga. The significance of the joint test on women-specific variables for women labour supply and household food production in the case of Kiboga further confirms the nonseparability. There is also evidence to justify the nonseparability of household food security and women's labour, although it varied considerably across the districts.

7.4 Estimated Results of Husband Labour Supply

The results of the husband labour supply are reported in Table 7.13. The education and age variables included were those of a husband.

Table 7.13 Results of the Nonseparable Agricultural Household Model for Men Family Labor Supply

	Kiboga		Mbarara		Pallisa	
Variable	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
*ln*Pmeat	-0.00	-0.07	-0.03	-0.66	0.03	0.38
*ln*Pcereal	0.03	0.68	0.16	1.66*	-0.04	-1.09
*ln*Poils	-	-	0.00	0.00	0.43	1.56
*ln*Ptubers	-0.04	-0.62	0.03	0.62	0.04	0.47
*ln*Plegumes	-0.08	-0.69	-0.05	-0.44	-0.08	-1.67*
*ln*Pmatooke	0.05	0.70	0.10	1.45	-0.04	-0.11
*ln*Pmiscellaneous	-0.02	-0.34	0.08	0.86	0.22	1.52
Educh1	0.41	0.74	-	-	-	-
Educh2	0.05	0.34	0.48	1.76#	0.17	1.40#
Educh3	-	-	0.40	1.37#	0.04	0.27
*ln*Ageh	0.49	9.18*	0.32	3.86*	-0.03	-0.18
Hmem	0.53	1.72*	-	-	-0.14	-1.41
*ln*Size	-0.40	-2.10*	0.05	0.24	0.03	0.27
*ln*Cw	-	-	0.18	1.54#	0.07	0.93
*ln*Market	0.07	1.18	-0.05	-0.48	-	-
Extension service	0.18	1.01	-	-	-	-
Hired labour	0.28	1.87*	-0.28	-1.57	-	-
Improved seeds	-	-	-	-	0.51	2.64*
Credit facilities	-	-	0.58	2.74*	-	-
Farming land	-0.10	-0.80	-	-	-	-
Farming equipment	-	-	-	-	0.16	1.31
Constant	0.74	0.69	-1.18	-0.96	-4.00	-1.25
$\bar{R}^2$	0.65		0.48		0.58	

Notes: *Significant at 90% level of significant or better using a two-tailed t-test
#Significant at 90% level of significant or better using a one tailed t-test

7.4.1 Effects of Food Prices

Like a woman's labour supply, most food prices were not significant in the husband labour supply. Of the food price variables, only the price of cereals significantly affected the time husbands spent on productive activities in the case of Mbarara. Despite the price of matooke showing a high t-ratio, it was not statistically significant at the 90 percent level of significance using a two-tailed test. An increase in the prices of matooke and cereals increased husband labour supply. Using the sample mean level, an increase in the price of cereals would result in a husband spending an additional eight hours a week, and five hours a week in the case of matooke.
Of the food price variables, only the price of legumes significantly affected husband labour supply in Pallisa. The price of the miscellaneous foods, oils and cereals showed somewhat high t-ratios, albeit insignificant. Using the sample mean levels, an increase in the price of legumes would lead a husband to supply an additional three hours a week. Surprising to note was the insignificance of food prices in Kiboga. The study by Pitt and Rosenzweig (1985) also found food prices to have little effect on male labour supply in Indonesia.

7.4.2 Effects of Other Variables

In all districts, the primary education of the husband was positively related to his labour supply; however, it was statistically significant only in Mbarara and Pallisa. Secondary education maintained the same sign but was only significant in Mbarara. Primary education, therefore, showed a higher impact than secondary education. This is consistent with the findings above. Using sample mean levels, a husband in Pallisa with primary education will supply six hours a week more than one with no such education, *ceteris paribus*.

As a husband gets older his labour allocated to productive activities increases in the case of Kiboga and Mbarara, contrary to expectations. The age of a husband also significantly affected his labour supply in Kiboga and Mbarara. In absolute terms, the impact of age was slightly higher in Mbarara. The positive sign on the age of a husband was contrary to that of a woman in Mbarara. The explanation for the positive sign could be as follows. The younger men were more likely to be involved in activities other than farming than older ones.

The poor health of other members of the household negatively affected the time the husband spent on productive resources in Pallisa. Using the sample mean levels, the poor health of other members of the household would reduce a husband's labour supply by five hours a week relative to a household with members in good health. The explanation for the positive sign on the poor health of other members of the household could be as follows. Since men were mostly responsible for settling the medical bills, they had to put in more time so as to earn more.

Household size negatively and significantly affected a husband's labour supply in Kiboga. Using the sample mean levels, an increase in household size would require a husband to increase his labour supply by fifteen hours a week, *ceteris paribus*. On the contrary, household size was not statistically different from zero in Mbarara and Pallisa, though positive. However, the consumer:worker ratio in the case of Mbarara increased a husband's labour supply as expected.

A woman's access to hired labour significantly increased a husband's labour supply in the case of Kiboga, by fourteen hours a week, on average. The reverse was true for Mbarara district, reducing a husband's time by fifteen hours a week, on average. In Pallisa, a woman's access to improved seeds significantly increased the husband's labour supply, by nineteen hours a week, on average. This was contrary to what was observed for a women labour supply in the same district. The woman's access to farming land in Pallisa showed a somewhat high t-ratio though statistically insignificant.

7.5 Diagnostic Tests

Diagnostic tests in applied econometrics have become a rule rather than an exception. However, the type of tests to be carried out remains an empirical issue. Diagnostic tests were carried out on the econometric problems related to cross-sectional data, and nonseparability of the production and consumption decisions in rural Uganda. The results of the diagnostic tests carried out on the systems of equations as discussed Chapter 6 are as shown in Tables 7.14-7.16.

7.5.1 Testing for Diagonal Covariance Matrix

Results in Table 7.14 suggest that the B-P-G test statistic values were less than the 95% critical χ^2 values. Consequently, the null hypothesis of a diagonal variance-covariance matrix is rejected. Instead the errors across equations were contemporaneously correlated. Under such circumstances estimation carried out using ordinary least squares or 2SLS will definitely lead to inefficient parameter estimates.

Table 7.14 Test for Diagonal Variance-Covariance Matrix

District	Likelihood Ratio Test	95% Critical χ_2 value
Kiboga	$\chi^2_{(15)} = 226.58$	25.00
Mbarara	$\chi^2_{(15)} = 183.98$	25.00
Pallisa	$\chi^2_{(15)} = 217.43$	25.00

7.5.2 Testing for Heteroscedasticity

Results of tests for heteroscedasticity are presented in Table 7.15. All equations except for the output equation in Mbarara rejected the alternative hypothesis that errors were heteroscedastic. The output equation for Mbarara district was corrected for heteroscedasticity using the procedure discussed in the previous chapter. Therefore, the results as reported for Mbarara district above and in Table 7.15 were after correcting for heteroscedasticity.

Table 7.15 Testing for Heteroscedasticity

District/Equation	B-P-G Test statistic	95% Critical χ^2 value
Kiboga District		
Calories	$\chi^2_{(17)} = 12.39$	27.59
Protein	$\chi^2_{(16)} = 21.32$	26.30
Iron	$\chi^2_{(17)} = 23.58$	27.59
Output	$\chi^2_{(14)} = 10.86$	23.69
Woman's labour	$\chi^2_{(15)} = 23.27$	25.00
Man's labour	$\chi^2_{(15)} = 23.61$	25.00
Mbarara District		
Calories	$\chi^2_{(18)} = 11.37$	28.87
Protein	$\chi^2_{(17)} = 18.55$	27.59
Iron	$\chi^2_{(18)} = 12.45$	28.87
Output*	$\chi^2_{(18)} = 22.07$	28.87
Woman's labour	$\chi^2_{(16)} = 13.09$	26.30
Man's labour	$\chi^2_{(15)} = 26.33$	25.00
Pallisa District		
Calories	$\chi^2_{(17)} = 21.55$	27.59
Protein	$\chi^2_{(17)} = 20.74$	27.59
Iron	$\chi^2_{(17)} = 20.74$	27.59
Output	$\chi^2_{(17)} = 18.25$	27.59
Woman's labour	$\chi^2_{(15)} = 23.52$	25.00
Man's labour	$\chi^2_{(15)} = 10.79$	25.00

7.5.3 Plausibility of the Nonseparable Agricultural Household Model Results

As discussed in Chapter 6, the overall system $\overline{R}^2$ could not be used to measure the goodness-of-fit of the model; instead the LR test statistic was used. The goodness-of-fit measure, as reported in Table 7.16, rejected the null hypothesis that all slopes of the parameter estimates in the system of equations were zero. The individual equations $\overline{R}^2$ (see Tables 7.1-7.3, Tables 7.6, 7.10 and 7.12 above) were consistent with those derived from previous studies that employed cross-sectional data. Statistical tests were employed to assess the significance of the parameter estimates. To test the individual parameter estimates, the t-test statistic was employed and for the joint test on some variables in the equations, a Wald χ^2 test was employed.

Table 7.16 Results on the Overall Goodness-of-Fit of the Complete Model

District	LR test
Kiboga	$\chi^2_{(94)} = 436.56$
Mbarara	$\chi^2_{(94)} = 430.48$
Pallisa	$\chi^2_{(94)} = 385.15$

Multicollinearity was detected using two techniques discussed in Chapter 6: simple correlation analysis and auxiliary regressions. Both techniques helped to detect multicollinearity among the explanatory variables within the equation. Some variables were dropped such as age in Kiboga and woman's health status in Mbarara. After dropping such variables, no serious cases of the problem were detected to warrant dropping more variables. Thus, the insignificance of some variables in the above estimated models was not due to the presence of multicollinearity.

The consequences of omission of relevant, and inclusion of irrelevant, variables in a model are discussed in econometrics textbooks and need not be repeated here. To minimise the biases, economic theory, logic and the researcher's knowledge of the sample study area played a role in the choice of the explanatory variables included in the model. The study had to go beyond economic theory, as there are obvious limits to the information that such theory can provide especially in developing countries. However, some variables such as household storage facilities as a proxy for post-harvest technologies and land degradation were not included in the production function as it was not easy to quantify them. Additionally, the omission of a measure of drought may be responsible for the insignificance of the food prices in Pallisa district. On the consumption side, it was not easy to quantify culture, which is known to influence household consumption patterns in rural areas. These omitted variables may have had an impact on the significance of some of the included variables.

The identification problem is a mathematical problem associated with a simultaneous equations system. It gives information of the possibility of getting meaningful results.

Therefore, when estimating a system of equations, identification becomes a rule rather than an exception. The system of equations for a nonseparable agricultural household for each of the districts was over-identified, consequently justifying the application of the 3SLS estimation method. Additionally, the finding above that errors across the equations in all districts were contemporaneously correlated supported the application of three-stage least squares over two-stage least squares.

The overall performance of the complete nonseparable agricultural household model was encouraging given the data deficiencies and restrictive assumptions under which it was estimated for each district. The magnitudes of some variables were sizeable and the signs of most variables were as expected. The positive signs on some food prices on the consumption side of the model were due to the profit effect in the full income. To some extent, the model performed best for Kiboga households compared to those in other two districts. The estimation of the model took into account the zero consumption and production for some households, a problem that has been ignored by most previous food demand analysis studies. There was enough evidence to justify the application of a nonseparable agricultural household model for rural households in Uganda. This was obvious from the results that suggested that variables that explained household food consumption also explained household food production especially, women-specific variables. The results further suggested that factors that explained household food consumption and production also explained the family labour supply.

7.6 Concluding Remarks

This chapter has gone beyond the descriptive analysis approach, which has dominated the previous studies carried out on food security in Uganda. The results offer useful inputs in the policy making and decision-making processes despite the restrictive assumptions under which the complete nonseparable agricultural household model was estimated. They have provided insights on the signs and magnitudes of the changes of exogenous variables, especially women-specific variables, on both sides of the model. The elasticities of household food security proxies were derived directly unlike the previous studies carried out elsewhere that employed an indirect approach.

The application of a nonseparable agricultural household model to rural households in Uganda was supported by the study findings. This was evident from the fact that some factors that affected household food consumption also affected household food production. It was further observed that the factors that affected household consumption and production also affected the women labour supply on the farm. Results have shown that the impact of key exogenous variables on both the consumption and production sides of the model varied considerably from district to district and across the three proxies of household food security. Such variations have to be taken into consideration in the policy making and decision-making processes.

In cases where food prices were statistically significant, the elasticities were sizeable. This is indicative that rural households respond to changes in food prices. Legumes showed a higher impact in Kiboga, matooke in Mbarara and tubers in Pallisa for all proxies of household food security. The behaviour of some food prices was contrary to that expected theoretically. This was partly attributed to the fact that food prices were affected by both demand and supply forces. This is among the circumstances when theory fails to predict the direction of change when a complete nonseparable agricultural household model is estimated.

Results in Chapter 5 indicated that a relatively high number of households failed to receive even 75 percent of their recommended daily dietary intakes (in terms of calories, protein and iron) even with no increases in food prices. With the assumption of doubling food prices, the number of households at risk of food insecurity increases in those cases where the sign was negative and reduces where it was positive.

The impact of women-specific variables could no longer be generalised. The elasticities of household food security with respect to women-specific variables were more responsive than most of the other variables included in the model. The same was true for household food production. These empirical findings further emphasise the crucial role a rural woman plays in ensuring the three pillars of household food security. It is interesting to note from these findings that results derived from food demand studies that ignore inclusion of women-specific variables in developing countries in general and Africa in particular would lead to biased estimates, consequently doubting the policies based on such estimates.

Incorporating time allocation by gender in the model yielded very interesting observations: firstly, it made visible and confirmed the role of women's time allocation in household food security; secondly, imperfect substitution of labour time between women and men. The impact of a woman's time spent on productive activities on household food security and household food production was significantly higher than that of a man.

While time women spent on productive activities negatively affected household food security, a positive impact was observed for household food production. As a woman spends more time on productive activities, less time is left for domestic activities. This negatively affects household food accessibility and consequently threatens household food security. Such findings are very useful to policymakers in their campaign to increase rural women's involvement in income-generating activities.

Education has the potential to bring about important changes in the status of a woman. Literacy of a woman affected not only household food security but also household food production and her labour supply. Generally speaking, education of a woman had a slightly higher impact on protein and/or iron than caloric security in Mbarara and Pallisa. Results of primary education on overall household food security support the current government policy on primary education for all. Surprising to note was the insignificance of education variables in Kiboga district.

As expected, the health status of a woman and other members of the household affected household food security. Poor health of a woman significantly reduced her labour supply and reduced household food security in Pallisa and Kiboga, with a slightly higher impact in the former than in the latter. Caloric intake was more affected in Pallisa and iron intake in Kiboga. The health of other members of the household had a slightly higher impact on women labour supply than on household food security.

The age of a woman consistently reduced household food security in all districts. The impact was slightly higher in protein security. The household food security proxies were more responsive to age of a woman than most food prices and health variables. Woman labour supply was significantly reduced with her aging. This has serious implications for the current trend where the influx of younger girls to the urban areas, leaving behind the older women to manage land and household is on the increase.

Although some previous studies (see Chapter 3) argued that female-headed households were more disadvantaged than men-headed households, this study found the opposite in terms of food security. The male-headed households in all the districts were more likely to be food insecure than female-headed households, *ceteris paribus*. This suggests a need to identify and address problems faced by women according to their socio-economic factors rather than headship.

The income variable had a higher impact on caloric intake in Mbarara and Pallisa and on iron intake in Kiboga. It is interesting to note that in Pallisa, a district more prone to food insecurity, the impact of income was less elastic than that in the other districts. In all districts and for all proxies of food security, household size was more elastic than income, an indication of decreasing returns to scale, except for calories in Pallisa. The high income elasticities observed across the household food security proxies were not surprising given the widespread poverty in rural Uganda. This is an indication that food security cannot be isolated from poverty. On the other hand, the household food security impact of increased income would be limited if not linked to improvements such as in health and education.

On the production side of the model very interesting observations emerged. The impact of productive resources individually varies from district to district. There was no systematic behaviour (in terms of signs and size) of the impact of a particular resource across districts. Generally speaking, the impact of accessibility was highest where there was little of it. These results have provided insights on how the government could start addressing the issue of improving women's access to productive resources. Generally, where a woman's access to a particular productive resource was statistically significant, it was found to have a higher impact on household food production and her labour supply than most of the variables.

In the light of the above findings, what policy implications can be drawn? This is the subject of the next chapter.

8 Policy Implications and Recommendations

The results derived from a nonseparable agricultural household model were presented and discussed in the previous chapter. The intent of this chapter is to draw the relevant policy implications from the results and make recommendations, taking into consideration the political, social, economic, cultural and ecological environment in Uganda. As Pinstrup-Andersen (1993) observes, the political environment shapes policy and consequently affects the relevance of researchers' policy recommendations. The organisation of this chapter is as follows. The discussion of the policy implications of the results is the subject of section one. The implications for some of the sectoral and macro-level policies that are inextricably linked to food security at the household are discussed in sections two and three, respectively. A synthesis of the policy implications and discussion of the issues arising from the above sections is presented in section four prior to concluding remarks.

8.1 Empirical Study Results and Implications

Notwithstanding the restrictive assumptions under which a complete nonseparable agricultural household model was estimated the results provide useful inputs into the policy making process. As indicated in Chapter 2, policies have been based on descriptive analyses. The results provide a step forward for food security planning, design and implementation, and the decision-making process. They demonstrate how food security of rural households is affected by changes in exogenous variables.

8.1.1 Income Elasticities

The conventional positive effect of income on household food security is supported by the findings. Earlier empirical studies which examined the relation between nutrient intake, in particular caloric intake, and income were marked by strong disagreements, with some showing income elasticities close to zero (such as Wolfe and Behrman 1983) and others high and significant elasticities (such as Strauss 1984 1986). The results of this study suggested that the income elasticity is high - between 0.46 to 0.64. Results suggest that increases in income would lead to substantial reduction in caloric, protein and iron insecurities; however, the impact varied greatly from district to district. Generally, such increases would have a higher impact on households in

Mbarara and a smaller impact on those in Pallisa. Raising real income would be an effective strategy for increasing caloric intake, especially in Mbarara and Pallisa, where there are proportionately more caloric insecure households (see Chapter 5). For those households in Mbarara who already have excessive protein and iron intakes, the increase in income might worsen their nutritional well being instead.

On the other hand, this study supports the finding from previous studies such as Ali and Pitkin (1991), Ayres and McCalla (1996) and several studies of the World Bank that raising income is a long-term strategy for improving food security at least in developing countries. This is especially true for those households already unable to reach 75 percent of the recommended daily dietary intakes, especially in Pallisa district. At the current one-digit economic growth rate of Uganda, *ceteris paribus*, it will take several years for these households to be food secure. This calls for short- term interventions, which are discussed in the latter sections of this chapter. Clearly, in the short run, raising real income is a necessary but not sufficient condition for improved household food security.

8.1.2 Price Elasticities

The price variables included in the demand equations were those of quantity rather than of attributes of food, as these are the prices directly affected by government policies. Rural households in Uganda can no longer be treated as being at the level of subsistence production. They are not 'uncaptured peasants' operating outside the money economy, as Hyden (1983) would have us believe, but respond to changes in food prices despite deriving much of their consumption from own production. The signs on some food groups were positive, contrary to those expected by the traditional consumption theory. This was particularly true for legumes in Kiboga (in the range 0.09-0.27) and tubers in Mbarara (in the range 0.03-0.08). This was due to the fact that food is grown partly for consumption and partly for sale, such that a change in price affects household profits and income, in turn, influences household food security. This suggests that increasing production of these particular food crops will increase the incomes of these rural households.

On the other hand, the negative signs on matooke price in Kiboga (in the range of 0.08-0.11) and Mbarara (in the range of 0.09-0.13) and tubers in Pallisa (in the range

0.05-0.23) partly demonstrate that the households may have sold food from their subsistence. A shift in these price elasticities from negative to positive is possible in the long run when their production increases above subsistence levels, *ceteris paribus*.

Unlike some governments in Africa (such as Zambia and Zimbabwe), the Ugandan government exercises no control over food prices (see Chapter 2). Consequently, a solution to improve food security may not lie in food price regulation *per se*. The solution could flow from implementing policies that remove the current constraints that hinder women's efforts to increase food production to meet other household obligations.

8.1.3 Elasticities of Women-Specific Variables

Generally speaking, results from the study emphasised the crucial role rural women play in household food security and food production. Rural women's status undoubtedly influences the overall household command over food. The impact of women-specific variables (including their socio-demographic characteristics and entitlements) was higher than some other variables included in the model. Notably, the impact of these variables was not uniform across districts, suggesting that planning and designing policies at the national level for addressing women's constraints should seriously consider such variations. Nevertheless, improving the status of rural women is central to improving household food security and production. Without this intervention, the government's rural-based development programs cannot reasonably be expected to succeed.

Health services

Generally, the health services in Uganda are inadequate, especially in the rural areas. The status of these services affects women both indirectly and directly. The study results have demonstrated that a sound health status of the household members, including that of women, is necessary for improving household food security. There is a need for the government to invest not only in women's health but also in the health of the entire rural community if food security improvements are to be realised. This is contrary to the findings of those studies (including IFPRI, World Bank and FAO studies) that have continued to advocate such investments in women only. This would raise the productivity of all household members and save a woman's time that would have been taken up caring for the sick. Improving health services and their delivery should be a means for improving protein and iron intakes in all districts. The health services in Pallisa should particularly be given more serious attention.

