Gender Impacts of Molecular-Assisted Breeding: The Case of Insect and Disease Resistant Cassava in Nigeria

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(ABSTRACT)

Cassava is the main staple crop in Nigeria. Using primary data from four south eastern states in Nigeria, the study assessed the gender impacts of improved cassava varieties. Comparative statistical analysis reveals that total female labor is higher than total male in cassava production, processing and marketing. Women spend more labor days than males for planting, weeding, harvesting, marketing and processing. The total female family labor is higher for adopters of new improved cassava varieties. There is however lower family labor input for both male and female adopters for clearing and plowing which are normally done by men.

Significant determinants of female labor supply are number of children in the household, percent of females in the household providing labor on the farm, area under improved cassava varieties and total land area. There is a positive unexpected relationship between total female labor supply and number of children.

For each of the decision making variables, there is a significant association between the gender of the spouse and the decision made except for the decision on family labor allocation. Probit results show a significant decrease in the probability that the wife makes the decision for family labor allocation, what inputs to buy and borrowing and traditional cassava income control with adoption.

Results indicate that both men and women spend their income on services directly linked to the household's welfare. More than half of the women ranked food as number one.

DEDICATION

To my family which has sacrificed so much for me to be where I am today. I love you with all my heart.

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CHAPTER 1: INTRODUCTION

1.1. Background

Molecular-assisted breeding has the potential to improve incomes and livelihoods of impoverished rural households in Africa. In the developing world, the development of national technical capacity has proven to be a key determinant of income generation and poverty reduction (Thomas, 2003; Thomas and Slater, 2006). In African countries, the introduction of technological innovations for food crops such as cassava, which are often produced by women, exposes household food security both to potential benefits and to potential market risks, and may affect the internal intra-household distribution of power if women, for example, lose control of food crops they have traditionally managed. Cassava supplies the bulk of energy intake in Southern Nigeria and can be processed into many different forms. Roots can be eaten raw or boiled, processed into granulated flour used to make "gari" or pastes, or processed to produce vital raw materials such as adhesives, alcohol, and starch, which are useful in the livestock, feed, alcohol/ethanol, textile, confectionery, wood, food and soft drinks industries (Phillips, et al., 2004). Cassava is a major staple in Nigeria, but it is prone to pests which include green mites, white flies, mealy bugs, and diseases such as the cassava mosaic disease (CMD). Post harvest physiological deterioration (PPD) is also another problem faced by smallholder farmers in Nigeria and throughout the world where cassava is grown. In sub Saharan Africa, it is estimated that close to 30-40% of the harvested cassava root is lost due to CMD and this is equivalent to as much as 23 tons of food annually (Taylor, et al., 2004). Yield loss is estimated to be greater than US$ 1.5 billion per year (Thresh, et al., 1994). In Malawi, severe yield losses of up to 90% have occurred in some varieties (Sandifolo, 2003). In response, national agricultural research programs with support from international

agricultural research centers such as International Institute of Tropical Agriculture (IITA) and International Centre for Tropical Agriculture (CIAT) have worked to produce improved technologies such as cassava varieties that are resistant to insects and diseases and delay post harvest physiological deterioration. (CIAT, 2002 and 2008; Altman and Colwell, 1998). Recently, with funding from the Generation Challenge Program (GCP) of the Consultative Group for International Agricultural Research (CGIAR), CIAT and the National Root Crops Research Institute in Nigeria (NRCRI) and the Crops Research Institute (CRI) in Ghana have undertaken a project on Molecular-Assisted Breeding (MAB) to speed up the breeding program. Improved varieties with resistance to CMD and green mites are currently being tested in the field (GCP, 2008).

Improved cassava varieties that are resistant to insects and diseases such as CMD are likely to increase yields and may reduce the risk of crop failure. MAB therefore should increase cassava production and increase market surplus, with potentially significant impacts by gender within the household. Not-recognizing the gender implications of new technologies and increased agricultural commercialization might cause unintended social consequences; according to IFAD (1998) increased commercialization can lead to reduced nutrition and food security risks. Agricultural development planners often focus their attention on mechanisms for promoting access to and implementation of technologically improved crop varieties as a strategy for increasing income possibilities of smallholder African agricultural populations without looking critically at possible intra-household welfare and livelihood security effects, especially for socially disadvantaged women and children. This study seeks to assist development of progressive strategies that unambiguously increase the

welfare and livelihood of rural families in Nigeria while acknowledging and enhancing the strategic roles of women in family farms.

1.2. Nature of the problem

There are uncertain intra-household gender implications of the modernization process of transforming subsistence production into commercially-oriented farming systems. Women run the risk of being dispossessed of their previous economic rights and socioeconomic status within their families and communities (von Braun and Kennedy, 1994). The introduction of a new technology such as cassava varieties that are resistant to insects and diseases may create external market opportunities because of the increased production. In Nigeria and Ghana, it is reported that use of IITA's new high-yielding Tropical Manioc Selection (TMS) varieties increased cassava yield by 40 percent without fertilizer application (Nweke, 2004). The same is expected from varieties that are being tested from the CIAT-NRCRI-CRI molecular-assisted breeding program. In Nigeria, cassava is a crop that women traditionally are heavily involved in growing, and increased production leading to greater marketable surpluses may result in loss of control of income realized by the women to their husbands. In most African traditional agricultural communities, men assume control of most income from marketable crops, in part due to implicit gender biases in local commodity marketing contracts that have to be entered into by (male) heads of households (Gordon, 1996). According to Gordon (1996:138), 'If food crops become major sources of cash income, men can redefine them as cash crops and take them over for their own benefit'. A diagnostic study that was done in Uganda showed that once a crop became profitable, men took over its control and earnings (FAO 2000). In a study that was done in the Isoko Area of Bendel State, Nigeria, 14.28 percent of the women who planted cassava

on their husband's farm did not have access to the income later realized from the product (Udele,1981 in Timothy and Adeoti, 2006)

Commercialization programs including agribusiness extension and training often overtly target male heads of families even when focusing on traditionally women-managed crops. Women are further excluded when many extension agents –if not all- are men (Commonwealth Secretariat, 2001; (Mbagaya and Anjichi, 2007). In some communities social institutions attach a negative stigma to women involved in distance marketing of produce (Kevane and Wydick, 1999*)* and a positive stigma to reward men for long distance trafficking of produce from women's crops, reinforcing control and dispossession of women. A study done in Bwisha, Zaire revealed that women are socially obligated to get permission from their husbands for long distance travel thus reducing their trading opportunities (Fairhead, 1992). Several studies in Africa indicate that women have limited access to income, extension services, and markets (Mutangadura, 