Time allocation

Clearly, there is an urgent need to break the 'zero-sum game' time allocation faced by rural women. Although increases in time spent on productive activities increased overall household production, it led to a deterioration in household food security with a higher impact on protein and iron in all districts. However, breaking the 'zero-sum game' is more urgent for solving food insecurities in Pallisa than the other two districts. Without breaking their 'zero-sum game' time allocation, the current government's campaign for rural women's involvement in income-generating activities will imperil their household food security. Improving their efficiency, both on the farm and within the household, could ease their workload and in turn lead to realisation of a 'positive sum game'.

Improving their efficiency could be achieved through the introduction of appropriate labour - and energy - saving technologies. Bringing water closer to rural communities through the provision of boreholes will save not only a woman's time and energy but also improve the overall hygienic conditions, especially in Kiboga and Mbarara districts. Introduction of low-cost grinding mills at the community level, especially in Pallisa and Mbarara, will not only reduce time spent on cereal processing but also increase consumption of foods such as millet, which are very nutritious. Introduction of fuel-saving techniques and devising ways of reducing the time required to prepare some food items will save women some time. Successful integration of women in planning and designing stages will boost implementation of these labour - and energy - saving technologies.

Education

Female education undoubtedly plays an important role in the overall welfare of the household members. This was vindicated by the study that women's education led to improvements not only in household food security but also in food production. Contrary to the conventional wisdom of policymakers (see, for example, Sibalwa 1993), improving access of women to education is not a poor investment, with low returns. It actually leads to improvements in household food security, with a higher impact on protein than caloric intake. As Dasgupta (1993, p.154) cites Summers (1992) female education is a socially cost-effective investment in poor countries. The removal of barriers hindering girls' access to education should be taken seriously.

On the other hand, education should not be looked at as a goal in itself but a tool to realise development goals (van Riezen 1996). As much as education may have the power to improve the social status of women, and their economic and political power, it does not guarantee the same. For instance, training rural women in food preservation technologies when such technologies are not readily available to them would fail to realise the intended goals.

Access to Productive Resources

There is a lot that has been said about increasing women's access to productive resources, such as land, extension services, credit and hired labour. Little attention, however, has been paid to the issues of how these resources, individually, affect household production and in turn household food security. The study has demonstrated that the impact of these factors varied greatly within and across the districts. Improving access to extension services should be a top priority in Kiboga district, followed by farming land and hired labour. Improving rural women's access to farming land is still possible in Kiboga district given that less than 30 percent of the arable land is under cultivation.

On the contrary, results for Pallisa indicated a negative sign on a woman's access to farming land. As stated in Chapter 7, this could be that women in Pallisa district have access to marginal land. More than 70 percent of the arable land in Pallisa is currently under extensive cultivation, implying that the government should invest in intensification of agricultural production rather than merely improving access to farming land which is not available. Generally, discussions on improving access to farming land ignore issues such as size and quality of land. Such issues need to be taken seriously if women's access to farming land is to yield the expected results.

Access to productive resources without ensuring women's control over those resources may not yield the desired results because access alone does not guarantee women's security. In the case of land, far-reaching agrarian reform policies need to be considered. These policies should emphasise equity and empowerment of the stakeholders in agriculture, in particular women *vis-a-vis* landlords. Unfortunately, the newly enacted Land Act 1998 by the Ugandan government does little to address the dual inheritance system. The statutory and customary laws, which threaten women's ownership of land, were by and large left intact in this land legislation. Unless this issue is addressed and the offending laws removed, improving the condition of women as ensurers of food security and protectors of the natural resources on which food production depends will remain threatened.

The negative sign on the coefficient of the credit facilities does not in any way suggest that such facilities are not crucial to rural women. The tying of credit to nonfood crops may partly explain this result as pointed out in the previous chapter. The major form of rural financing in Uganda has been through formal and non-formal credit, and state-targeted credit schemes as discussed in section 2.3. Unfortunately, these avenues have had little, if any impact in rural areas. Despite this, the government still has a role to play in promoting rural financing, where private sector involvement is still insignificant. This poses the question of the best means to deliver credit to the rural population. Provision of credit in terms of agricultural inputs will minimise the misuse of loans for consumption purposes, as has been the case. Voluntary rural savings were noted to be negligible inspite of the large population in the rural areas (see section 2.2). Rural households should also be encouraged to save as an alternative way of promoting rural financing.

Improving access of women to extension services would greatly improve the overall household food production in Kiboga district. This seems to be a medium- to long-term strategy. There is also a need to devise short-term interventions. In the short run, linkages among farmers should be encouraged where farmers could share knowledge on better soil conservation and farming practices, and food preservation methods. Sharing of knowledge on farming practices was to some degree being practised among farmers in Mbarara. This should be encouraged in other districts, especially where extension services are inadequate. The transfer of such knowledge should also be encouraged across districts. This kind of linkage among farmers should not be taken as a substitute for the provision of extension services by the government.

Targeting across Women

In addition to the government of Uganda's policies being gender-blind, such policies have been perceived to have the same impact across the population. Elsewhere in the developing world, women have been portrayed to belong to either of the two so-called 'homogeneous' groups, namely, female-headed and male-headed (see section 3.4.12). The past 23 years, since the UN Decade for Women, have been marked with a tendency by donor agencies and some NGOs to target women in the female-headed households. This has been done on the presumption that women in these households are worse off than their counterparts in male-headed households. In contrast, this kind of categorisation and the subsequent targeting is not empirically supported by findings of this study. In fact, the findings demonstrated that male-headed households were more likely to be insecure than female-headed households. However, this does not in any way suggest targeting male-headed households. The results have indicated that there are other women-specific variables that affect household food security and need to be taken into account. The view of the women respondents, as discussed in Chapter 5, is that women should not be assisted according to headship. Rather, the government, donor agencies and NGOs should employ needs and situation assessments as tools in providing guidance on how to target rural women.

8.1.4 Implications for Dietary Intake Patterns and Practices

Consuming a variety of foods may not necessarily increase the probability of a household meeting its minimum daily dietary requirements. The dietary intakes in the sampled districts showed a tendency toward staple foods (such as roots and tubers, and matooke) that were richer in one nutrient but deficient in others. In the short run, food fortification, which is the addition of nutrients to widely consumed foods to improve the quality of dietary intakes, should be encouraged. To some extent, this is practised in Mbarara and Pallisa, where cassava and millet flours are mixed. However, it is not clear whether the proportions used necessarily help to meet the required dietary intake.

It was further observed that food consumption patterns are deeply entrenched in people's culture. This points to the difficulty that will be involved in attempts to introduce new foods, however nutritious they may be. If households decide to preserve their traditional food preferences, they need to be encouraged to include a wider variety of foods in their diets in proportions that would enable them to attain the daily recommended dietary intakes. However, this is not to totally ignore the promotion of shifting consumption to richer foods, which should form the basis of the long-run strategy. Nutrition education could also be used to help to change the existing food consumption behaviours. Sensitisation strategies to promote awareness of the risks involved in inadequate dietary intake will also help to solve the problem.

8.2 Implications for Sectoral Policies

8.2.1 Education Policy

Since 1997, the government has formulated a policy of UPE which offers 'free' basic education to four children per family (see section 2.5.4). The point is to boost the basic literacy and numeracy skills of children as well as vocational skills such as carpentry. The current emphasis on primary education by the government was supported by the results, which indicated that the primary education of a woman could substantially improve household food security and food production. However, no mechanism is in place to ensure gender balance, which may have implications for girls' access to primary education. Critics of UPE (see, for example, Kiiza 1997) have argued that the current emphasis on primary education, which is obviously pushed by the World Bank, is a means of redirecting government resources from tertiary education. This is evident from the on-going phasing-out of government's financing in higher institutions of learning. It is hard to predict the long-run implications of such a policy on the stock of skilled human resources in the country.

It is important to note that the current government's affirmative action policy (see section 2.5.4) is skewed toward improving girls' access to tertiary education. To increase their enrolment in tertiary education, the government introduced a system whereby girls were given a bonus of 1.5 points. However, it leaves out the girls in rural areas who most need it. Additionally, little emphasis is placed on secondary and high school education. Measures should also be extended to secondary education, as it was found to further improve food security, especially for caloric security in Mbarara and protein in Pallisa. In fact, girls' access to education should be supported throughout the country, as this will ensure the next generation's stock of human capital. Their education will not only improve household food security but will also indirectly reduce the currently high fertility rates and high rates of pregnancies among teenagers. This will in turn check the burgeoning population growth, which is among the highest in the African region. Consequently, environmental degradation and the consumer : worker ratio will to some extent be reduced, which in turn will improve food security.

On the other hand, parents' role in fostering education has not been taken as an important issue. There has been limited involvement of parents, especially, women in the planning process and the identification and resolution of constraints working against girls' access to formal education. Effective participation of the parents is necessary for the success of the policies aimed at improving girls' access to education.

It is evident from the available literature that more emphasis has been placed on formal education (which is a long-term policy), paying little attention to non-formal education. What can be done in the short run? What policies should be put in place to target those women who were unable to attend school or dropped out of school early? This could be done through promotion of non-formal educational programs. As Hoffmann (1993) suggests, such programs should go beyond mastering writing and reading skills to include basic skills in crop cultivation, post-harvest methods, nutrition education, better soil management practices, resource management skills and improvement of managerial skills both in the household and on the farm. For the females who dropped out of school, a variety of non-conventional educational programs are needed, to prepare them for self-employment either in or outside agriculture. Undoubtedly, increased agricultural growth and improved road infrastructure will improve education eventually. However, direct government action is necessary if faster and greater impacts on household food security are to be achieved.

By extension, therefore, the government, in alliance with other stakeholders, needs to revise the current curricula at all levels of education to suit the country's development goals. Nutrition education, primary health education and other development-related aspects should be explicitly incorporated into the curricula at all levels of formal education. A participatory approach should be used in the development of the curriculum. There are strong beliefs among the population that farming is an activity for the illiterate. Thus, these programs should be structured in a way that the rural population appreciate and treasure agriculture as a profession and profitable way of life.

8.2.2 Health Policy

The health delivery system in Uganda has four levels of health care: primary, secondary, tertiary and quaternary. The health policy is skewed toward primary health care (Sahn 1994; Okounzi and MacRae 1995; Okello *et al.* 1998). The health sector reform places emphasis on reviving the health centre as a unit that provides a family with basic health services. Focusing more on preventive measures, the main functions of the health centre are spelt out. The approach is very appealing but falls short in terms of implementation.

The institutional structures are in place but the delivery of the services is still very inadequate. In part, this is attributed to the financial crisis under which the sector is operating. The financing of the primary health care sector is predominantly donor-funded. In part, this has led donor agencies to push for alternative policies that they think are practicable. The introduction of the user fee scheme, which was mainly pushed by the World Bank, is a prime example. According to the World Bank, this was a means of increasing revenue and releasing public sector resources for other activities. Unfortunately, the intended results have not been forthcoming. For the rural population, the fees are too high in the midst of growing poverty. On the part of the health sector, the fees charged are too low to have an impact on the financing crisis the sector is undergoing. This is exacerbated by the misuse and poor accountability of the health units.

Clearly, even in the presence of the user fee scheme, delivery of health services has not improved. Some issues do emerge. As much as the donor agencies may come in to assist the ailing health sector, the Ugandan government has to stand firm on what is best for its population. While the emphasis on preventive care is very appealing, especially for the rural population, the introduction of the user fee scheme has aggravated their inaccessibility to health services. The implications for household food security are enormous, as the findings of the study have demonstrated. Exempting the rural population from the user fee scheme, in the short run, would do a lot of justice to household food security and to the overall welfare of the household members. However, this will necessitate the government to raise taxes to cover up such services.

8.2.3 Industrialisation Policy

The Ugandan government has identified priority areas for industrialisation among which is the agro-processing industry. As discussed in Chapter 2, much of the food produced both in rural and urban areas is consumed fresh. The poor storage facilities and preservation methods (as noted in section 2.3.5) have to some extent impeded increased food production at the household level. Promoting the agro-processing industry is perceived by policymakers as a key strategy for increasing the demand for rural produce as inputs into these industries; and subsequently improving the income of the rural population. Income earned can eventually be invested back into agriculture, which in turn will improve household food security.

Currently, there are a few industries that are involved in agro-food processing. However, there are no mechanisms in place to control these industries to utilise the locally available raw materials. For instance, there is growing evidence, albeit anecdotal, that the pineapple and passionfruit industries are actually using imported concentrates rather than the locally available raw materials. As pointed out in Chapter 1 and 2, over 80% of the population is rural based and depends on agriculture for a livelihood. Thus, using locally available inputs will provide gainful employment to the rural population. This will result in increased income and the subsequent improvements in their food security. Consequently, the situation as it is does not benefit the agricultural sector, particularly the small-scale farmers in the rural areas, in the long run. Nor does it benefit the government in terms of its development goals. The government needs to come up with a policy regime that would force industries to forge strategic links with the agricultural sector.

8.3 Implications for Macro-Level Policies

8.3.1 Agricultural-led Growth and Trickle-Down Policies

The debate on the relationship between poverty and food security is not new. Low incomes in developing countries have been ascribed for perpetuating food inaccessibility, especially of the poor (Reutlinger 1985; Riley 1994; Pinstrup-Andersen and Pandya-Lorch 1995). However, no blueprint exists on what such countries should do as a means of raising incomes. Given the vital role of agriculture in terms of employment and livelihood in developing countries in general and in particular SSA countries, the popular strategies put forward are achieving economic development (Asefa 1991) and economic growth (Maxwell 1992; Pinstrup-Andersen and Pandya-Lorch 1995; Staatz 1996; Ayres and McCalla 1996) through agricultural growth. Agricultural growth is perceived as the engine to economic growth for most developing countries. The World Bank concurs with this view. It is implicitly assumed that growth in the agricultural sector will translate into increased command over food (Maxwell 1990, 1992) and other necessities of life. Indeed, Ayres and McCalla (1996) and Abdulai and Hazell (1995) have argued that agricultural growth is the most efficient means of alleviating rural poverty, protecting the environment, improving food security and generating broad-based economic growth. This is a strategy adopted by the Uganda government.

Despite its strong economic growth in the region, Uganda is still among the poorest countries and lags behind all East African countries in terms of social indicators (see, section 2.1). Studies such as Oxfam (1996), MoPED (1996b) and UNDP (1997b) indicate that there has been an intensification of poverty, especially in the rural areas. This should not be taken to imply that agricultural growth does not lead to poverty reduction. Instead the intensification of poverty could partly be attributed to distribution of growth among other factors. However, this is not peculiar to Uganda. Islam (1990) reported that high growth rates in the Philippines and Malaysia did not lead to a reduction in poverty, although success stories were reported in Thailand during the 1960s and 1970s. Quinn (1994) also notes that the benefits of economic growth did not trickle down to all Malawians.

Some researchers, such as Maxwell (1992) and Norton and Alwang (1994), argue that economic growth without providing secure and gainful employment to poor and vulnerable persons cannot enhance food security. In addition to employment, increasing the vulnerable persons' accessibility to social infrastructure and policy actions that increase demand for their most important factor of production, labour, will enhance food security (FAO 1996a). Other researchers (such as Tyler *et al.* 1993) have contended that growth without redistributive measures may not lead to poverty reduction. The common theme among all these views is the reversal of the neoclassical theory of poverty reduction through economic growth to a theory of economic growth through poverty reduction. This new theory identifies human welfare perspective by emphasising job creation, and effective accessibility to social services, in particular for the most vulnerable persons.

The neoclassical growth theory of poverty reduction through growth has dominated policy making in Uganda under the structural reforms programs. Thus, agricultural growth leading to poverty reduction will only be realised if the new Land Act explicitly gave tenure security to all including the poor and women; improving access to social services to all; addressing distributional issues; and enhancing the ability to create gainful employment either directly or indirectly. However, this has to take into account the heterogeneous nature of the regions, districts and communities. More importantly, strategies should be geared toward investments that raise the productivity of rural women and hence ensure their participation in growth and development processes.

8.3.2 Agricultural Liberalisation Policies

The government of Uganda does not exercise control over agricultural inputs and food prices (see Chapter 2). And yet, food production is still a necessary condition for ensuring food security of rural households, which in turn depends on the availability of agricultural inputs. This is to some extent reflected in the study findings where nonseparability existed between food production and consumption. The withdrawal of government's involvement in the market for agricultural inputs in the hope that the private sector would take over has not effectively materialised as expected. Driven by the logic of profit maximisation, private investors appear to perceive the sector as non-viable. The market for inputs is fragmented, characterised by seasonality in demand, a small rural market, low returns in relation to other investments, rampant rural poverty, and high dependence on foreign markets for supply (see Chapter 2). Some farmers can no longer afford even the basic input, the traditional hoe[46], due to the very high prices. Intuitively, in the presence of market forces, farmers would be expected to raise prices

[46]On average, a hoe costs the equivalent of US $3.

for their produce in order to be able to buy agricultural inputs. Unfortunately, this does not take place. In addition to the problems cited above, the asymmetry in market information and underdeveloped rural road infrastructure prohibit farmers from taking the 'would-be' more effective option. This suggests that direct intervention by the government in the agricultural inputs market is crucial. As previously suggested, the government could intervene through provision of credits to the rural population, in particular women, in the form of agricultural inputs. Alternatively, the government could lower input prices by providing zero tariff rates on imports of agricultural inputs.

Similarly, distortions in the market for the outputs are prevalent despite the abolition of the state bureaucracies that used to operate in the form of produce marketing boards. In 1989, the produce marketing boards were scrapped leaving the output market to demand and supply forces. The shift from produce marketing boards to a market-based system has not resulted in improved welfare for the farmers. In other words, no fundamental changes have been realised following liberalisation. There is evidence to suggest that farmers are promptly paid[47] but the farm gate prices are at times reported to be below the cost of production. This indirectly affects their income that in turn affects their household food security status. In light of this, what steps should the government take? In the long run, streamlining the flow of market information and provision of road infrastructure, in particular feeder roads, will to some extent rectify the situation. This will give farmers a stronger bargaining platform and at the same time reduce the transaction costs on the part of the private sector. Revitalising and promoting cooperatives may also give farmers a better bargaining platform. However, this is contingent on streamlining the flow of market information, better road networks and improving the physical abilities and skills of the farmers.

The state has a critical role to play, particularly in the pursuit of equitable food distribution. The study findings in Chapter 5 confirmed that households in Pallisa were more food insecure compared to those in the other two districts. They further confirmed that even in Mbarara and Kiboga, which are regarded to be food surplus

---

[47]With the market-based system in place, farmers get paid on the spot unlike before when they had to wait for ages to be paid under the produce marketing boards.

districts, some households were at risk of becoming food insecure. The private sector whose aim is to maximise profits will not transport food to deficit localities when returns are minimal or nonexistent. This shows that the government has to get involved in the distribution of food to such areas considered by the private sector as non-profitable. Alternatively, the government should put in place the necessary incentives that will attract the participation of the private sector in such areas. On the issue of ensuring a more efficient food distribution network, the government can then encourage farmers to concentrate on food crops in which they have a competitive advantage, ecologically.

Removal of government interventions in the agricultural input and output markets are among the policies suggested for the poor nations by the World Bank; ignoring that such interventions are still important even among the developed nations. Most developed countries such as Canada and United States still offer domestic support to farmers. To this end, the Ugandan government's intervention is still important in both the input and output markets if food security for all is to be ensured, with a stronger bias in the former markets, and can co-exist with some degree of market-oriented policies.

8.3.3 Export Diversification Policy

To broaden its economic base, Uganda is pursuing an export diversification strategy that includes exports of non-traditional crops such as maize, beans and simsim. These food items are the major sources of protein and iron. They are also sources of income among the households in the sampled districts as discussed in Chapter 5. The export diversification strategy is also perceived as an opportunity for raising incomes of the rural population. This is an appealing policy on its face value, but its practicability without perpetuating household food insecurity is questionable. The negative signs on the coefficients of some food prices and household type have serious implications for the export diversification policy as long as the current food yields do not improve. In part, this finding meant that some households were involved in selling foods from their own subsistence. Therefore, mechanisms need to be put in place to ensure that raising income does not jeopardise improving household food security. Firstly, a mechanism needs to be put in place skewed toward ensuring food security first. Secondly, there is a need to critically examine the impact of a shift in resources to more remunerative food crops, given that mixed results have been observed elsewhere. For instance, the introduction of vanilla growing in Mukono district led to the removal of labour including women's labour from food production to vanilla growing. Nabuguzi (1993) also reports a shift of labour from staple food production to rice growing in Busoga.

Thirdly, the food export strategy does not offer mechanisms of any kind for protecting farmers from income fluctuations, particularly when food prices go below their production costs. Fourthly, increased production is contingent on the removal of constraints facing rural women, and the improvement of the flow of market information and road networks, in particular feeder roads. Fifthly, the food export strategy is gender-blind in that it fails to discern the implications for household food security of rural women's participation in export diversification. Lastly, under the liberalisation policy framework of the current government the private sector is playing an increasing role in the food export sector. No mechanisms appear to have been put in place to ensure that food exports do not take place in the presence of food deficits in some parts of the country. For instance, exports of beans and maize were realised in the midst of deficits in some districts as discussed in section 2.3.2. Undoubtedly, if these issues are not addressed, and given the current level of food production and increasing rural poverty, deleterious impacts on household food security will be inescapable.

8.3.4 National Food and Nutrition Policy

This policy fully recognises food as a basic need for all persons, and it further recognises that food security needs a multisectoral approach, which is implicitly supported by the findings in this study. The multisectoral approach may minimise duplication of efforts and lead to a better utilisation of the scarce resources. This presupposes, however, that a well-streamlined coordination network is in place.

However, the policy ignores the economic, social and political constraints facing the country. This is usually taken lightly by researchers and policymakers. But, as argued by Pinstrup-Andersen (1993), this has negatively affected efforts by governments in developing countries to improve food security. Further, the policy fails to explicitly separate short-, medium- and long-term strategies for improving food security.

Although the policy does not totally ignore other levels of food security, it still suffers from placing too much emphasis at the national level rather than the lower levels, particularly the household. While Mbarara and Kiboga are considered as food surplus districts, the findings in this study have demonstrated that household food insecurities are prevalent, especially in terms of calories. This reveals a need to break this current obsession of the policymakers to use the national level to evaluate food security at the household level. The focus should be shifted to household food security since security at this level translates into security at the higher levels.

8.4 Synthesis and Issues Arising

A number of issues emerge from the discussion above are worth noting. These include funding, the question of sustainability of food security and natural resources, the essence of a participatory approach, the role of the private sector, advocacy and competitiveness of food exports in the African region.

8.4.1 Funding

There is now consensus that women play a crucial role in ensuring food security at the household level, regionally, nationally and even globally. FAO and the World Bank have argued that raising the productivity of women is fundamental for ensuring food security. The strategies for achieving this, however, are in the hands of the individual governments. They cannot effectively be sought globally. Raising women's productivity will not be possible without increased investments as discussed above. Given the budgetary constraints the Ugandan government is facing today, donor agencies' assistance is crucial in the short run.

As the government appeals to donor agencies for assistance, it should be firm on strategies that tackle the causes rather than the symptoms of household food insecurity. There is evidence that donor agencies in the African region have concentrated on the latter. The efforts by these countries, individually, to seek corrective measures have been frustrated internationally. For instance, quoting an ex-US agricultural Secretary "... the idea that developing countries should feed themselves is an anachronism from a bygone era. They could better ensure their food security by relying on US agricultural products which are available, in most cases, at a lower cost." Shiva (1993, p.234). However, given the economic constraints, most of these countries cannot afford to rely on international trade and/or food aid.

8.4.2 Sustainability of Household Food Security and Natural Resources

Throughout the study, regular occurrences of drought, increasing land degradation, poor soil conservation, weather changes and burgeoning population growth were noted. Their implications for sustainable food security in rural Uganda cannot be taken lightly. This coincides with the on-going debate on improving food security of the poor and vulnerable groups and sustainability of natural resources. This is a challenge to Uganda where the masses depend on agriculture for their livelihood and where food availability from own production is still a necessary condition for ensuring their food security. Clearly, agricultural production cannot sustain people's livelihoods if, at the same time, it destroys the natural resources that production depends on.

JA-Zenchu (1997) observes the challenge of achieving food security is the need to increase food production to match the growing food demands of the population and, at the same time, balancing the demands in an ecologically sound manner to preserve the welfare of future generations. FAO/UNDP (1994) announced a collaboration to promote sustainable food security globally, particularly in LIFDCs, and urged policymakers in the affected countries to ensure that policies to increase agricultural growth consider effective utilisation of the natural resources. The trade-off is eminent, particularly among the poor households whose food security is uncertain. The poor are faced with a choice of meeting current food consumption and protecting the natural resources to meet future food demands.

On the contrary, Vosti (1992) contends that goals of sustainable use of natural resources should not undermine a nation's economic growth and poverty alleviation. Wiebe (1998) argues that protection of natural resources at the expense of necessary consumption levels, and thus a minimum standard of human health, is not sustainable in the long run. Nor would the maintaining of consumption levels by irreversible natural resources degradation. Vosti (1992) and Wiebe (1998) argue that the interactions between food security and sustainable resource use are important in the long run.

Much of the environmental degradation Uganda is facing today is poverty-induced (UNICEF 1994). This, in turn, has serious consequences on household food security. Entitlement failure, notably ineffective access to land by women to practise environmentally sustainable agricultural production, protect natural resources against degradation and adopt better farming methods that enable the soil to regain fertility, threatens the attainment of sustainable livelihoods. Poverty alleviation is, therefore, crucial for sustainability of natural resources and hence household food security, particularly for the poor. Hence, protection of women's entitlements is central for achieving sustainable food security and sustainable use of the natural resources.

A means of improving food security without compromising the natural resource base must be sought. To ensure sustainability of resources in SSA, UNDP (1996) suggests agricultural intensification by promoting soil quality through planned soil nutrition management and fertiliser use. There is growing evidence that further intensification has resulted in resources degradation in some Asian countries, notably China and India (see Byerlee *et al.* 1997) and some Latin American countries (see Pichon and Uquillas 1997). Undoubtedly, such trends may have serious implications for food security in these countries.

The effectiveness of intensification depends on the area's potential for agricultural production (Byerlee *et al.* 1997). Implicit in this is how to go about implementing ecologically sound agricultural intensification. This poses the question of whether a unified agricultural intensification approach is a feasible option for Uganda. Although agriculture in Uganda is rain-fed, it is not uniform across the country. Rather, it ranges from high-potential areas with assured rainfall and to some extent fertile soils to low-potential drought-prone districts with poor soils. In addition, the extent of soil degradation varies considerably across areas. Thus, a uniform intensification approach is not practical given such differences. There is no doubt that agricultural intensification when managed properly increases agricultural productivity with minimal degradation of the natural resources. But implementing agricultural intensification requires the government's commitment to increase its spending in agricultural research, which is currently very low.

The implications of intensification on household food security are twofold. First, with women still trapped under a 'zero-sum game' time allocation, intensification[48] of agriculture in general and food production in particular may worsen household food security. Second, when intensification of agriculture occurs concurrently with time- and energy-saving technologies, improved household food security will be realised.

8.4.3 Participatory Approach

The efforts to raise the status of rural women in Africa have failed partly due to the lack of their participation during the planning stage (Bryceson 1995). The conventional top-down approach[49] has dominated not only policy making and decision-making processes in Uganda, but also technology development in the agricultural research centres. This approach could partly account for the failure of the government development programs and policies (such as income-generating activities, and the Entandikwa credit scheme), and the observed reluctance of farmers to adopt improved technologies. The beneficiaries should be given the opportunity to articulate their needs and priorities, which in turn will provide a more effective way for formulating national development policies and appropriate technologies. The rural women should, as suggested above, be encouraged to participate in such efforts as developing technologies that will lead to saving their time and energy.

The most effective means to realise rural women's full participation must be sought. First, impediments such as cultural, religious and legal constraints, and their 'zero-sum game' must be addressed. To expedite the process, men should be made aware of women's problems and how they affect household food security. Second, to voice their concerns and views effectively, forming groups/organisations might be an alternative way to reinforce their participation. However, this presupposes that these women have the physical abilities and skills that are essential for their participation.

[48]Intensification might increase the demand on their time since it would be possible to produce more crops per year, which will in turn demand more time for weeding and harvesting.
[49]Top-down approach where decisions are made at the centre with little input from below.

8.4.4 Advocacy

Undoubtedly, advocacy is necessary to promote efforts aimed at improving household food security. This is especially important in the Uganda of today where the household food security concept is misunderstood by many, including policymakers. As a first step, researchers and NGOs involved in food security-related activities should streamline coordination amongst themselves. A strong food security advocate group can then follow to carry out the campaign. Policymakers and politicians should be the target at the macro-level. This should be the starting point. On the other hand, there are many issues competing for scarce government resources. Advocacy in this case will play a role in reminding politicians that food security is a societal issue. This may attract more resources to addressing issues surrounding household food security than would otherwise be the case.

At the household level, awareness of the risks related to inadequate dietary intakes should be the central issue aimed at targeting both men and women. This is particularly important in efforts to promote changes in dietary behaviour that are deeply entrenched by people's culture and to promote food security first. Due to other pressing needs, it was shown that households sell foods even in times when they do not have enough for their own consumption.

8.4.5 Role of the Private Sector

Some neo-liberal proponents would argue that imperfect markets are more tolerable than imperfect states (see Colclough and Manor 1991). This study does not argue for full government intervention. Nor does it argue for a fully market-based system. Instead a variety of market-oriented and interventionist policies in diverse mixes should be adopted. For instance, the government's intervention in the market for agricultural inputs is necessary at least in the short run.

The discussion so far has pointed to the insignificant role of the private sector in the agricultural sector. This is mainly so due to the risks that characterise the sector. Streamlining the flow of market information, improving the physical infrastructure, provision of utilities such as electricity and water, and provision of financial assistance by the government, can boost the private sector's presence in the agricultural sector.

Once these are in place, the private sector may be attracted to invest in agro-processing industries in the rural areas closer to the source of raw materials. This, in turn will increase the demand for agricultural products and the subsequent improvement in their income and food security.

8.4.6 Competitiveness in the Food Export Markets

The government is shifting its agricultural export policy from traditional exports to non-traditional exports (see section 8.3.3). This, however, raises concern whether Uganda's food exports in the African region, the key target market, will be competitive. The more competitive the food exports, the more benefits will accrue to rural women, including improved command over food. There are some external factors that are likely to hamper this outcome. For instance, while Uganda is a member of some regional trade blocs, notably COMESA and IGADD, trade relations among member states are still poor. Retaliatory actions that may not be beneficial to either party are the order of the day. For instance, Kenya, which is a key market for Ugandan maize, imposed an import ban on maize imports. Uganda retaliated by imposing a levy import surcharge on a range of Kenya goods. In part, this is blamed on the regional agreements that lack enforcement mechanisms (Collier 1997). On the other hand, the targeted trade partners have not adopted the same kind of extensive liberalisation reforms as Uganda. This may make it difficult for Uganda's food exports to penetrate some markets.

Finally, the impact of dumping subsidised foods from the developed countries, notably the United States, to the African region should not be taken lightly. For instance, in the early 1990s Uganda had barter trade arrangements with Tanzania to supply maize in return for transformers. The United States sabotaged this by supplying 'free' maize to Tanzania. The recent visit to the African region by the United States President, Bill Clinton, on a supposed initiative for United States companies to penetrate the region leaves a lot to be desired. If these companies were to deal with food in the same markets Uganda is targeting, where does it leave the future of rural women? Given the small domestic market for rural food commodities, the Ugandan government needs to come up with strategic plans aimed at improving the competitiveness of its rural food exports in the African region. This will in turn improve the incomes of rural households and hence their food security.

8.5 Concluding Remarks

The empirical results presented here have provided some useful input for policy making and decision-making processes. The policies and strategies suggested above take into account the social, economic, cultural and ecological environment in the country. This was considered important to avoid making untimely recommendations that are beyond the reach of the government. Undoubtedly, raising the productivity of rural women both within the household and on the farm is crucial for improving household food security.

A number of short-term strategies emerged from the discussion that requires the attention of the government. The government should devise avenues to assist rural women to utilise the resources they have optimally and to promote non-formal education aimed at targeting women who were unable to attend school and girls who dropped out of school early. Rural women should be empowered to enable them to fully participate in the country's development. The government should intervene in the agricultural markets either through provision of credit in terms of agricultural inputs or imposing a zero tariff on imports, distribution of food to deficit areas, and encourage the building of storage facilities at the household level. In the long run, the government should improve girls' access to formal education, strengthen the rural infrastructure, promote ecologically and sustainable agricultural intensification, alleviate rural poverty, and construct food reserves at district, regional and national levels.

The study could not provide answers to all the questions concerning household food security in rural Uganda. However, it is a step forward in closing the existing gaps. Therefore, further research is needed to broaden the understanding of the causes and nature of the dimensions of household food insecurity both in the rural and urban areas. Specific suggestions on future research are presented in the next chapter.

9 Summary and Conclusions

The overall objective of the study was to empirically examine the role of women in household food security and how their role can be enhanced. The organisation of the chapter is as follows: In section one a summary of the major conclusions of each chapter are presented. The central caveats of the data and modelling framework used are examined in section two. Implications for further research are discussed in section three prior to concluding remarks.

9.1 Summary

More than 80 percent of Uganda's population reside in rural areas, deriving a livelihood from the agricultural sector in general, and the food sub-sector in particular. Small-scale farmers, mostly women, dominate the sector. The strong economic growth Uganda is enjoying today derives mostly from the food sub-sector. In Chapter 2, the existing gaps in addressing household food security in rural Uganda were identified. Uganda appears to be lagging far behind other African countries in addressing food security at all levels. Persistence of child malnutrition and anecdotal observations of households in some localities feeding on wild foods, question the country's food security in the midst of national food self-sufficiency and positive economic growth. The failure on the part of the government to inform household food security was attributed to three inextricably linked issues: misconception of the food security concept by policymakers, insufficient data at the household level, and the low status of women in rural areas. Policymakers lacked knowledge on how food security of rural households responds to changes in key exogenous factors, including the low status of women.

Since the World Food Conference of 1974, the concept of food security has evolved; so has the process of integrating women in the development process since the UN Decade for Women of 1975. The pertinent issues were discussed at length in Chapter 3. The modelling and estimation procedures employed by earlier studies were reviewed to provide guidance on the choice of the model for this study. The agricultural household models, particularly in the developing world, are continuing to receive a wider application despite criticisms, especially from the feminist movement. Most empirical agricultural household models have their theoretical underpinning from household theories. Such models have proved to be important in investigating the consumption activities and/or production activities and/or labour allocation of the household.

Empirical application of the agricultural household model has so far suffered several shortcomings, especially where it has been applied to food-related issues in rural settings. The failure to explicitly include women in such models, the assumption of perfect markets for inputs and outputs, and the failure to consider the gender division of labour are such shortcomings. On the other hand, the paucity of data on household consumption and production, and the complexity of the non-separable agricultural household model have partly hindered its wider application in SSA despite its ability to capture rural household behaviour.

The theoretical considerations that could be used to examine the interactions between women and household food security in rural Uganda were the subject of Chapter 4. To have an understanding of the behaviour of the rural households in relation to their food security, traditional consumption theory could not be appealed to, nor could traditional production theory. The household production theory that integrates consumption and production behaviour was instead employed. It was considered a suitable paradigm for analysing the response of rural households to changes in key exogenous factors that influence their food security. The theoretical framework of this study appealed to the new household economics and Chayanovian household theories with some modifications to suit rural Uganda and issues of food security.

Addressing the objectives of this study could not have been possible without primary data collection. Thus, the methodology used to gather data and limitations associated with it were the subject of Chapter 5. The coverage of the survey ensured price variability across households to circumvent the conventional demand analysis with cross-sectional data where price is excluded. The key players, the women, were the main respondents. The data on consumption and production activities were collected from the same households for all three surveys. This was important for the estimation of a complete agricultural household model. More importantly, the data collected on consumption were those on food consumed unlike previous studies that have employed food expenditures.

A cursory statistical analysis was carried out to fully understand the data that were to be employed in the estimations. The empirical evidence from the analysis supported the application of the household production theory. The analysis confirmed the households as both producing and consuming units. The household produced food partly for own consumption and partly for sale, but was faced with imperfections in both the input and output markets. The assumption of joint preferences among members of the household was also supported from the analysis. The majority of the decisions in the households was made jointly, and from most respondents' perspective food was fairly distributed among members. If unequal intra-household distribution of food were common, application of a unitary model would have been questionable. However, this was not the case.

Using both objective and subjective measures of household food security, food insecurity among rural households existed in the midst of positive economic growth and self-sufficiency at the national level. This will remain a serious issue in the future if it continues unchecked. The role of the government to ensure food security for all has become more important than ever, calling for a more focused approach at the household level. The severity of household food insecurity and dietary sources varied greatly from district to district, with households in Pallisa at a higher risk.

The strategies adopted by households in Pallisa to cope with food shortages were also worrying compared with households from the other two districts. The post-harvest technologies at the household level were extremely poor, from the harvesting stage to the pot, leading to massive crop losses. The increasing occurrences of drought, land degradation and unpredictable weather conditions leaves the government with no other option than taking necessary measures to address the issue. Improving the existing indigenous knowledge on food preservation and storage facilities should be taken seriously.

The non-separable agricultural household model employed to estimate the results was discussed in Chapter 6. The model took into account the issues that emerged in Chapter 5 from the cursory statistical analysis and the weaknesses of the earlier studies, as highlighted in Chapter 3. The responses by rural households to changes in the exogenous variables that influence their food security were examined within the non-separable framework. The dependent variables on the consumption side of the model were explicitly expressed in a way that measures household food security directly. Calories, protein and iron were employed as proxy measures of household food security. This was a variation from the previous studies carried out elsewhere in Africa that have concentrated exclusively on caloric intake. Households consumed a variety of food items over the survey period. Parsimonious estimation of a complete non-separable household model required aggregation across food items. As a result the foods consumed were aggregated into seven food groups.

The empirical results from the non-separable agricultural household model were presented and discussed in Chapter 7. The estimation of a complete model was carried out using 3SLS. Despite some data weaknesses and restrictive assumptions under which the model was estimated, the results were encouraging. They showed that the impact of exogenous variables on both the consumption and production sides of the model varied considerably from district to district and across all the three proxies of household food security. Such impacts have implications for the policy-making and decision-making processes.

The coefficients of some food prices were significantly different from zero, despite the households deriving much of their consumption from own production. The elasticities with respect to prices of food were sizeable, providing evidence that rural households are not operating outside the monetary economy. To some extent the impact of changes in prices reflected the importance of the food items in the overall dietary intake. Some price elasticities were positive, contrary to the expectation of the conventional consumption theory. This was mainly due to the 'profit effect' in the full income of the households. It was demonstrated that if the food prices were to increase, the number of households unable to meet 75 percent of the recommended daily dietary intake would increase in cases where the price elasticity was negative and reduce where it was positive.

Generally, the results demonstrated that a woman's status influences her household's command over food. There are numerous conclusions that can be drawn. Firstly, changes in women-specific variables did not have a uniform impact on all the three proxies of household food security either within or across districts. In part, this did not indicate that as far as informing food security is concerned women can be treated as a homogeneous group; nor is the categorisation according to headship satisfactory. Secondly, the magnitudes of the elasticities with respect to women-specific variables were slightly higher than most of the other variables included in the model.

Thirdly, the results demonstrated that the time allocation of a rural woman had a significant impact on household food security, with a higher impact for protein and iron intakes. It was demonstrated that the labour of the wife was an imperfect substitute for that of the husband. Fourthly, a woman's education and health status influenced household food security. Fifthly, households with older women were more vulnerable to food insecurities than those with younger women. Implications for modelling food-related issues in the African context are obvious. Undoubtedly, failure to explicitly incorporate the role of rural women will lead to biased estimates. Hence, the subsequent questioning of policies based on such estimates.

In rural Uganda, poverty influences household food security. The results of the study supported the conventional wisdom that increasing income is crucial for improving household food security, and is a long-term strategy. The high income elasticities observed across the household food security proxies were not surprising given the widespread incidence of poverty in rural Uganda. However, it is not a sufficient condition. Considerable variations of income elasticities were observed across household food security proxies and from district to district. The income variable had a higher impact on caloric intake in Mbarara and Pallisa and on iron intake in Kiboga. It was interesting to note that Pallisa, a district more prone to food insecurity, was less income-elastic than the other districts. In contrast, the impact of increased income would be limited if such increases were not linked to improvements in social services such as in health and education.

Very interesting observations emerged when access to productive resources by rural women was included as a variable in the empirical analysis. The impact of productive resources, individually, varied greatly from district to district. There was no systematic behaviour (in terms of signs and size) of the impact of a particular resource across districts. Generally speaking, the impact of accessibility was greater where there was little of it. Insights were provided on how the government could start addressing the issue of improving women's access to productive resources. Generally, where a woman's access to a particular productive resource was statistically significant, it was found to have a higher impact on household food production and her labour supply than most of the variables.

The results demonstrated that a household being secure in calories did not guarantee security in terms of protein and iron. The income, price and women-specific elasticities were shown to be significantly different across the three proxies used to measure household food security. Intuitively, household food security in rural Uganda should not be considered only in terms of caloric intake. The study also demonstrated that the factors that affected household food security also jointly affected household food production, particularly the women-specific variables, which supports the application of a non-separable agricultural household model.

In Chapter 8, the implications of the study results were discussed and policies were drawn for the attention of policymakers. Clearly, the results of this study provide some useful input for policymaking and decision-making processes. The policies and strategies suggested took into account the political, social, economic, cultural and ecological environment in the country. This was considered important to avoid making untimely policies and strategies that are beyond the 'reach' of the government. There is no doubt that raising the productivity of rural women both within the household and on the farm is crucial for improving household food security.

Short- and long-term policies were suggested. In the short term, women should be assisted to utilise the resources at their disposal optimally and promote non-formal education targeting those women who were unable to attend school and those who dropped out early. Rural women should be empowered to fully participate in the development process of their country. Despite liberalisation of the markets for agricultural inputs and outputs, participation by the private sector in these markets is still insignificant. This is partly due to the uncertainties in these markets. Thus, the government's intervention in the agricultural markets through provision of agricultural inputs and distribution of food to deficit areas is still important, at least in the short term. Rural households should be encouraged and assisted, if necessary, to have food storage facilities. However, effective utilisation of these facilities is contingent not only on production but also on the preservation technologies.

In the long term, the government should improve girls' access to formal education; strengthen rural infrastructure; promote ecologically sound and sustainable agricultural intensification; alleviate rural poverty; and construct food reserves at district, regional and national levels. Sustainability of food security is important, as current security does not guarantee tomorrow's security. This can only be achieved if the natural resources on which food production depends are utilised in a sustainable manner.

9.2 Caveats of the Study and Suggestions for Further Research

The limitations of the data set employed in this study were discussed in Chapter 5. The education variable used was collected in terms of level rather than the number of years. This was an oversight as the former conceals a lot of very useful information. In addition, household income was not disaggregated by gender, which made it difficult to examine the impact of income by gender on household food security. Efforts were taken to control measurement errors due to transforming foods from village-localised units of measurement to nutritional equivalents. Inevitably, a number of food items such as amaranthus, maize on cob, fish, eggplant, sugarcane, pawpaw and mango were not included in daily dietary intake, as it was difficult to quantify them.

Despite some data deficiencies, the results have revealed that household food insecurity does exist, and the consumption and production decisions are inseparable, especially in terms of women-specific variables. Thus, there is a need for a regular data collection system at the household level covering both consumption and production activities. Particular attention should be given to relevant data that would broaden the analysis of the production side of the model. Examples are detailed data on the division of labour across tasks[50], area planted by crop, labour inputs, other farm inputs, and soil quality; where possible such data should be disaggregated by gender. The problem posed in recording production of continuous crops (such as potatoes, cassava and matooke) by households should be taken seriously.

[50] This study considered a broad gender division of labour. There is need to disaggregate the gender division of labour further across tasks on the farm, such as planting, weeding and harvesting.

The model was estimated under very restrictive assumptions that need to be relaxed. Certainly, the assumption of risk neutrality in food production and consumption is a very unrealistic assumption in Uganda, especially in recent years, where weather conditions have become less predictable than ever. The labour inputs of other household members, including children, should be explicitly incorporated into such models. The time dimension of the food security concept was completely ignored by assuming a static model. Clearly, a household being food secure today does not guarantee its security tomorrow and this may affect household responses to changes in exogenous variables. Hence a need to incorporate such dynamism. Estimating the production side as a single aggregate food may have concealed a lot of useful information for the policymaking process. This was inevitable, due partly to zero production for some food items by some households, since the survey covered only a single production season. It is hoped that with regular surveys, zeros will be reasonably minimised making possible the estimation of a multicrop output on the production side of the model that will capture the diversity of food crops grown by rural households. This will also provide knowledge on how crop mix by households is affected by changes in government policies.

The modelling procedure assumed risks or shocks to household food security to be shared equally among members. However, in some instances some members, particularly women, may share a higher burden from the shocks than other members of the household. For instance in time of food shortages, women may decide either to go hungry or eat less for the sake of the kids. There is a need to relax this assumption.

The study covered only three out of the thirty four districts in Uganda. The results indicated the signs and magnitudes of the exogenous variables to have varied greatly from district to district. It was further demonstrated that the coping strategies adopted by households to lessen the impact of ephemeral food shortages varied across districts. Hence, the study should be extended to other districts. Further, the study focused on the rural areas paying no attention to the urban areas. Unfortunately, the behaviour of households in the rural and urban areas differs in many facets. Thus, results based on rural Uganda may fail to give insights into household food security in urban areas. Hence, there is a need for research on household food security in urban areas. To sum up, all this would provide a firm foundation for an overall household food security policy for the country.

There is a need for research to critically investigate the interactions between household food security and the post-harvest technologies, and the different type of technologies used at each stage: harvesting, drying, processing and preservation. This would also provide useful information for agricultural scientists on how best to improve on the indigenous technologies. An environmental assessment should be carried out at all levels. This would provide insights on how best to plan, design and implement ecologically sound agricultural intensification that will ensure sustainability of the natural resources and in turn ensure sustainable household food security.

Another deficiency in the study is that coping strategies were monitored for a single growing season only. There is a need to track them over a much longer period. Such information could then be employed to have a better understanding of how rural households strike a balance between meeting food needs today and sustainability of resources for future consumption. In other words, what is the role of coping strategies in managing this challenge faced by the household, particularly the poor? This may give indications on whether household members are not starving at a significant cost of impoverishment.

Generally speaking, agricultural household models are built on many assumptions. If these are the best alternative for understanding peasant behaviour, there is a need to develop sound tests for the validity of the assumptions under which they are built.

9.3 Concluding Remarks

Evidently, there are no blueprint remedies for developing countries to follow in order to improve food security at all levels. Remedies are localised, depending on the causes and the nature of the dimensions of the food insecurity problem. This is to suggest that remedies employed elsewhere to address household food security may not be replicable in Uganda. Hence, this necessitated an independent study specifically on Uganda.

It appears that this is the first study of its kind to analytically address the issue of household food security in rural Uganda. Policies that affect consumption and production decisions, and in turn food security, have been based on *ad hoc* measures. The modelling framework employed captured the non-separability that exists between consumption and production decisions among rural households. While ignored by previous studies, this study incorporated the imperfections in the markets for inputs and output, the gender division of labour that exists in rural settings and the women-specific variables.

The study has provided insights on how food security of rural households respond to changes in exogenous factors, including the status of women. It has provided useful inputs for effective policymaking and decision-making processes regarding the issues of household food security. There is no single policy that can be employed to effectively improve food security of the rural household. Instead a mix of policies were suggested, explicitly addressing the issues that are central to raising the productivity of these women. Rural women should be assisted to improve their productivity on an ecologically sound and sustainable basis. This is a key determinant of the government's success in achieving sustainable food security for all.

Lastly, given the dynamism of household food security, there is a need to systematically collect data on the relevant data parameters on a regular basis. However, this requires the government's commitment to investment in the data collection systems and subsequent utilisation of such information in the policymaking process.

References

Abdulai, A. and Hazell, P. (1995). 'The Role of Agriculture in Sustainable Economic Development in Africa', *Journal of Sustainable Agriculture*, 7(2/3), pp.101-119.

ACC/SCN (1997). *Third Report on the World Nutrition Situation,* ACC/SCN, Geneva.

ACC/SCN (1992). *World Declaration on Nutrition.* http://www.fao.org/es%2A/esn/icn.

ACFODE (1989). *Uganda: Women's Needs Assessment Survey*, Kampala.

Aczel, J. (1966). *Lectures on Functional Equations and their Applications*, Academic Press, New York.

Ademola, A. (1994). 'Women Farmers in Ondo State, Nigeria', *Journal of Anthropological Research*, 50, pp.311-326.

Adulavidhaya, K., Kuroda, Y., Lau, L. J. and Yotopoulous, R. A. (1983/84) 'The Comparative Statics of the Behaviour of Agricultural Households in Thailand', *Singapore Economic Review*, 28-29, pp.67-95.

Alderman, H. and Garcia, M. (1993). *Poverty, Household Food Security, and Nutrition in Rural Pakistan.* Research Report 96, International Food Policy Research Institute, Washington, D.C.

Alderman, H., Chiappori P. A., Haddad, L., Hoddinott, J. and Kanbur, R. (1995). 'Unitary Versus Collective Models of the Household: Is it Time to Shift the Burden of Proof?', *The World Bank Research Observer*, 10(1), pp.1-19.

Ali, R. and Pitkin, B. (1991). 'Searching for Household Food Security in Africa', *Finance and Development*, 28(4), pp.3-6.

Al-Najjar, N. (1993). 'Nontransitive Smooth Preferences', *Journal of Economic Theory*, 60(1), pp.14-41.

Anon. (1991). 'A Review of Malnutrition in Africa', *Rural Progress*, 10(1), pp.29-47.

Ardayfio-Schandorf, E. (1993). 'Household Energy Supply and Rural Women's Work in Ghana', in Momsen, J. H. and Kinnaird, V. (ed.), *Difference Places, Different Voices: Gender and Development in Africa, Asia and Latin America*, Routledge, London, pp.15-29.

Asefa, S. (1991). 'Enhancing Food Access in Africa: The Botswana Experience', *Studies in Comparative International Development*, 26(3), pp.59-83.

Ayres, W. S. and McCalla, A. F. (1996). 'Rural Development, Agriculture and Food Security', http://www.worldbank.org/fandd/english/1296/articles/021296.htm.

Aziz, A. S. (1986). 'Alleviating Rural Poverty in sub-Saharan Africa', *Food Policy*, 11(1), pp.7-11.

Barnum, H. and Squire, L. (1979). *A Model of an Agricultural Household: Theory and Evidence*, The John Hopkins University Press, Baltimore.

Barrett, H. R. and Browne, A. W. (1994). 'Women's Time, Labour Saving Devices and Rural Development in Africa', *Community Development Journal*, 29(3), pp.203-214.

Barten, A. P. and Bohm, V. (1982). 'Consumer Theory', in Arrow K. J. and Intriligator, M. E. D. (eds), *Handbook of Mathematical Economics,* VII, North-Holland Publishing Company, Amsterdam and New York, pp.381-429.

Barten, A. P. (1969). 'Maximum Likelihood Estimation of a Complete System of Demand Equations', *European Economic Review*, 1, pp.7-13.

Battese, G. E. (1997). 'A Note on the Estimation of Cobb-Douglas Production Functions when Some Explanatory Variables have Zero Values', *Journal of Agricultural Economics*, 48(2), pp.250-252.

Becker, G. S. (1965). 'A Theory of the Allocation of Time', *The Economic Journal,* 75, pp.493-517.

Beggs, J. J. (1985). 'Diagnostic Testing in Applied Econometrics', *The Economics Record*, 64(185), pp.81-101.

Behrman, J. R. (1995). *Household Behaviour and Micronutrients: What We Know and What We Don't Know, Agricultural Strategies for Micronutrients*, Working Paper #2, International Food Policy Research Institute, Washington, D.C.

Behrman, J. R. and Deolalikar, A. B. (1987). 'Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India', *Journal of Political Economy*, 95(3), pp.492-507.

Behrman, J. R. and Wolfe, B. L. (1984). 'More Evidence on Nutrition Demand: Income Seems Overrated and Women's Schooling Underemphasised', *Journal of Development Economics*, 14(1/2), pp.105-128.

Bender, W. and Smith, M. (1997). 'Population, Food and Nutrition', *Population Bulletin*, 51(4), pp.5-12.

Benjamin, D. (1992). 'Household Composition, Labour Markets, and Labour Demand: Testing for Separation in Agricultural Household Models', *Econometrica*, 60(2), pp.287-322.

Berger, M. (1989). 'Giving Women Credit: The Strength and Limitations of Credit as a Tool for Alleviating Poverty', *World Development*, 17 (7), pp.1017-1032.

Berndt, E. R. (1991). *The Practice of Econometrics: Classic and Contemporary*, Addison-Welsey Publishing Co, Sydney.

Bezuneh, M., Deaton, B. J. and Norton, G. W. (1988). 'Food Aid Impacts in Rural Kenya', *American Journal of Agricultural Economics*, 70(1), pp.181-191.

Bibangambah, J. R. (1983). 'A Mischievous Attitude to African Agriculture', *Food Policy*, 8(4), pp.262-263.

Blundell, R. (1988). 'Consumer Behaviour: Theory and Empirical Evidence - A Survey', *The Economic Journal*, 98(389), pp.16-65.

Boserup, E. (1970). *Women's Role in Economic Development*, Allen & Unwin, London.

Bouis, H. E. (1994). 'The Effect of Income on Demand for Food in Poor Countries: Are our Food Consumption Databases Giving us Reliable Estimates?' *Journal of Development Economics*, 44, pp.199-226.

Bouis, H. and Haddad, L. (1992). 'Are Estimates of Calorie-Income Elasticities too High?: A Recalibration of the Plausible Range', *Journal of Development Economics*, 39(2), pp.333-364.

Bryceson, D. F. (1995). 'Wishful Thinking: Theory and Practice of Western Donor Efforts to raise Women's Status in Rural Africa', in Bryceson, D. H. (eds), *Women Wielding the Hoe: Lessons from Rural Africa for Feminist Theory and Development Practice* Cross-Cultural Perspectives on Women, Berg Publishers, Oxford and Washington D. C, 16, pp.201-222.

Byerlee, D., Hazell, P. and Kerr, J. (1997). 'Critical Resource, Technology, and Environmental Issues for Meeting Future Grain Production Needs in Asia', *American Journal of Agricultural Economics*, 79(5), pp.1480-1484.

Capps Jr O. (1983). 'Alternative Estimation Methods of Nonlinear Demand Systems', *Western Journal of Agricultural Economics*, 8(1), pp.50-63.

Carloni, A. S. (1981). 'Sex Disparities in the Distribution of Food Within Rural Households', *World Food Day*, FAO,pp.3-11.

Cecelski, E. (1987). 'Energy and Rural Women's Work: Crisis, Response and Policy Alternatives', *International Labor Review*, 126(1), pp.41-64.

Chambers, R. G. (1988). *Applied Production Analysis: A Dual Approach*, Cambridge University Press, Cambridge.

Charlton, S. E. M. (1984). *Women in Third World Development*, Westview Press, Boulder and London.

Chayanov, A. V. (1966). *The Theory of Peasant Economics*, ed and introd. By Thorner, D., Kerblay, B. and R.E.F. Smith, Irwin, Homewood, Illinois.

Chiappori, P. A. (1988). "Rational Household Labor Supply," *Econometrica*, 56(1), pp.63-90.

Colclough, C. and Manor, J. (ed.) (1991). *States or Markets?: Neo-liberalism and the Development Policy Debate*, Clarendon Press, New York.

Collier, P. (1997). 'The Trade Policy Review of Uganda', *World Economy*, 20(5), pp.649-664.

Coyle, B. T. (1993). 'Allocatable Fixed Inputs and Two stage Aggregation Models of Multioutput Production Decisions', *American Journal of Agricultural Economics*, 75(2), pp.367 -376.

Coyle, B. T. (1994). 'Duality Approaches to the Specification of Agricultural Household Models', in Caillavet, F., Guyomard, H. and Lifran, R. (eds), *Agricultural Household Modelling and Family Economics*, Elsevier, Amsterdam and Tokyo, pp.49-64.

Crehan, (1992). 'Rural Households: Making a Living', in Bernstein, H., Crow, B. and Johnson, H. (eds), *Rural Livelihoods: Crises and Responses*, Oxford University Press, Oxford, pp.87-113.

D'Agostiono, V. C. (1988). Coarse Grain Production and Transactions in Mali: Farm Household Strategies and Government Policy, Unpublished MSc Thesis, Michigan State University, East Lansing.

DANIDA (1993). *Uganda Country Report*, Kampala.

Dasgupta, P. (1993). *An Inquiry into Well-being and Destitution*, Clarendon Press, Oxford.

de Janvry, A., Sadoulet, E., Fafchamps, M. and Raki, M. (1992). 'Structural Adjustment and the Peasantry in Morocco: A Computable Household Model', *European Review Agricultural Economics*, 19, pp.427-453.

Deaton, A. (1988). 'Quality, Quantity and Spatial Variation of Price', *American Economic Review*, 78(3), pp.418-430.

Deaton, A. and Muellbauer, J. (1980a). *Economics and Consumer Behaviour*, Cambridge University Press, Cambridge and New York.

Deaton, A. and Muellbauer, J. (1980b). 'An Almost Ideal Demand System', *American Economic Review*, 70(3), pp.312-326.

Delforce, J. (1993). Smallholder Agriculture in the Kingdom of Tonga: A Farm-household Analysis, Unpublished PhD Thesis, Department of Agricultural Economics and Business Management, University of New England, Armidale.

Delforce, J. (1994). 'Separability in Farm Household Economics: An Experiment with Linear Programming', *Agricultural Economics*, 10(2), pp.165-177.

Delforce, J., Lyne, M. and Sharma, K. (1987). 'Farm Household Economics in Developing Countries: Approaches and Difficulties', *Occasional Papers in Economic Development* No. 7, University of New England, Armidale.

Delisle, H., Alladoumgue, M., Begin, F., Nandjingar, K. and Lasoersa, C. (1991). 'Household Food Consumption and Nutritional Adequacy in Wadi Zones of Chad, Central Africa', *Ecology of Food and Nutrition*, 25(3), pp.229-248.

Dione, J. (1987). The Use of Farm and Marketing Survey Data to Inform Food Security Policy in Mali, Unpublished PhD Thesis, Michigan State University, East Lansing.

Dodge, C. P. and Alnwick, D. (1986). 'Karamoja: A Catastrophe Contained', *Disaster*, 10(1), pp.15-16.

Due, J. M. and Gladwin, C. H. (1991). 'Impacts of Structural Adjustment Programs on African Women Farmers and Female-Headed Households, *American Journal of Agricultural Economics*, 73(5), pp.1431-1447.

Duncan, G. M. (1983). 'Estimation and Inference for Heteroscedastic Systems of Equations', *International Economic Review*, 24(3), pp.559-566.

El Ghonemy, M. R. (1990). *The Political Economy of Rural Poverty: The Case for Land Reform*, Routledge, London and New York.

Ellis, F. (1992). *Agricultural Policies in Developing Countries*, Cambridge University Press, Cambridge.

Ellis, F. (1993). *Peasant Economics: Farm Household and Agrarian Development*, 2nd ed., Cambridge University Press, Cambridge.

Evans, A. (1992). *Rural Labour Market Assessment-Uganda*, Preliminary Observations and Conclusions, Agricultural Secretariat, Bank of Uganda.

Evenson, R. E. (1981). 'Food Policy and the New Home Economics', *Food Policy*, 6(3), pp.180-193.

Fan, S., Wailes, E. J. and Cramer, G. L. (1995). 'Household Demand in Rural China: A Two Stage LES-AIDS Model', *American Journal of Agricultural Economics*, 77, pp.54-62.

FAO/WHO (1973). *Energy and Protein Requirements,* Ad hoc Expert Committee, FAO, Nutrition Meetings Report Series No. 52, FAO, Rome.

FAO (1983). World Food Security: A Reappraisal of the Concepts and Approaches, Director-General Report, Rome.

FAO (1987), 'Women in African Food Production and Food Security', in Gittinger J. P., Leslie J. and Hoisington C. (eds), *Food Policy: Integrating Supply, Distribution and Consumption,* The Johns Hopkins University Press, Baltimore and London.

FAO (1992). *The State of Food and Agriculture: World and Regions Reviews Marine Fisheries and the Law of the Sea*, Rome, pp.60-63.

FAO (1996a). World Food Summit, http://www.fao.org/wfs/homepage.htm, Rome, Italy, 13-17th August.

FAO (1996b). World Food Summit: Food Security Situation and Issues in the Africa Region, Nineteenth FAO Regional Conference For Africa, Ouagadougou, Burkina Faso, 16-20 April.

FAO (1996c). SWWD, http://www.fao.org.

FAO (1996d). Focus, http://www.fao.org.

FAO (Several issues). *Food Aid in Figures 1993, 1994*, Rome.

FAO (Several issues). *Trade Yearbooks*, Rome

FAO/WFP (1997). 'Crop and Food Supply Assessment Mission to Uganda. Special Report', http://www.reliefweb.int.

FAO/WHO (1985). *Energy and Protein Requirements*, Technical Report Series #724, World Health Organisation, Geneva.

Fleming, E. M. and Hardaker, J. B. (1993). 'Micro-Level Approaches to Analysing Rural Development Problems', *Review of Marketing and agricultural Economics*, 61(2), pp.213-226.

Fomby, T. B., Hill, R. C. and Johnson, S. R. (1984). *Advanced Econometric Methods*, Springer-Verlag, New York.

Garcia, M. (1990). 'Impact of Female Sources of Income on Food Demand among Rural Households in the Philippines', *Quarterly Journal of International Agriculture*, 29(1), pp.109-124.

Gender C G Newsletter, several issues, http://www.cgiar.org/ifpri.

Goldman, S. M. and Uzawa, H. (1964). 'A Note on Separability in Demand Analysis', *Econometrica*, 32(3), pp.387-398.

Green, W. H. (1997). *Econometric Analysis*, 3rd ed., Prentice Hall, New Jersey.

Griffiths, W. E., Hill, R. C., and Judge, G. G. (1993). *Learning and Practicing Econometrics*, John Wiley and Sons, Inc., New York and Toronto.

Gronau, R. (1977) 'Leisure, Home Production and Work: The Theory of the Allocation of Time Revisited', *Journal of Political Economy*, 85(6), pp.1099-1124.

Haddad, L. (1991). 'Gender and Poverty in Ghana: A Descriptive Analysis of Selected Outcomes and Processes', *IDS Bulletin*, 22 (1), pp.5-16.

Hall, R. E. (1973). 'The Specification of Technology with Several Kinds of Output', *Journal of Political Economy*, 81, pp.878-892.

Hardaker, J. B., MacAulay, T. G., Soedjono, M. and Darkey, C. K. G. (1985). 'A Model of a Padi Farming Household in Central Java', *Bulletin of Indonesian Economic Studies*, 21(3), pp.30-50.

Heckman, J. (1974). 'Shadow Prices, Market Wages and Labour Supply', *Econometrica*, 42(4), pp.679-694.

Heien, D. and Wessells, C. R. (1990). 'Demand Systems Estimation with Microdata: A censored Regression Approach', *Journal of Business and Economic Statistics*, 8(3), pp.365-371.

Henn, J. K. (1983). 'Feeding the Cities and Feeding the Peasants: What Role For Africa's Women Farmers?', *World Development*, 11(12), pp.1043-1055.

Hoddinott, J. and Haddad, L. (1995). 'Does Female Income Share Influence Household Expenditures? Evidence from Cote D'Ivoire', *Oxford Bulletin of Economics and Statistics*, 57(1), pp.77-96.

Hoffmann, H. K. F. (1993). 'Strengthening Education and Training in Support of Food Security in Developing Countries', in Thimm, H. U. and Hahn, H. (eds), *Regional Food Security and Rural Infrastructure*, Volume II, International Symposium, 3rd – 6th May, pp.3-12.

Hopkins, J., Levein, C. and Haddad, L. (1994). 'Women's Income and Household Expenditure Patterns: Gender or Flow? Evidence from Niger', *American Journal of Agricultural Economics*, 76(5), pp.1219-1225.

Hyden, G. (1983). *No Shortcuts to Progress: African Development Management in Perspective*, Heinemann, London.

IBRD (1995). Annual Report. http://www.worldbank.org/html/extpb/annrep95/index.htm.

IDS Bridge (1996). http://www.ids.ac.uk/bridge/

IFPRI Report (Feb 1996, June 1994). http://www.cgiar.org/ifpri/

Iqbal, F. (1986). 'The Demand and Supply of Funds among Agricultural Households in India', in Singh, I., L. Squire and John Strauss (Eds.), *Agricultural Household Models: Extensions, Applications and Policy*, The Johns Hopkins University Press, Baltimore and London, pp.183-205.

Islam, R. (1990). 'Rural Poverty, Growth and Macroeconomic Policies: The Asian Experience', *International Labour Review*, 129(6), pp.693-714.

Jacoby, H. G. (1992). 'Productivity of Men and Women and the Sexual Division of Labour in Peasant Agriculture of the Peruvian Sierra', *Journal of Development Economics*, 37(1/2), pp.265-287.

Jacoby, H. G. (1993). 'Shadow Wages and Peasant Family Labor Supply: An Econometric Application to the Peruvian Sierra, *Review of Economic Studies*, 60(4), pp.903-921.

Jamal, V. (1988). 'Coping Under Crisis in Uganda', *International Labor Review*, 127(6), pp.679-701.

Jarawan, E. (1991). 'Women in Development: Current Issues and Agenda for Further Research', *AF2PH Working Paper.*

JA-Zenchu (1997). 'A new Challenge for Alleviating Potential Global Food Crises in the 21st Century', http://www.janis.or.jp.

Jiggins, J. (1989). 'How Poor Women Earn Income in sub-Saharan Africa and What Works Against Them', *World Development*, 17(7), pp.953-963.

Judge, G. G., Griffiths, W. E., Hill, R. C., Lutkepohl, H., and Lee, T. C. (1985). *The Theory and Practice of Econometrics*, 2nd ed., John Wiley and Sons, Inc., New York and Brisbane.

Kabra, K. N. (1996). 'Rethinking Food Security in the Context of Development Paradigms', *Asia-Pacific Journal of Rural Development,* 6(1), pp.71-82.

Katz, E. G. (1995). 'Gender and Trade Within the Household: Observations from Rural Guatemala', *World Development*, 23(2), pp.327-342.

Kennedy, E. F. and Oniango, R. (1993). 'Household and Pre-Schooler Vitamin A Consumption in South Western Kenya', *Journal of Nutrition*, 123(5), pp.841-846.

Kiiza, J. (1997). 'Liberalisation Policies and University Education in Uganda: An Assessment of the Cost-Sharing Policy', *Makerere Political Science Review*, 1(1), pp.70-86.

Kikafunda, J., Sserunjogi, L. and Migadde, M. (1994), *Report on the Establishment of a Nutrition Based Absolute Poverty Line for Uganda,* Ministry of Finance and Economic Planning and Program for the Alleviation of Poverty and Social Costs of Adjustment, Kampala.

Kim, T. and Richter, M. K. (1986). 'Nontransitive-nontotal Consumer Theory', *Journal of Economic Theory*, 38, pp.324-363.

Kmenta, J. (1986). *Elements of Econometrics*, 2nd ed., Collier MacMillan, New York and London.

Koopman, J. (1991), 'Neoclassical Household Models and Modes of Household Production: Problems in the Analysis of African Agricultural Households', *Review of Radical Political Economics,* 23(3 and 4), pp.148 -173.

Kumar, S. K. (1994). *Adoption of Hybrid Maize in Zambia: Effects on Gender Roles, Food Consumption and Nutrition*, Research Report # 1000, International Food Policy and Research Institute, Washington, D.C.

Kwesiga, J. and Muhereza, F. E. (1997). 'Uganda: Gender and Poverty', *Social Watch, http://www.chasque.apc.org/socwatch/Uganda.htm*.

Kyereme, S. S. and Thorbecke, E. (1991). 'Factors Affecting Food Poverty in Ghana', *Journal of Development Studies*, 28, pp.39-51.

LaFrance, J. T. (1991). 'When is Expenditure 'Exogenous' in Separable Demand Models?', *Western Journal of Agricultural Economics*, 16 (1), pp.49-62.

Lambert, S. and Magnac, T. (1994). 'Measurement of Implicit Prices of Family Labor in Agriculture: An Application to Cote D'Ivoire', in Caillavet, F., Guyomard, H. and Lifran, R. (eds), *Agricultural Household Modelling and Family Economics*, Elsevier, Amsterdam and Tokyo, pp.9-24.

Lancaster, K. J. (1966). 'A New Approach to Consumer Theory', *Journal of Political Economy*, 74, pp.132-157.

Larson, B. A. and Frisvold, G. B. (1996), 'Fertilisers to Support Agricultural Development in sub-Saharan Africa: What is Needed and Why', *Food Policy*, 21(6), pp.509-525.

Lau, J. L. (1972). 'Profit Functions of Technologies with Multiple Inputs and Outputs', *Review of Economics and Statistics*, 54, pp.281-289.

Lau, W., Lin, L. and Yotopoulous, P. (1978). 'The Linear Logarithmic Expenditure System: An Application to Consumption and Leisure Choice', *Econometrica*, 46(4), pp.843-868.

Lipton, M. (1983). *Poverty, Undernutrition and Hunger*, World Bank, Washington, D.C.

Lopez, R. E. (1982). 'Applications of Duality Theory to Agriculture', *Western Journal of Agricultural Economics*, 7(2), pp.353-365.

Lopez, R. E. (1984). 'Estimating Labour Supply and Production Decisions of Self-Employed Farm Producers', *European Economic Review*, 24, pp.61-82.

Lopez, R. E. (1986). 'Structural Models of the Farm Household that Allow for Interdependent Utility and Profit Maximisation Decisions', in Singh, I., Squire, L. and Strauss, J. (eds), *Agricultural Household Models: Extensions, Applications and Policy*, The Johns Hopkins University Press, Baltimore and London, pp.306-324 .

Loveridge, S. (1988). Uses of Farm and Market Survey Data to Inform Food Security in Rwanda, Unpublished PhD Thesis, Department of Agricultural Economics, Michigan State University, East Lansing.

Low, A. (1986). *Agricultural Development in Southern Africa: Farm Household Economics and the Food Crisis*, Colset Pte, Singapore.

Lubwama, H. (1991). *Uganda Secondary School Atlas*, MacMillan, London.

Lyne, M. (1988). 'Farm Household Economics: Some Policy Implications for Emergent Farmers in Southern Africa', *Development Southern Africa*, 5(1), pp.97-100.

Madeley, J. (1985). 'Does Economic Development Feed People?', *Ecologist*, 15(1/2), pp.36-41.

Mamdani, M. (1992). 'Class Formation and Rural Livelihoods: A Ugandan Case Study', in Bernstein, H., Crow, B. and Johnson, H. (eds), *Rural Livelihoods: Crises and Responses*, Oxford University Press, Oxford and New York, pp.195-216.

Marangu, L. (1989). 'Food Crisis in Africa', *Canadian Home Economics*, 39(4), pp.144-148.

Maxwell, D. G. (1996). 'Measuring Food Insecurity: The Frequency and Severity of 'Coping Strategies', *Food Policy*, 21(3), pp.291-303.

Maxwell, S. (1990). 'Food Security in Developing Countries: Issues and Options for the 1990s', *IDS Bulletin*, 21(3), pp.2-13.

Maxwell, S. (1992). 'Food Security in Africa: Priorities for Reducing Hunger', *Brief: Africa Recovery*, 6, pp.1-12.

Maxwell, S. (1996). 'Food Security: a Post-Modern Perspective', *Food Policy*, 41(2), pp.385-399.

Maxwell, S. and Smith, M. (1992). 'Household Food Security: A Conceptual Review', in Maxwell, S. and Frankenberger, T. R. (eds.), *Household Food Security: Concepts, Indicators, Measurements. A Technical Review*, Jointly Sponsored by UNICEF and IFAD, pp.1-72.

May, C. A. (1992). An Agricultural Household Model for Burkina Faso, West Africa, Unpublished PhD Dissertation, University of Florida.

McElroy, M. and Horney, M. J. (1981). 'Nash-Bargained Household Decisions: Toward a Generalisation of the Theory of Demand', *International Economic Review*, 22(2), pp.333-349.

McGuire, J. S. and Popkin, B. M. (1990). *Helping Women Improve Nutrition in the Developing World: Beating the Zero Sum Game*, World Bank Technical Paper Number 114, Washington D.C.

Mencher, J., Mann, C.K. and Huddleston, B. (1986). 'Women and Agriculture' in Mann, C.K. and Huddleston, B. (eds.), *Food Policy: Frameworks for Analysis and Action*, pp.39-49.

Millman, S. (1990). 'Hunger in the 1980s: Backdrop for Policy in the 1990s', *Food Policy*, 15(4), pp.277-285.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) (1996). The Republic of Uganda. Country Position on Food Security, A Paper Presented at FAO Regional Conference for Africa. 19th Session, Quagadougou, Burkina Faso, 16-20th April.

Ministry of Agriculture, Animal Industry and Fisheries(undated). *Uganda Nutri-Guide System*, Home Economics Department, Entebbe.

Ministry of Finance, Planning and Economic Development (MoPED) (1998). *Background to the Budget 1998/99: Budgeting for Poverty Eradication*, The New Vision Printing and Publishing Corporation, Kampala.

Ministry of Planning and Economic Development (MoPED) (1995). *Food Security and Exports: A Technical Report*, Export Policy Analysis Unit, Kampala.

Ministry of Planning and Economic Development (1996a). *The Republic of Uganda Statistical Abstract*, Department of Statistics, Entebbe.

Ministry of Planning and Economic Development (1996b). *The Republic of Uganda, National Food Strategy: A Response to Overcome the Challenge of Poverty and Growth*, Export Policy Analysis Unit, Kampala.

Moldau, J. H. (1996). 'A Simple Existence Proof of Demand Functions without Standard Transivity', *Journal of Mathematical Economics*, 25(3), pp.325-333.

Moschini, G., Moro, D. and Green, R. D. (1994). 'Maintaining and Testing Separability in Demand Systems', *American Journal of Agricultural Economics*, 76(1), pp.61-73.

Moser, C. O. N. (1989). 'Gender Planning in the Third World: Meeting Practical and Strategic Gender Needs', *World Development*, 17(11), pp.1799-1825.

Mrema, G. C. and Mrema, M. J. (1993). 'Draught Animal Technology and Agricultural Mechanisation in Africa: Its Potential Role and Constraints', *NAMA-Newsletter*, 1(2), pp.12-33.

Muellbauer, J. (1975). 'Aggregation, Income Distribution and Consumer Demand', *Review of Economic Studies*, 42(4), pp.526-543.

Muller, C. (1994). 'The role of Production Decisions in Modelling the Consumption Patterns of Rural Households', in Caillavet, F., Goyomard, H. and Lifran, R., (eds) *Agricultural Household Modelling and Family Economics*, Elsevier, Amsterdam and New York, pp.25-47.

Museveni, Y. K. (1997). *Sowing the Mustard Seed: The Struggle for Freedom and Democracy in Uganda*, MacMillan Publishers Ltd, London and Basingstoke.

Mwadime, R. K. N. and Baldwin, S. L. (1994). 'Relationship Between Household Access to Food and Malnutrition in Eastern and Southern Africa', *East African Medical Journal*, 71(9), pp.571-579.

Mwaka, V. (1990). 'The Population, Environment and Food Security, with Special Reference to Uganda in *Workshop on Population, Food, and Agricultural Development in sub-Saharan Africa*, United Nations (eds), New York, pp.88-103.

Nabuguzi, E. (1993). 'Peasant Response to Economic Crisis in Uganda: Rice Farmers in Busoga', *Review of African Political Economy*, 56, pp.53-67.

Nakajima, C. (1986). *Subjective Equilibrium Theory of the Farm Household*, Elsevier, Amsterdam.

Natukunda, E., Tickodri-Togboa, S. S. and Guwatudde, C. (1991). Baseline Survey of the West Nile Community Self-Reliance Project, CARE, Kampala.

Newman, J. L. and Gertler, P. J. (1994). 'Family Productivity, Labor Supply, and Welfare in a Low Income Country', *The Journal of Human Resources*, 29(4), pp.899-1026.

Njoku, J. E. and Nweke, F. I. (1994). 'Household Food Consumption in a Developing Economy: Evidence on Rice from Nigeria', *Journal of International Food and Agribusiness Marketing*, 6(3), pp.51-65.

Norton, G. W. and Alwang, J. (1992). *Introduction to Economics of Agricultural Development*, McGraw-Hill Inc, London and Sydney.

Obbo, C. (1995), 'What Women Can Do: AIDS Crisis Management in Uganda', in Bryceson, D. H. (eds.), *Women Wielding the Hoe: Lessons From Rural Africa for Feminist Theory and Development Practice*, Cross-Cultural Perspectives on Women, Berg Publishers, Oxford and Washington, D. C, 16, pp.165-178.

Okello, D. O., Lubanga, R., Guwatudde, D. and Sebina-Zziwa, A. (1998). 'The Challenge to Restoring Basic Health Care in Uganda', *Social Science and Medicine*, 46(1), pp.13-21.

Okuonzi, S. and MacRae, J. (1995). 'Whose Policy is it Anyway? International and National Infuences on Health Policy Development in Uganda', *Health Policy and Planning*, 10(2), pp.122-132.

Ohri-Vachaspati, P., Rogers, B. L., Kennedy, E. and Goldberg, J. P. (1998). 'The Effects of Data Collection Methods on Calorie-Expenditure Elasticity Estimates: a Study from the Dominican Republic', *Food Policy*, 23(3/4), pp.295-304.

Oxfam (1996). *A Study of Poverty in Selected Districts of Uganda*, Oxfam, Kampala.

Payne, J. (1990). 'Measuring Malnutrition', *Institute of Development Studies*, 21(3), pp.14-30.

Peters, P. E. (1995). 'Uses and Abuses of the Concept of Female Headed Households: In Research on Agrarian Transformation and Policy' in Bryceson, D. F (eds), *Women Wielding the Hoe: Lessons from Rural Africa for Feminist Theory and Development Practice*, Cross Cultural Perspectives on Women v. 16. University of Oxford and Berger Publishers, Oxford, pp.93-108.

Phillips, T. P. and Taylor, D. S. (1990), 'Optimal Control of Food Insecurity: A Conceptual Framework', *American Journal of Agricultural Economics*, 72, pp.1304-1310.

Pichon, F. J. and Uquillas, J. E. (1997). 'Agricultural Intensification and Poverty Reduction in Latin America's Risk-Prone Areas: Opportunities and Challenges', *The Journal of Developing Areas*, 31, pp.479-514.

Pinstrup-Andersen, P. (1993). *The Political Economy of Food Nutrition Policies*, IFPRI Food Policy Statement #16, http://www.cgiar.org/ifpri.

Pinstrup-Andersen, P. and Pandya-Lorch, R. (1995). *Agricultural Growth is the Key to Poverty Alleviation in Low-Income Developing Countries*, IFPRI 2020 Vision, http://www.cgiar.org/ifpri.

Pinstrup-Andersen, P. and Pandya-Lorch, R. (1997a). 'World Food Needs Toward 2000', *American Journal of Agricultural Economics*, 79(5), pp.1465-1470.

Pinstrup-Andersen, P. and Pandya-Lorch, R. (1997b). *Food Security: A Global Perspective*, Plenary paper prepared for the 23rd International Conference of Agricultural Economists on 'Food Security, Diversification, and Resource Management: Refocussing the Role of Agriculture?', Sacramento, California, 10-16th August.

Pitt, M. M. and Rosenzweig, M. R. (1985). 'Health and Nutrient Consumption across and within Farm Households, *Review of Economics and Statistics*, 67(2), pp.212-223.

Poleman, T. T. (1981). 'Quantifying the Nutrition Situation in Developing Countries', *Food Research Institute Studies*, 18(1), pp.1-58.

Pollak, R. A. and Wachter, M. L. (1975). 'The Relevance of the Household Production Function and Its Implications for the Allocation of Time', *Journal of Political Economy*, 82(2), pp.255-277.

Pollak, R. A. and Wales, T. J. (1980). 'Comparison of the Quadratic Expenditure System and Translog Demand Systems with Alternative Specifications of Demographic Effects', *Econometrica*, 48(3), pp.595-612.

Pollak, R. A. and Wales, T. J. (1981). 'Demographic Variables in Demand Analysis', *Econometrica*, 49(6), pp.1533-1551.

Pollak, R. A. and Wales, T. J. (1992). *Demand System Specification and Estimation*. Oxford University Press, New York and Oxford.

Pudney, S. E. (1981). 'An Empirical Method of Approximating the Separable Structure of Consumer Preferences', *Review of Economic Studies*, 48(4), pp.561-577.

Quinn, V. J. (1994). 'A History of the Politics of Food and Nutrition in Malawi: The Context for Food and Nutritional Surveillance', *Food Policy*, 19(3), pp.255-271.

Quinn, V. J. and Kennedy, E. (1994). 'Food Security and Nutrition Monitoring Systems in Africa: A Review of Country Experiences and Lessons', *Food Policy*, 19(3), pp.234-254.

Quisumbing, A. R., Brown, L. R., Feldstein, H. S., Haddad, L. and Pena, C. (1995). *Women: The Key to Food Security*, Food Policy Report, International Food Policy Research Institute, Washington D.C.

Radimer, K. L., Olson, C. M. and Campbell, C. C. (1990). 'Development of Indicators to Assess Hunger', *Journal of Nutrition*, 120(11), pp.1544-1548.

Ramanathan, R. (1997). *Introductory Econometrics with Applications*, 3rd ed., The Dryden Press, London and Sydney.

Ramezani, C. A., Rose, D. and Murphy, S. (1995). 'Aggregation, Flexible Forms and Estimation of Food Consumption Parameters', *American Journal of Agricultural Economics*, 77(3), pp.525-532.

Rathgeber, E. M. (1990). 'WID, WAD, GAD: Trends in Research and Practice', *The Journal of Developing Areas*, 24(4), pp.489-502.

Raunikar, R. and Huang, C. L. (1987). *Food Demand Analysis: Problems, Issues and Empirical Evidence*, Iowa State University Press, Ames.

Republic of Uganda (1996). *National Food and Nutrition Policy*, Government Printery, Entebbe.

Reutlinger, S. (1985). 'Food Security and Poverty in LDCs', *Finance and Development*, 22, pp.7-11.

Riley, B. (1994). *Food Security in Uganda*, A Document prepared for the USAID.

Roe, T. (1983) *The New Household Economics and its Use in Food Policy Analysis in Developing Countries*, United States Department of Agriculture, Office of International Cooperation and Development, Washington, D.C.

Rogers, B. L. (1996). 'The Implications of Female Household Headship for Food Consumption and Nutritional Status in The Dominican Republic', *World Development*, 24(1), pp.113-128.

Rosenhouse, S. (1989). 'Identifying the Poor: Is Headship a Useful Concept?', *Living Standards Measurement Study*, Working Paper Number 58, World Bank. Washington D.C.

Rosenzweig, M. R. (1980). 'Neoclassical Theory and the Optimising Peasant: An Econometric Analysis of Market Family Labour Supply in a Developing Country', *Quarterly Journal of Economics*, 94, pp.31-55.

Saha, A. (1994). 'A Two-Season Agricultural Household Model of output and Price Uncertainty', *Journal of Development Economics*, 45, pp.245-269.

Sahn, D. E. (1988). 'The Effect of Price and Income Changes on Food Energy Intake in Sri Lanka', *Economic Development and Cultural Change*, 36(2), pp.315-340.

Sahn, D. E. (1994). 'Nutritional Effects of Structural Adjustment in sub-Saharan Africa' in Biswas, M. R. and Gabr, M. (ed), *Nutrition in the Nineties: Policy Issues*, Oxford University Press, Delhi.

Savadogo, K. and Brandt, J. A. (1988). 'Household Food Demand in Burkina Faso: Implications for Food Policy', *Agricultural Economics*, 2, pp.345-364.

Sckokai, P. and Moro, D. (1995). 'Direct Separability in Multi-output Technologies: An Application to the Italian Agricultural Sector', *European Review of Agricultural Economics*, 23(1), pp.95-116.

Sen, A. (1981). *Poverty and Famine: An Essay on Entitlement and Deprivation*, Clarendon Press, Oxford.

Sen, A. (1990). 'Food, Economics and Entitlements', in Dreze, J. and Sen, A. (eds), *The Political Economy of Hunger: Entitlement and Wellbeing*, volume 1, Clarendon Press, Oxford, pp.34-52.

Senauer, B., Sahn, D. and Alderman, H. (1986) 'The Effect of the Value of Time on Food Consumption Patterns in Developing Countries: Evidence from Sri Lanka', *American Journal of Agricultural Economics*, 68, pp.920-927.

Sengendo, J. (1997). 'The Socio-Economic Implications of Banana Cultivation on Nutrition in Uganda', A paper presented at the Sub-Regional Workshop on Culture, Population and Poverty Eradication for Eastern and Southern Africa, Mukono, Uganda, 2nd – 5th April.

Shiva, V. (1993). 'GATT, Agriculture and Third World Women', in Mies, M. and Shiva, V. (eds), *Ecofeminism*, London, pp.231-245.

Sibalwa, D. (1993). 'Women's Contribution Towards National Development in Zambia', *Convergence*, 25(2), pp.38-43.

Singh, I., Squire, L. and Strauss, J. (1986). *Agricultural Household Models: Extensions, Applications and Policy*, The Johns Hopkins University Press, Baltimore and London.

Singh, L. and Subramanian, J. (1986). 'Agricultural Household Modelling in a Multicrop Environment: Case Studies in Korea and Nigeria', in Singh, I., Squire, L. and Strauss, J. (eds.), *Agricultural Household Models: Extensions, Applications and Policy*, The Johns Hopkins University Press, Baltimore and London, pp.95-115.

Skoufias, E. (1993). 'Labour Market Opportunities and Intrafamily Time Allocation in Rural Households in South Asia', *Journal of Development Economics*, 40, pp.277-310.

Skoufias, E. (1994). 'Using Shadow Wages to Estimate Labour Supply of Agricultural Households', *American Journal of Agricultural Economics*, 76(2), pp.215-227.

Smith, M., Pointing, J. and Maxwell, S. (1992). 'Household Food Security: Concepts and Definition – Annotated Bibliography', in Maxwell, S. and Frankenberger, T. R. (eds.), *Household Food Security: Concepts, Indicators, Measurements. A Technical Review*, Jointly Sponsored by UNICEF and IFAD, pp.135-192.

Sonnenschein, H. (1971). 'Demand Theory Without Transitive Preferences, with Application to the Theory of Competitive Equilibrium', in Chipman, J. S., Hurwis, L., Richter, M. K. and Sonnenschein, H. (ed.), *Preference, Utility and Demand*, Harcourt Brace Jonanovich, New York, pp.913-920.

Srinivasan, T. N. (1985). 'Undernutrition: Extent and Distribution of its Incidence', in Agriculture in a Turbulent World Economy. Proceedings of the 19th International Conference of Agricultural Economics, Held at Malaga, Spain 26th August - 4the September, Gower Publishing Company Limited.

Ssekiboobo, A. M. N. and Kakande, M. (1994). Uganda Food Balance Sheet. Ministry of Finance and Economic Planning: Program for Alleviation of Poverty and Social Costs of Adjustment.

Staatz, J. M. (1996). 'Comments on Improving Food Access to Poor and Vulnerable Groups', *Agricultural Economics Staff Paper*. Michigan State University, 24-25 June.

Strauss, J. (1984). 'The Joint Determination of Food Consumption and Production in Rural Sierra Leone: Estimates of a Household Firm Model', *Journal of Development Economics*, 14(1/2), pp.77-103.

Strauss, J. (1986). 'Estimating the Determinants of food Consumption and Caloric Availability in Rural Sierra Leone' in Singh, I., Squire, L. and Strauss, J. (eds). *Agricultural Household Models: Extensions, Applications and Policy*, The Johns Hopkins University Press, Baltimore and London, pp.116-152.

Strauss, J. and Thomas, D. (1995). 'Human Resources: Empirical Modelling of Household and Family Decisions', in Behrman, J. and Srinivasan, T. N. (eds.), *Handbook of Development Economics*, Vol 3A, North Holland, New York, pp.1885-2023.

Stone, J. R. N. (1953). 'Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand', *Economic Journal*, 64, pp.511-527.

Summers, L. (1992). 'The Most Influential Investment', *Scientific American*, #267.

Svedberg, P. (1988). 'Undernutrition in sub-Saharan Africa: Is there a Gender Bias?', *Journal of Development Studies*, 26(3), pp.469-486.

Teklu, T. (1996). 'Food Demand Studies in sub-Saharan Africa: A Survey of Empirical Evidence', *Food Policy*, 21(6), pp.479-496.

Tichagwa, W. (1994). 'The Effects of Drought on the Condition of Women', *Focus on Gender*, 2(1), pp.20-25.

Todaro, M. P. (1994). *Economic Development and the Third World*, 5th ed., Longman, New York.

Toulmin, C. (1991). 'Natural Resource Management at the Local Level: Will this Bring Food Security to Sahel', *IDS Bulletin*, 22(3), pp.22-30.

Trenchard, E. (1987). 'Rural Women's Work in SSA and the Implications for Nutrition', in Momsen, J. H. and Townsend. J. (eds), *Geography of Gender in the Third World*, State University of New York Press, London and Sydney, pp.153-172.

Tyler, G. J., El-Ghonemy, R. and Couvreur, Y. (1993). 'Alleviating Rural Poverty Through Agricultural Growth', *Journal of Development Studies*, 29(2), pp. 358-364.

UNDP (1994). *Human Development Report*, Oxford University Press, New York and Oxford.

UNDP (1996). Special Event, web site

UNDP (1997a). *Human Development Report*, Oxford University Press, New York and Oxford.

UNDP (1997b). *Uganda: Human Development Report 1997*, Print World Ltd, Kampala.

UNDP (1998). *Human Development Report*, Oxford University Press, New York and Oxford.

UNICEF (1989). *Children and Women in Uganda: A Situation Analysis*, Kampala.

UNICEF (1994). *Equity and Vulnerability: A Situation Analysis of Women, Adolescents, Children in Uganda*, Kampala.

USAID (1996). 'Uganda Country Program', http://www.usaid.gov.

Van Riezen, K. (1996). 'Non-formal Education and Community Development: Improving the Quality', *Convergence*, 29(1), pp.82-94.

Van-Marrewijk, C. (1993). 'A Note on Transitivity and the Indifference Curves', *Economic Notes*, 22(3), pp.528-534.

Varian, H. R. (1992). *Microeconomic Analysis*, 3rd ed., W. W. Norton and Company, New York and London.

Vilks, A. (1992). 'A Set of Axioms for Neoclassical Economics and Methodological Status of the Equilibrium Concept', *Economics and Philosophy*, 8(1), pp.51-82.

Von Braun, J., Bouis, H., Kumar, S. and Pandya-Lorch, R. (1992). *Improving Food Security of the Poor: Concept, Policy and Programs*, International Food Policy Research Institute, Washington, D.C.

Vosti, S. A. (1992). 'Linking Sustainability to Agricultural Growth and the Alleviation of Poverty – The Critical Triangle', IFPRI Food Policy Statement #15, http://www.cgiar.org/ifpri.

Wall, C. A. and Fisher, B. S. (1988). 'Supply Response and the Theory of Production and Profit Functions', *Review of Marketing and Agricultural Economics*, 56(3), pp.383-403.

Wandel, M. (1989). 'Household Food Consumption and Seasonal Variations in Food Availability in Sri Lanka', *Ecology of Food and Nutrition*, 22, pp.169-182.

Ward, J. O. and Saunders, J. H. (1980). 'Nutritional Determinants and Migration in the Brazilian Northeast: A Case Study of Rural and Urban Ceara', *Economic Development and Cultural Change*, 29(1), pp.141-163.

Waterfield, C. (1985). 'Disaggregating Food Consumption Parameters: Designing Targeted Nutritional Interventions', *Food Policy*, (Nov) pp.337-351.

Weekes-Vagliani, W. (1985). 'Women, Food and Rural Development', in Rose, T (eds), *Crisis and Recovery in sub-Saharan Africa*, Development Centre of the Organisation for Economic Cooperation and Development, Paris, pp.104-110.

West, C. E., Pepping, F. and Temalilwa, C. R. (1988). *The Composition of Foods: Commonly Eaten in East Africa*, Wageningen Agricultural University, Wageningen.

White, K. J. (1997). *Shazam User's Reference Manual Version 8*, McGraw-Hill Book Company, New York.

Whitehead, A. (1990a). *Food Crisis and Gender Conflict in the African Countryside, Food Question: Profits versus People*, Earthscan, London.

Whitehead, A. (1990b). 'Rural Women and Food Production in Sub-Saharan African', in Dreze, J. and Sen, A. (eds), *The Political Economy of Hunger: Entitlement and Wellbeing*, volume 1, Clarendon Press, Oxford, pp.425-474.

Whitehead, A. (1994). 'Wives and Mothers: Female Farmers in Africa', in Adepoju, A. and Oppong, C. (eds.), *Gender, Work and Population in sub-Saharan Africa*, James Currey Publisher, London, pp.35-53.

Wiebe, K. D. (1998). 'Sustainable Resource Use and Global Food Security', A paper presented at the AAEA Annual meeting, 2-5 Aug.

Wolfe, B. L. and Behrman, J. R. (1983). 'Is Income Overrated in Determining Adequate Nutrition?, *Economic Development and Cultural Change*, 31(3), pp.525-549.

World Bank (1986). *Poverty and Hunger: Issues and Options for Food Security in Developing Countries*, World Bank Policy Study, Washington, DC.

World Bank (1988). *The Challenge of Hunger in Africa: A Call to Action*, Washington DC.

World Bank (1990). *Structural Adjustment and Poverty: A Conceptual, Empirical and Policy Framework*, SDA Unit, Africa Region. Washington D.C.

World Bank (1993a). *Uganda Agricultural Sector Memorandum*, Washington DC.

World Bank (1993b). *Uganda: Agriculture*, A World Bank Country Study, Washington DC.

World Bank (1993c). *World Development Report*, Oxford University Press, New York.

World Bank (1994a). *A New Agenda for Women's Health and Nutrition*, Washington DC.

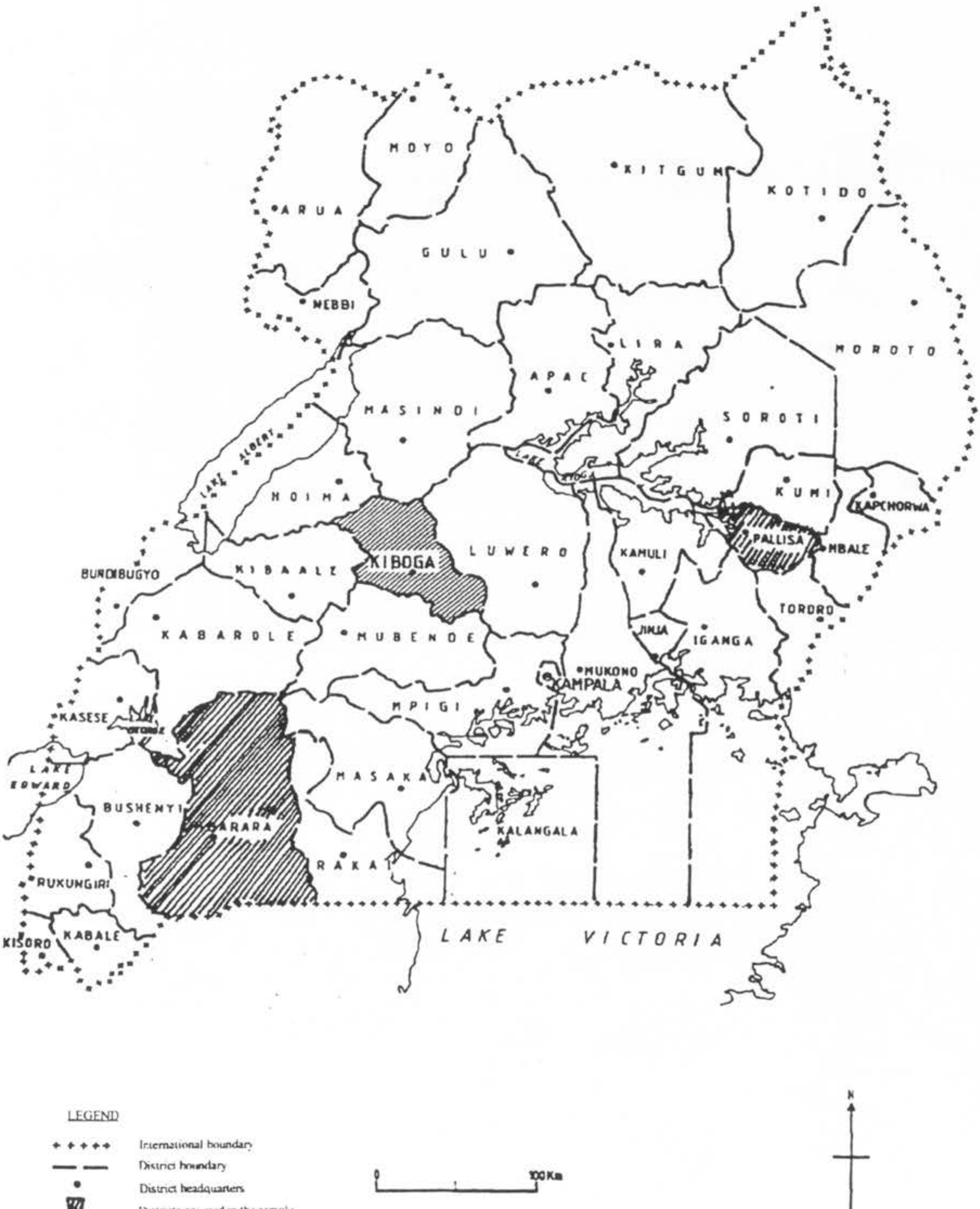
World Bank (1994b). *Enhancing Women's Participation in Economic Development: A World Bank Policy Paper*, Washington DC.

World Bank News, several issues. http://www.worldbank.org/htm/extdr/current.htm.

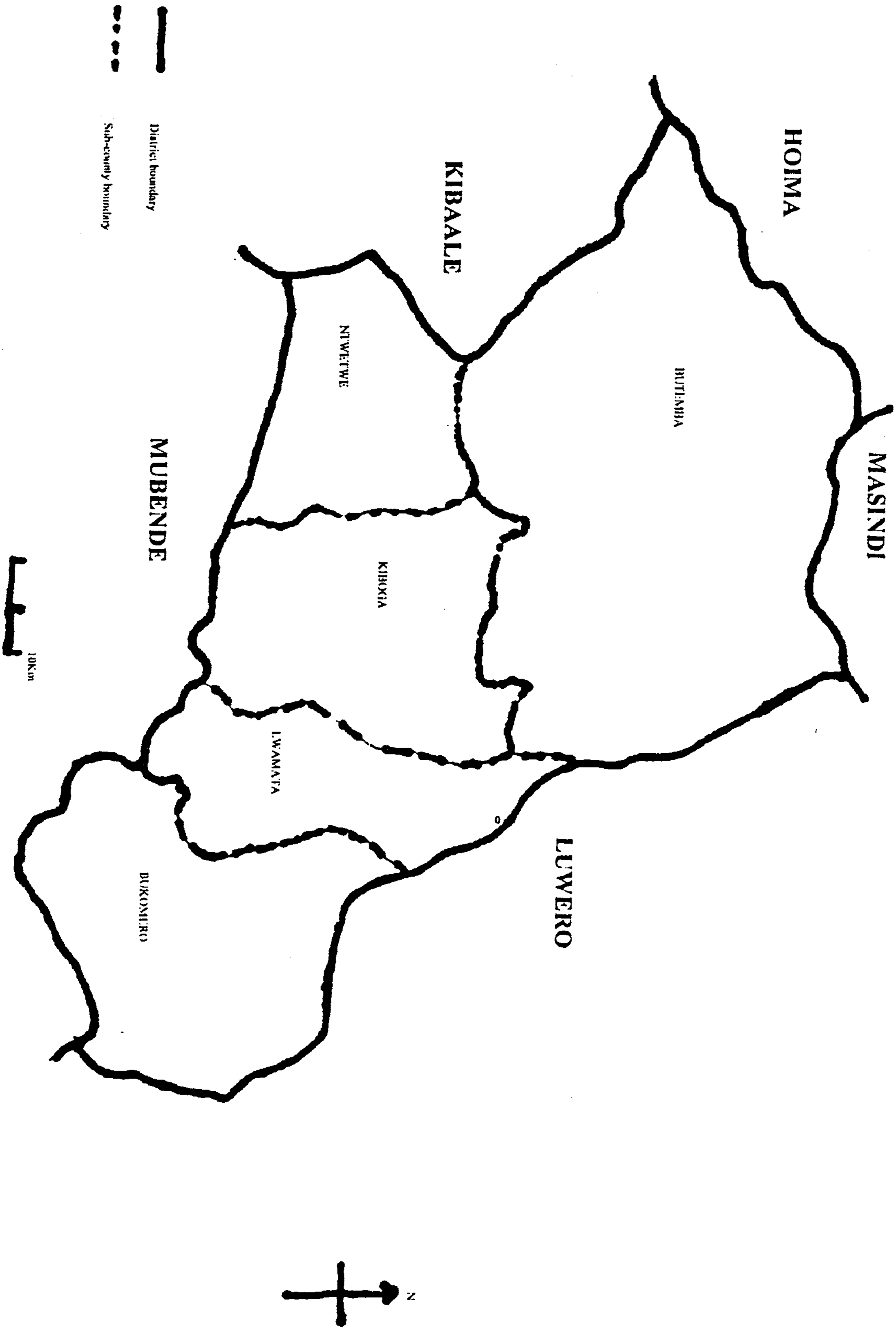
Zake, J. Y. K. (1992), 'Issues Arising from the Decline of Soil Conservation: The Uganda Example', in Tato, K. and Hurni, H. (eds.), *Soil Conservation for Survival*, Soil and Water Conservation in Cooperation with International Soil Conservation Organisation and World Association of Soil and Water Conservation, pp.59-64.

Zindi, C. (1997). Econometric Analysis of Smallholder Agricultural Household for Zimbabwe, Unpublished MSc Thesis, Department of Agricultural Economics and Farm Management, The University of Manitoba, Winnipeg, Manitoba.

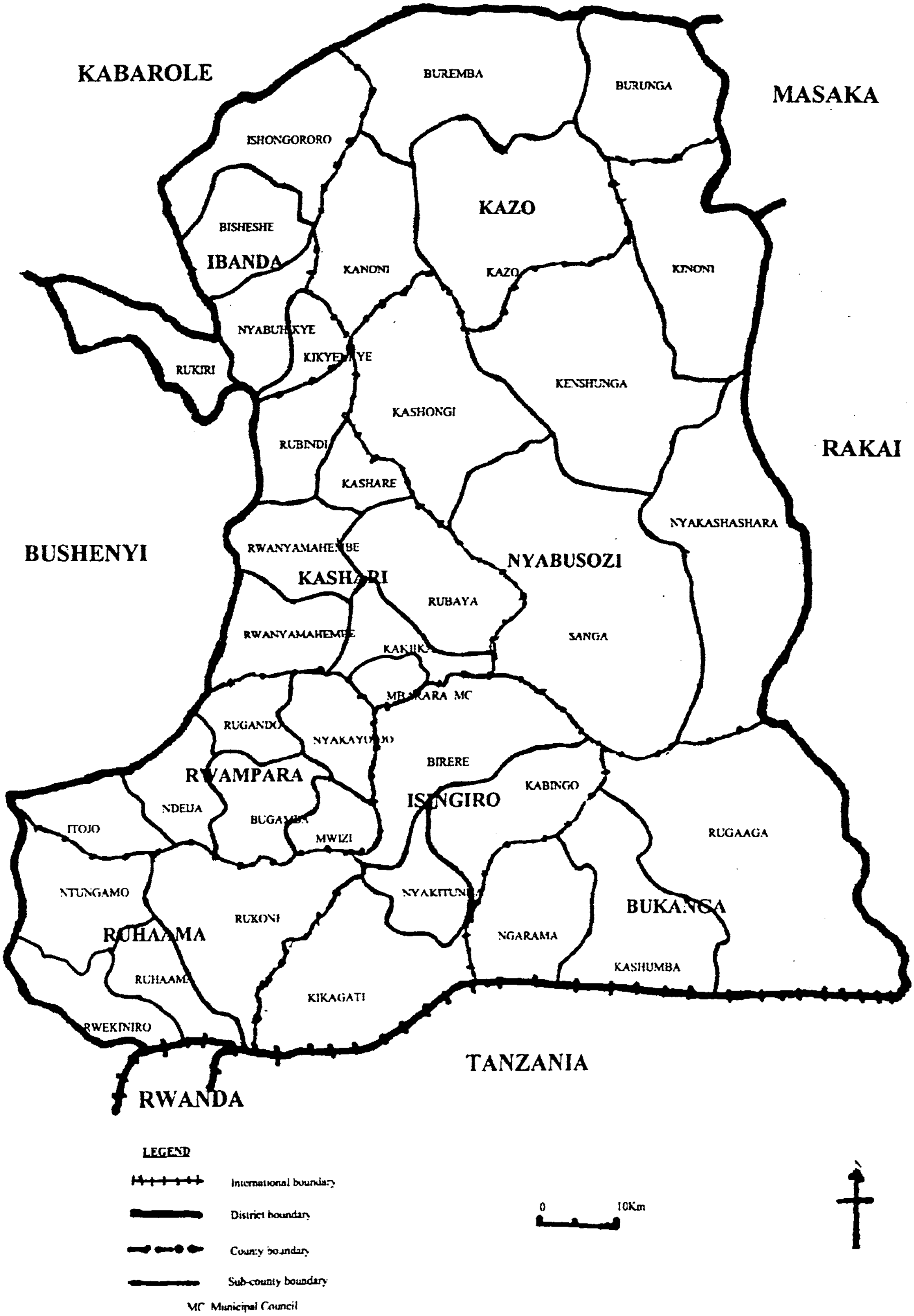
Appendix 1 Map of Uganda



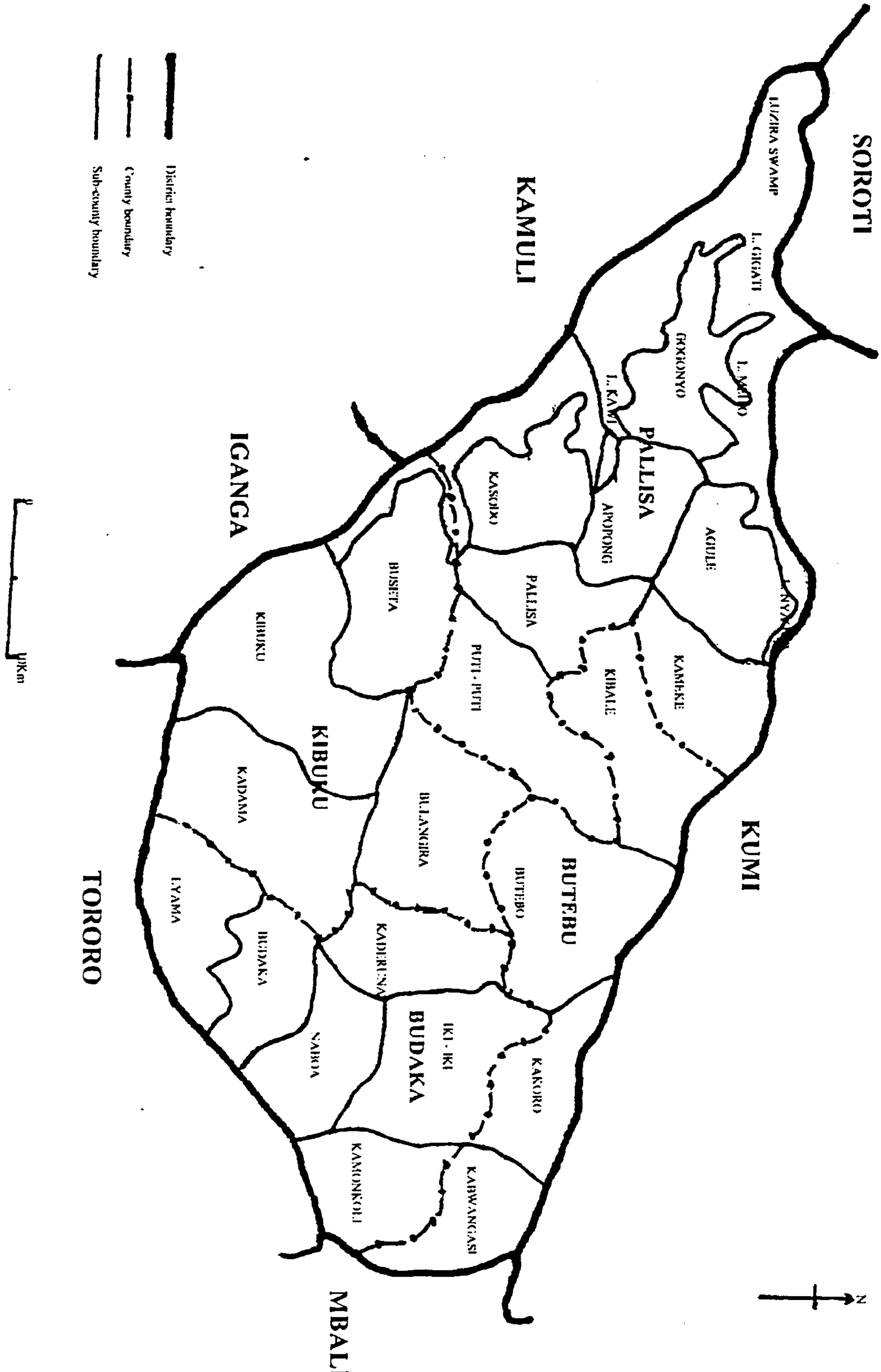
Appendix 2 Map of Kiboga District



Appendix 3 Map of Mbarara District



Appendix 4 Map of Pallisa District



Appendix 5 Descriptive Statistics for Selected Variables

	Kiboga			Mbarara			Pallisa		
	Mean	Standard deviation	Valid cases	Mean	Standard deviation	Valid cases	Mean	Standard deviation	Valid cases
I: Group Prices (Ug.Shs)									
a) Consumption side									
Meat	1,262.60	453.00	97	852.50	448.10	93	1,323.30	672.90	65
Cereal	565.90	172.00	93	333.40	154.50	98	267.90	116.50	95
Oils	1,409.10	638.60	90	2,778.90	654.60	87	1,413.10	378.70	37
Roots and tubers	117.00	52.10	95	162.70	79.40	89	117.00	66.50	99
Legumes	456.90	156.40	98	375.80	127.60	99	362.40	,92.20	97
Matooke	113.70	20.30	96	73.40	14.60	92	121.30	26.80	27
Miscellaneous	630.70	239.40	98	609.10	263.20	98	817.50	287.40	55
b) Production side[51]									
Cereal	94.49	23.22	90	125.08	40.66	78	65.12	22.34	89
Legumes	347.18	154.21	87	322.79	99.88	95	331.11	164.49	91
Roots and tubers	216.78	123.37	71	180.21	41.58	85	147.85	74.48	92
Matooke	115.22	20.52	90	73.74	12.84	81			
II: Household Dietary Intake									
a) Actual intake									
Calories (kcal)	2,297.1	1,230.2		2,225.6	1,007.1		1,518.7	928.4	
Protein (gm)	66.3	42.5		64.9	34.1		39.8	22.2	
Iron (mg)	19.8	13.6		18.3	9.5		12.3	6.6	
b) Recommended intake									
Calories (kcal)	2,219.9	180.7		2,304.6	202.6		2,292.8	169.7	
Protein (gm)	39.7	3.7		41.6	4.2		41.4	3.4	
Iron (mg)	11.9	1.4		11.7	1.2		12.3	1.3	

[51] The food items included in the food groups differ slightly from those under the consumption side.

Appendix 5 Contd.

c) Actual/Recommend (%)									
Calories	100.96	46.46		96.69	44.36		69.01	34.21	
Protein	160.18	85.80		153.97	73.97		98.94	52.13	
Iron	158.13	92.20		151.77	70.25		107.19	53.10	
III: Age									
Women	35.6	12.9		37.7	14.2		37.0	11.5	
Men	39.8	14.3		43.5	13.6		44.0	13.4	
IV: Time Allocation									
a) Productive activities									
Women	5.0	2.3		5.3	2.2		4.7	1.4	
Men	8.7	3.1		9.0	3.1		6.3	2.7	
VI: Household characteristics									
a) Household size	6.4	2.79		7.4	3.34		7.9	4.4	
b) Proportion of children (%)	58.56	15.48	98	57.86	16.26	94	50.86	16.12	95
c) Proportion of female (%)									
d) Number of hoes	3.88	3.14		3.12	1.87		2.07	0.92	
VII: Distance to social infrastructure (km)									
a) Safe drinking water	1.69	1.24		0.81	1.04		0.83	0.68	
b) Primary school	1.79	1.20		2.10	1.58		1.95	1.05	
c) Secondary school	4.28	2.00		4.31	2.56		3.91	1.85	
d) Trading centre	2.53	1.85		2.91	2.34		2.10	1.64	
e) Market	3.87	2.24		5.32	2.18		4.40	1.98	
f) Health centre/hospital	3.35	1.77		3.89	2.67		4.28	2.01	
g) Bus/taxi/motorable road	2.98	2.10		3.70	2.54		1.39	1.21	
VIII: Others									
a) Savings - Women	10,125.00	9,252.79	24	16,293.44	22,278.20	32	3,650.00	1,915.58	10
b) Income - Women	6,414.04	8,610.09	54	15,250.97	33,767.83	73	5,353.51	13,959.84	76
- Men	12,889.74	14,805.61	39	25,885.03	45,685.36	72	9,696.57	14,680.27	77

Appendix 6 Contribution of Each Food Group to the Daily Dietary Intakes by District by Survey

	Main Survey								
District/group	Kiboga	Mbarara	Prob	Kiboga	Pallisa	Prob	Mbarara	Pallisa	Prob
	%	%		%	%		%	%	
Calories									
Matooke	25.14	30.04	0.04	25.14	2.50	0.00	30.04	2.50	0.00
Tubers	24.88	11.86	0.00	24.88	46.46	0.00	11.86	46.46	0.00
Cereal	13.26	25.24	0.00	13.26	24.46	0.00	25.24	24.46	*0.73*
Meat	5.86	11.03	0.00	5.86	2.5	0.00	11.03	2.5	0.00
Legumes	25.22	18.25	0.00	25.22	23.09	*0.33*	18.25	23.09	0.02
Oil	4.29	2.03	0.00	4.29	0.82	0.00	2.03	0.82	0.00
Miscellaneous	1.35	1.55	*0.46*	1.35	0.17	0.00	1.55	0.17	0.00
Protein									
Matooke	13.22	15.32	*0.15*	13.22	1.53	0.00	15.32	1.53	0.00
Tubers	8.05	3.67	0.00	8.05	19.05	0.00	3.67	19.05	0.00
Cereal	12.22	23.52	0.00	12.22	25.59	0.00	23.52	25.59	*0.38*
Meat	17.13	21.94	0.02	17.13	7.30	0.00	21.94	7.30	0.00
Legumes	47.77	34.22	0.00	47.77	46.44	*0.67*	34.22	46.44	0.00
Miscellaneous	1.60	1.33	0.20	1.60	0.09	0.00	1.33	0.09	0.00
Iron									
Matooke	16.74	19.17	*0.18*	16.74	1.74	0.00	19.17	1.74	0.00
Tubers	19.33	9.10	0.00	19.33	36.16	0.00	9.10	36.16	0.00
Cereal	9.89	25.42	0.00	9.89	24.11	0.00	25.42	24.11	*0.56*
Meat	6.76	6.55	*0.80*	6.76	2.31	0.00	6.55	2.31	0.00
Legumes	43.23	35.82	0.00	43.23	35.42	0.01	35.82	35.42	*0.89*
Miscellaneous	3.99	3.86	*0.84*	3.99	0.26	0.00	3.86	0.26	0.00

Appendix 6 (continued)

	First Follow-up Survey								
	Kiboga	Mbarara	Prob	Kiboga	Pallisa	Prob	Mbarara	Pallisa	Prob
Calories									
Matooke	28.64	35.56	0.00	28.64	2.56	0.00	35.56	2.56	0.00
Tubers	28.13	9.85	0.00	28.13	54.79	0.00	9.85	54.79	0.00
Cereal	10.81	22.00	0.00	10.81	25.33	0.00	22.00	25.33	*0.15*
Meat	6.93	10.24	0.01	6.93	1.45	0.00	10.24	1.45	0.00
Legumes	19.77	18.67	*0.46*	19.77	14.68	0.00	18.67	14.68	0.01
Oil	3.73	2.19	0.00	3.73	1.06	0.00	2.19	1.06	0.00
Miscellaneous	2.00	1.51	0.00	2.00	0.15	0.00	1.51	0.15	0.00
Protein									
Matooke	15.60	17.85	*0.12*	15.60	1.65	0.00	17.85	1.65	0.00
Tubers	11.11	2.65	0.00	11.11	23.38	0.00	2.65	23.38	0.00
Cereal	10.28	20.37	0.00	10.28	33.74	0.00	20.37	33.74	0.00
Meat	21.82	22.81	*0.62*	21.82	3.65	0.00	22.81	3.65	0.00
Legumes	38.04	34.06	0.08	38.04	37.10	*0.75*	34.06	37.10	*0.29*
Miscellaneous	3.16	2.26	0.01	3.16	0.48	0.00	2.26	0.48	0.00
Iron									
Matooke	19.33	22.23	0.10	19.33	1.69	0.00	22.23	1.69	0.00
Tubers	24.91	6.92	0.00	24.91	43.60	0.00	6.92	43.60	0.00
Cereal	8.35	23.25	0.00	8.35	29.16	0.00	23.25	29.16	0.02
Meat	8.93	7.24	0.06	8.93	0.75	0.00	7.24	0.75	0.00
Legumes	31.54	35.06	*0.14*	31.54	24.09	0.01	35.06	24.09	0.00
Miscellaneous	6.91	5.22	0.05	6.91	0.71	0.00	5.22	0.71	0.00

	Second Follow-up Survey								
	Kiboga	Mbarara	Prob	Kiboga	Pallisa	Prob	Mbarara	Pallisa	Prob
Calories									
Matooke	23.89	40.55	0.00	23.89	6.61	0.00	40.55	6.61	0.00
Tubers	43.91	15.57	0.00	43.91	32.01	0.00	15.57	32.01	0.00
Cereal	5.65	15.88	0.00	5.65	45.19	0.00	15.88	45.19	0.00
Meat	4.77	10.78	0.00	4.77	0.81	0.00	10.78	0.81	0.00
Legumes	19.47	13.80	0.00	19.47	14.49	0.00	13.80	14.49	*0.65*
Oil		2.37	*0.07*		0.48	0.00	2.37	0.48	0.00
Miscellaneous	1.75	1.06	0.00	1.75	0.41	*0.34*	1.06	0.41	0.00
Protein									
Matooke	15.24	23.26	0.00	15.24	4.21	0.00	23.26	4.21	0.00
Tubers	17.32	5.63	0.00	17.32	13.68	*0.06*	5.63	13.68	0.00
Cereal	6.71	16.30	0.00	6.71	47.10	0.00	16.30	47.10	0.00
Meat	14.27	23.21	0.00	14.27	1.87	0.00	23.21	1.87	0.00
Legumes	45.49	29.89	0.00	45.49	32.42	0.00	29.89	32.42	*0.35*
Miscellaneous	0.97	1.71	0.00	0.97	0.72	*0.35*	1.71	0.72	0.00
Iron									
Matooke	16.96	27.85	0.00	16.96	4.60	0.00	27.85	4.60	0.00
Tubers	37.59	13.16	0.00	37.59	25.38	0.00	13.16	25.38	0.00
Cereal	4.80	17.39	0.00	4.80	46.55	0.00	17.39	46.55	0.00
Meat	4.10	6.17	0.00	4.10	0.56	0.00	6.17	0.56	0.00
Legumes	34.74	31.09	*0.14*	34.74	21.71	0.00	31.09	21.71	0.00
Miscellaneous	1.77	4.25	0.00	1.77	1.19	0.00	4.25	1.19	0.00

Note: The figures in italic indicate no significant differences were found among the means.

Appendix 7 Main Survey Questionnaire

INSTITUTE OF STATISTICS AND APPLIED ECONOMICS
MAKERERE UNIVERSITY
KAMPALA, UGANDA

MAIN QUESTIONNAIRE

WOMEN AND RURAL HOUSEHOLD FOOD SECURITY IN UGANDA SURVEY

SARAH NAKABO-SSEWANYANA (MRS)

HOUSEHOLD IDENTIFICATION

Country (Ssaza)
Sub-county (Gombolola)
Parish (Muluka)
Village (Kyalo)
Household Identification Number
Respondent's name:
Interviewer's Name:
Date of Interview:

Section 1:
100 HOUSEHOLD RECORD FORM

Usual Residents and Visitors (1)	Relationship to household head (2)	RESIDENT (3)	(4) Did he/she sleep here last night? 1. Yes 2. No	SEX (5)	AGE (6)	Main Occupa tion (7)	educat ion (8)
Give the name of the persons who usually live with you or are staying with you now (starting with the head of the household)		Does he/she usually live here? 1 Yes 2 No		1. Male 2. Female	How old is he/she?	(Use the codes below this table)	(use the codes below this table)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							

(Put a tick on the respondent)

CODES:

Realtionship
1 Spouse 2 Son-in-law
3 Daughter-in-law 4 Son
5 Daughter 6 Grandchild
7 Father 8 Mother
9 Brother 10 Sister
11 Other relatives 12 Servant

Main occupation
1 Farming 2 Fishing
3 Manufacturing 4 Building
5 Trading[a] 6 Services
7 Unpaid family worker
8 Artisan[b] 9 Govt/parastatal employee
10 Student 11 na

Education
1 None 2 Less than P7
3 Primary 7 4 Secondary
5 Senior 5,6 6 TTC/Technician
7 Adult education 8 Agricultural training
10 University 11 Postgraduate 12 Other

Notes [a] includes food vendoring [b]such as tailoring, milling, hair dressing etc

101 For women whose main occupation is farming, give reasons for such a choice. ....

Section 2: **Socio-economic characteristics**

201. What is your religious affiliation?
1. Protestant 2. Roman Catholic 3. Moslem 4. Adventist 5. Orthodox 6. Other specify..........

202. Marital Status:
1. Never married 2. Currently married 3. Widowed 4. Divorced 5. Separated

203. How many wives does/did your husband have?.................

204. Who provides you with the <u>biggest</u> portion of assistance to sustain you from day to day?
1. Self 2. Husband 3. Brother/Sister 4. Son own child 5. Daughter own child 6. Other (specify)........

205. In what form is the assistance?
1. In kind 2. Cash 3. Both

Section 3: Time allocation

301 Time Allocation per day (average)

	1 Wife	2 Husband
A.M		
6.00 – 7.00		
7.00 – 8.00		
8.00 – 9.00		
9.00 – 10.00		
10.00 – 11.00		
11.00 – 12.00		
P.M		
12.00 – 1.00		
1.00 – 2.00		
2.00 – 3.00		
3.00 – 4.00		
4.00 – 5.00		
5.00 – 6.00		
6.00 – 7.00		
7.00 – 8.00		
8.00 – 9.00		
9.00 – 10.00		
10.00 – 11.00		
11.00 – 12.00		
P.M		
12.00 – 1.00		
1.00 – 2.00		
2.00 – 3.00		
3.00 – 4.00		
4.00 – 5.00		
5.00 – 6.00		

Section 4: Property Ownership

401. Do you have any property?
1. Yes 2. No (skip to Qtn. 405)

402 What property do you have? (Tick where applicable)

5					
	1 inheritance	2 lease	3 marriage	4 bought	5 other
1 Land					
2 House(s)					
3 Livestock					
4 Poultry					
5Agric. Equipment					
Other (specify)					

403. Do you own property with somebody else?
1. Yes 2. No (skip to Qtn 404)

404. Who? (Tick where applicable)
1. Husband 2. Relative 3 Friend 4 Co-wives 5 Other (specify)

405. Do you have any sources of income?
1. Yes 2. No (Skip to Qtn 501)

406. If yes, please give the sources and average income in the table below:

Source of Income	Average income (Shs)		
	Per week	Per Month	Is the income steady? 1
1.			
2.			

407 How do you spend your income? …………………………………………………………………………………………

408 Do you have control over your income?
1. Yes 2. No 3. Depends on the source

For men only

409 Do you have any sources of income?
1. Yes 2. No

410 If yes, give the source and average income per week and per month

Source of Income	Average income (Shs)		
	Per week	Per Month	Is the income steady? 1 Yes 2 No
1			
2			

Section 5: Decision-making: Tick whichever is appropriate

501. Who makes the decisions in the majority of cases as far as disposal of cash income in the household is concerned?

Sources of Income	1. Wife	2. Husband	3. Both
1) Income from employment a) Wife's job b) Husband's job			
2) Income from small enterprise a) Wife's enterprises b) Husband's enterprises			
3) Food & Fuel sales			

502. Who makes the decisions in the majority of cases as far as food consumption is concerned in terms of:

	1. Wife	2. Husband	3. Both
1) Quantity			
2) Diet consumption			
3) Frequency of meals a) full meals b) snacks			
4) Family size			

503. Who makes decisions in the majority of cases as far as disposal of output from own production is concerned?

	1. Wife	2. Husband	3. Both
a) Disposal of stocks 1. Crops: grains: a) Leaves b) Stems			
2. Commercial Trees: a)fruits b)firewood			
3. Livestock & Poultry: a) meat b) milk c) eggs d) manure			
b. Cash from the sales of farm produce			

504. Who makes decisions on the type of crops to be grown for food consumption?
1. Wife 2. Husband 3. Both 4. Other(s) Specify

505. Who makes decisions on the type of crops to be grown for sale?
1. Wife 2. Husband 3. Both 4. Other(s) Specify

Section 6: Household holding characteristics

601. State the Number of parcels making the holding ___________

602. Parcel Characteristics

IDENTIFICATION Parcel Number	Location of Parcel	Area (Holder's Estimate	LAND TENURE
	1. Within village 2. Within parish 3. Elsewhere in the parish 4. Elsewhere in the country	(Acres)	1. Freehold/ 2. Unregistered 3. Leasehold 4. Customary 5. Squatters 6. Other
1.			
2.			
3.			

603. Holding characteristics (in the last season)

Crops	Unit	Amount Produced	On going price	Estimated value
A: Main crops				
B: Minor crops				
C: Emergency/famine				

604. Does your husband grow crops for home consumption?
1. Yes 2. No

605. Do you "farm" on different plots/fields from your husbands?
1. Yes 2. No

606. Who is involved most in the following activities in your home? (see codes below)

Item #	Item	What determines this involvement?		
		Code	1 culture	2 Other (specify)
1	Cultivation of crops for food consumption			
2	Cultivation of crops for cash			
3	Wages for labourers			
4	Acquisition of seeds, fertilisers implements etc.			
5	Marketing of agricultural produce			
6	Buying of food and household goods			
7	Paying for food			
8	Paying for education and health expenses			
9	Paying of other household expenditures (specify)			
10	Preparing of food and other domestic duties			

CODES: 1 Wife 2 Husband 3 Children 4 Wife+Husband 5 Wife+Children 6 Husband+Children 7 Whole family 8 Others

607. Comment on your land quality as far as agricultural production is concerned.
1. Extremely good 2. Very good 3. Good 4. Fairly good 5. Poor

608. For how long have you been growing crops on the same fields?
1. Less than a year 2. 1 - 5 years 3. 5 - 10 years 4. 10 -20 years 5. above 20 years

610. Has there been any decline in your crop yield in general?
1. Yes 2. No [skip to Qtn 612]

611. If so, give reasons ……………………………………………………………………

612 To what extent has crop liberalisation helped you to improve the well being of you members of the household?
1. To a very great extent 2. To a great extent 3. To some extent 4. Not at all

613 Has crop liberalisation led you to shift your scarce resources from less remunerative crops to those receiving higher prices?
1. Yes 2. No

614 What impact has switching resources from less remunerative crops to those receiving higher prices has had on the household food security?..

615 It has been said that farmers have not benefited from crop liberalisation instead the middle men have.
What do you have any comments on this? ....

616 Do you have problems in marketing your produce?
1. Yes 2. No [skip to qtn 617] 3. Depends on the type of produce

617 Enumerate the problems below: ....

619. Water Source:

Source	For consumption		For animal consumption	
	1 Yes	2 No	1 Yes	2 No
1 Encatchment/pond				
2 Swamp				
3 Borehole				
4 Springs				
5 Valley dam				
6 River/lake				
7 piped/tanks				

620. State the nearest distance of each the following social infrastructure (Indicate unit used, mile/km)

1 Safe drinking water Source	2 Primary School	3 Secondary School	4 Trading Centre	5 Market	6 Health Centre/ Hospital	7 Bus/Taxi/ Motorable Road

Section 7: Access and Control of Productive Resources

701. Do you have access to extension services?
1. Yes 2. No [skip to qtn 703]

702. If Yes, comment on the availability of these services:
1. Very adequate 2. Adequate 3. Inadequate 4. very inadequate

703. Do you have access to hired labour?
1. Yes 2. No [skip to qtn 705]

704. If yes, comment on its availability
1. very adequate 2. adequate 3. Inadequate 4. very inadequate

705. Do you have access to improved seeds?
1. Yes 2. No

706. Do you have access to credit facilities?
1. Yes 2. No (skip to Qtn 709)

707. Have you obtained any financial assistance from any credit - giving institution during the past year?
1. Yes 2. No (skip to Qtn 709)

708. Who was it given to?
1. Wife 2. Husband 3. Both (Skip to Qtn 711)

709. Have you ever tried to obtain credit before?
1. Yes 2. No (skip to qtn 711)

710. Give reasons why you did not succeed? ……………………………………………………………………

711 Do you have access to farming land?
1. Yes 2. No

712 Do you have access to farming equipment?
1. Yes 2. No

713 What factors influence the accessibility to the above productive resources?
1. Social 2. Religious 3. Political 4. Cultural 5. Economic 6. Environmental 7. Other Specify

714 Who has control over the following productive resources?

Productive resource	1. Wife	2. Husband	3. Both
1. Extension services			
2. Credit			
3. Forest			
4. Improved seeds			
5. Land			
6. Hired labour			
7. Family labour			

715. Would you like to expand your farming operations?
1. Yes 2. No

716. Give the factors limiting your ability as an individual to increase output/production in order of severity?
………………………………………………………………………………………

Section 8: Farm Inventory by gender

801 Equipment/machinery/farm structure/implements inventory.

Item (1)	Quantity/no (1)	Source of supply (3)	How often do you use it in a month? (4)	Year purchased (5)	Unit value when new (shs) (6)
1 Wife					
2 Husband					

CODES for Source of supply: 1 nearest trading centre 2 Local market 3 nearest town 4. NGO

802 commercial trees

Type (1)	Acres/Number (2)	Age (Years) (3)	Production output /income in a year (4)	Use (5) 1 sale 2 consumption 3 Both

803. Livestock assets by gender

TYPE (1)	BREED (2)						
	EXOTIC (3)			CROSS BREED (4)		LOCAL (5)	
	NUMBER (6)	Unit value (7)	SPECIFY BREED (8)	NUMBER (9)	UNIT VALUE (10)	NUMBER (11)	UNIT VALUE (12)
1 Wife							
2 Husband							

804 Poultry assets by gender

Type (1)	Breed (2)		
	Number (3)	Unit value (4)	Specify breed (5)
1 Wife			
2 Husband			

805 Inputs used by farmers

Input (specify)	1 Uses 2 Does not use		Quantity (q) Price (p)		Source 1 union 2 rivate 3 others
	1 Wife	2 Husband	1 Wife	2 Husband	
1 improved seeds		Q	Q		
		P	P		
2 artificial fertilisers		Q	Q		
		P	P		
3 manure		Q	Q		
		P	P		
4 farm equipment		Q	Q		
		P	P		
Q805 contd.					

5 veterinary inputs		Q	Q		
		P	P		
6 pesticides		Q	Q		
		P	P		
7 feeds		Q	Q		
		P	P		
8 hired labour		Q	Q		
		P	P		
9 family labour		Q	Q		
		P	P		

Section 9:

901 Health conditions during the last 30 days (all persons)

Days of activities lost/suffered (1)	Medical attention (see codes below) (2)	Days in hospital/clinic (3)	Medical expenses (4)	Who incurred the expenses (5) [see codes below]		

Codes: 1 wife 2 husband 3 wife & husband 4 children 5 1 & 4

Section 10: Consumption

1001 Household consumption during the last 30 days

Item description		U	Purchases		Out of own production		Out of free collection/gift	
			Q	V	Q	V	Q	V
Root crops & matooke	Dried Cassava							
	Fresh Cassava							
	Fresh Sweet potatoes							
	Irish potatoes							
	Yams							
	Matooke							
	Dried Sweet potatoes							
	Other (specify)							
Cereals	Millet							
	Maize flour							
	Maize on comb							
	Sorghum							
	Rice							
	Bread							
	Other (specify)							
Oils and fats	Cooking oil							
	Blue band							
	Ghee							
	Kimbo							
	Kasuku							
	Cowboy							
	Others (specify0							
Fish	Fresh fish							
	Dried fish							
	Smoke fish							
Animal products	Beef							
	Pork							
	Goat's meat							
	Mutton							
	Poultry							
	Fresh milk							
	Powdered milk							
	Eggs							
	Others (specify)							
Legumes	Groundnuts							
	Fresh beans							
	Dried beans							
	Fresh peas							
	Soybeans							
	Simsim							
	Dried peas							
Vegetables	Onions							
	Cabbage							
	Eggplant							
	Amarathus							
	Pumpkin							
	Entura							
	Mushrooms							
	Tomatoes							
	Others (specify)							
Fruits	Orange							
	Sugarcanes							
	Pineapple							
	Pawpaw							
	Mango							
	Guava							
	Passionfruit							
	Jackfruit							
	Avacado							

Item description		U	Purchases		Out of own production		Out of free collection/gifts	
	Others (specify)							
Salt and other condiments	Salt							
	Sugar							
Non-alcoholic beverages	Coffee							
	Tea							
	Soft drinks							
	Ginger beer							
	Other (specify)							
Alcoholic beverages	Beer							
	Waragi							
	Tonto							
	Kasese							
	Wine							
	Ajon							
	Kwete							
	Others (specify)							

1001 Household consumption of non-food items during the last 30 days prior to the survey

Item #	Item description	Purchases during the last 30 days		
		U	Q	V
1 clothing	1 shirt			
	2 gomesi			
	3 clothes			
	4 other (specify)			
2 Energy	1 paraffin			
	2 charcoal			
	3 firewood			
3 footwear & repairs	1 shoes			
	2 slippers			
	3 other (specify)			
4 furniture	1 sofa chair			
	2 chairs			
	3 bed			
	4 window			
	5 door			
	6 other (specify)			
5 Transport				
6 health				
7 Education	1 fees			
	2 uniform			
	3 books			
	4 other (specify)			
8 local savings				
9 tobacco product	1 rex			
	2 sportsman			
	3 kali			
	4 other (specify)			
10 furnishings	1 bed sheets			
	2 mattress			
	3 blanket			
	4 other (specify)			
11 household appliances	1 sewing machines			
	2 radio			
	3 milking can			
	4 Other (specify)			
12 Glassware, tableware, utensils	1 cups			
	2 cutlery			
	3 jerrycans			
	4 flask			
	5 plates			
	6 pots			
	7 other (specify0			
13 non-durables	1 soap			
	2 detergents			
	3 cosmetics			
	Glassware, tableware & utensils			
14 miscellaneous				

1001 State the number of meals taken daily during the following seasons?

1 Season	2 heavy meals	3 light meals
1 Beginning of planting		
2 Harvesting		

1003 Indicate the coping strategies taken in the case of transitory food insecurity
1 Food exchange 2 Borrowing money from relatives/friends to buy food
3 Reducing on the number of meals eaten daily 4 Other(s) (specify) ……………………………………………………

1004 In the last 30 days, how many days did the members of you household have one meal? ________

1005 Main respondents perception of the household food security

	1 Lack of Money			2 Poor Harvest			3 Domestic Work Load		
	1 Never	2 Sometimes	3 Often	1 Never	2 Sometimes	3 Often	1 Never	2 Sometimes	3 Often
1. Do you ever worry about what food you will serve your household members the following day									
2. Do any of your household members ever go to bed hunger because of									
3. Do any of your household members ever eat less than you feel because of									
4. Do any of your household members ever skip meals because of									
5. Do you eat less than you think you should because of									

Section 11: Women's Group:

1101 Are you a member of any women groups?
1. Yes 2. No (skip to Qtn 1107)

1102 Which one (s)? ————————

1103 Are you aware of the objectives of women groups where you are a member?
1. Yes 2. No

1104 To what extent have these groups helped you to fight poverty?
1. To a very great extent 2. To some extent 3. Not at all

1105 How has the above membership assisted you in improving your standard of living? ————

1106 To what extent does your husband support such women groups?
1. Very Much 2. To some extent 3. Somehow 4. Not at all

1107 Do you think than women groups favour some category of women?
1. Yes 2. No

1108 Apart from being a member of any women group, how much have you participated in the group activities?
1. Very much 2. To some extent 3. Not at all

1109 Do you think women groups can raise a woman's social status?
1. Yes 2. No 3. It depends

11091 Do you view culture as an underlying factor rather than a constraint in improving your status as a woman?
1. Yes 2. No

11092 Explain ————————————

1110 Are women groups in your locality mainly for income generating purposes?
1. Yes 2. No

1111 Comment on how the following have affected your involvement in the women groups where you belong:

	1. Very Much	2. Some how	3. Not at all
1. Domestic workload			
2. Raising membership fee			
3. Inadequate capital to implement the objectives			
4. Lack of land			
5. Husband's negative mentality about such groups			
6. Inadequate sensitisation of the group objectives			
7. Misappropriation of the groups dividends			
8. Leadership skills			
9. Benefits are not forthcoming			
10. Other (specify)			

1112 It has been stated in other literature that many children raise the social status of the parents, more especially the women. What do you have to say about this? ……………………………………………………

1113 When you earn cash in the home eg from sale of produce and labour provided, who handles this money in the majority of cases?
1 Self 2 Husband 3 Both

11132 What determines who handles the cash? ……………………………………………………………………

11141 Do you think culture has directly affected your role in food production?
1. Yes 2. No [skip to qtn 1115)

11142 If so, explain how? ……………………………………………………………………………

1115 In your locality, are there any specific programs in agriculture aimed at improving the economic position of women?
1. Yes 2. No

1116 Who is responsible for the following household basic needs

	2. Wife	3. Husband	4. Both
a. food			
b. clothing			
c. shelter			
d. furniture			
e. cooking utensils			
f. parrafin			
g. soap			
h. medicare			
i. education			

Section 12: Dietary and Food Security knowledge

1201. Do you know what a balanced diet is all about?
1. Yes 2. No [skip qtn 1203]

1202. What was the source of such information?
1. Women group 2 TV/Radio 3 Church 4 Mwana Mugimu 5 Other specify ________

1203. What weaning foods do you give to your infants? ……………………………………

1204. Have you ever heard of food security?
1. Yes 2. No [skip qtn 1206]

1205. Give the sources of such information
1. Women group 2. Extension workers 3. TV/Radio 4. Other specify ----------

1206. What precautions have you taken to guarantee food security of your household? ……………………

1207. Does the method of food preparation influence the type of food consumed?
1. To some extent 2. Somehow 3. Not at all

1208. Give the energy types used in food preparation
1. Firewood 2. Paraffin 3. Charcoal stove 4. Other specify

1209. Give the factors that determine the type of food to cook in order of importance?
1. Availability of energy e.g. firewood 2. Domestic work load 3. Culture
4. Depends on what food is available 5. Other(s) specify……………………

1210 How much knowledge do you have on the following:

	1. Very much	2. Much	3. Fair	4. Not at all
1 Seed selection criteria				
2 Husbandry techniques				
3 Storage techniques				

1211 In your opinion, how much does the domestic workload influence the type of food to be consumed?
1. Very much 2. Much 3. Fair 4. Not at all

1212 Of the fruits/livestock/poultry you have how much is consumed by your household?

Item	(1) 70 % and above	(3) 50 – 70%	(3) 30 - 50%	(4) Less than 30%
1. Fruits				
2. Livestock				
3. Poultry				

1213 How often do you consume (out of production) any of the following items

	1 Frequently	2 Occasionally	3 Not at all
1 Fruits			
2 Livestock			
3 Poultry			

1214 If involved in food marketing, give the main food items which are mainly traded? ……………………… [else skip to qtn 1217]

1215 The food items traded in qtn 1214 above, are they traded as excess of the home production?
1. Yes [skip to qtn 1301] 2. No

1216 State the reasons why you sale the food items when you know that it is not in excess? ……………………

1217 Within your household is there a fair distribution of food among the members?
1. Yes 2. No 3. Depends

1218 It has been commented over and over, that women do serve their spouses with the best meals at the expense of their kids. What can you comment about this? ……………………………

Section 13: Food Storages

1301 Give the type of the storage facilities you have in your home ……………………………………………

1302 Give the type of food items stored and state the period

Type of food items stored	Period

1303 Do you have any problem with your storage facilities?
1. Yes 2. No [skip to qtn 1305]

1304 State the problems in order of severity ……………………………

1305 How do you preserve your food items?

Food item preserved	Preservation Method			
	1. Drying with chemicals	2. Drying without chemicals	3. Cooking	Other(s) specify

1306 Give the factors that affect food accessibility in order of severity? ……………………………………………………………………………

Section 14:

For Female headed household only

14011 Do you think that your household members would have been better off in terms of food security, if your household was headed by a male?
1. Yes 2. No 3. It depends

14012 Explain your response…………………………………………

1402 Give the problems you encounter in providing food to your household in order of severity ……………………

1403 Do you support the NGO's/Donors/government to give preferential treatment to female headed households?
1. Yes 2. No 3. It depends

For Male headed household

1404 How much do you depend on your husband for survival?
1. Very Much 2. Much 3. Not at all

Section 15: Shocks To Food Security during the last 30 days prior to the survey

Work Shocks

1501 Have you been sick for the last 30 days?
1. Yes 2. No

1502 Has any member of your household been sick for the last 30 days?
1. Yes 2. No [Skip to qtn 1504]

1503 Did a family members sickness affect your food production/purchases?
1. Yes 2. No

Output Shocks

1504 Did you experience any reduction in the yields due to

	1. Yes	2. No
1. Failure in rains		
2. Late planting		
3. Pests		
4. Sickness		
5. Labour shortages		

Asset shocks

1505 Did you experience any sudden fall in the quantity of assets?
1. Yes 2. No

1506 Did you experience any sudden fall in the prices of assets?
1. Yes 2. No

Income Shocks

1507 Did you experience any sudden fall in your income due to

	1. Yes	2. No
1. Crop failure		
2. Fall in prices		
3. Lack of customers		
4. Caring for the sick		
5. Other(s) specify		

Section 16: Other

1601 I understand that primary enrolment has been increasing, girls enrolment inclusive, then you as a woman what effect has this had on you productive activities? ……………………………………

Appendix 8 First Follow-up Survey Questionnaire

100 Has there been any changes in your household family size since the last visit?
1 Yes 2 No [skip to qtn 200]

101 Changes in household size

Name	1 join 2 left	Sex 1 female 2 male	age

200 Hired labour used by the household during the last 30 days

Names	Period (see codes below)	Sex 1 Female 2 Male	Wage/salary paid

Codes for the period: 1 daily 2 monthly 3 piecemeal 4 bi-weekly 5 other

200 Comment on the labour participation of indicated household members in the following activities [codes 1 fully 2 moderately 3 not at all]

Activity	1 husband	2 wife	3 children
1 domestic work			
2 food production			
3 production of crops for sale			
4 livestock			
5 poultry keeping			

200 Comment on how much you control children's labour in the productive activities.
1 very much 2 much 3 somehow 4 not at all

201 State the number of hours per week the children help you in the field.

Names	1 Age	2 Sex	3 hours per week
1			
2			
3			
4			
5			

204 State the number of hoes in poor shape …………….. bad shape ……………

205 Did you household involve itself in trading of the following (out of home production) during the last 30 days

Item (specify)	Involved 1 yes 2 no	Sold as excess 1 yes 2 no	Money handled by 1 husband 2 wife 3 both
1 food crops			
2 non-food crops			
3 fruits			
4 livestock			
5 poultry			

206 If so, give the details of the item(s) traded below

Item traded	Unit	quantity	Unit price

300 health conditions during the last 30 days (all persons)

Person who was sick (1)	Days of activities lost/suffered (2)	Medical attention (see codes below) (3)	Days in hospital/clinic (4)	Medical expenses (5)	Who incurred the expenses (6) [see codes below]		

Codes: 1 wife 2 husband 3 wife & husband 4 children 5 1 & 4

400 Household food consumption during the last 30 days [same as qtn 1000 in the main questionnaire]

401 Does your culture still prohibit you from eating certain food items?
1 Yes 2 No [skip to qtn 500]

402 If so, state the foods …………………………………………..

403 Household consumption of non-food items during the last 30 days [see qtn 1001 under the main survey questionnaire]

404 In the last 30 days, how many days did the members in your household have one meal? …………………

405 Did you experience any food shortages during the last 30 days?
1 Yes 2 No [skip to qtn 602]

406 If so, how did you overcome the shortages? ……………………………

407 Give the food items stored

Type of food items stored	Period	Amount stored	Is the current food stored enough to carry you up to the next main harvesting period? 1 yes 2 no

800 Rank the following factors according to how much they affect your household food accessibility in order of severity.
1 distance to the nearest market where one can purchase food items
2 scarcity of the required food items in the market
3 affordability of the food item 4 domestic workload
6 laziness 7 others (specify)

801 Give the problems you encounter in providing food to your household in order of severity …………………
802 Do you support the NGO/donors/government to give preferential treatment to female-headed households?
1 yes 2 no 3 it depends
803 Explain your response ………………………………………………..
804 Shocks to food security during the last 30 days prior to the survey

Work shocks

805 Have you been sick for the last 30 days?
1 yes 2 no
806 Has any member of your household been sick for the last 30 days?
1 yes 2 no [skip to qtn 905]
807 Did a family member's sickness affect your food production/purchases?
1 Yes 2 No

Assets shocks

808 Did you experience any sudden fall in the quantity of assets?
1 Yes 2 No
809 Did you experience any sudden fall in the prices of assets?
1 Yes 2 No

Income shocks

810 Did you experience any sudden fall in your income due to (use codes 1 yes 2 no]

	codes
1 crop failure	
2 fall in price	
3 lack of customers	
4 caring for the sick	
6 other(s) specify	

Appendix 9 Second Follow-up Survey Questionnaire

100 Has there been any changes in your household family size since the last visit?
1 Yes 2 No [skip to qtn 200]

101 Changes in household size

Name	1 join 2 left	Sex 1 female 2 male	age

102 Did you household involve itself in trading of the following (out of home production) during the last 30 days

Item (specify)	Involved 1 yes 2 no	Sold as excess 1 yes 2 no	Money handled by 1 husband 2 wife 3 both
1 food crops			
2 non-food crops			
3 fruits			
4 livestock			
5 poultry			

207 If so, give details of the item(s) traded below:

Item traded	Unit	quantity	Unit price	Sold as excess 1 yes 2 no

200 Time allocation by gender [same as qtn 301 under the main survey questionnaire]
201 Household holding characteristics [same as qtn 602 under the main survey questionnaires]
202 Inputs used by the farmers during the last season [same as qtn under the main survey questionnaire]
203 Hired labour used by the household during the last 30n days [same as qtn under main survey questionnaire]
204 Health conditions during the last 30 days (all persons) [same as qtn 301 under the first follow-up survey questionnaire].
205 In the last 30 days, how many days did the members in your household have one meal? …………………
206 Did you experience any food shortages during the last 30 days?
1 yes 2 No [skip to qtn 603]
602 If so, how did you overcome the food shortages? ………………………………………
207 Give the food items stored
208 Give the food items stored

Type of food items stored	Period	Amount stored	Is the current food stored enough to carry you up to the next main harvesting period? 1 yes 2 no

600 Household food consumption during the last 30 days [same as qtn 1000 in the main questionnaire]
601 Household consumption of non-food items during the last 30 days [see qtn 1001 under the main survey questionnaire]

Work shocks

700 Have you been sick for the last 30 days?
1 yes 2 no
701 Has any member of your household been sick for the last 30 days?
1 yes 2 no [skip to qtn 905]
702 Did a family member's sickness affect your food production/purchases?
1 Yes 2 No

Assets shocks

703 Did you experience any sudden fall in the quantity of assets?
1 Yes 2 No
704 Did you experience any sudden fall in the prices of assets?
1 Yes 2 No

Income shocks

705 Did you experience any sudden fall in your income due to (use codes 1 yes 2 no]

	Codes
1 crop failure	
2 fall in price	
3 lack of customers	
4 caring for the sick	
6 other(s) specify	

800 Comment on the availability of safe drinking water
1
801 Comment on the availability of firewood
1

Thanks for your cooperation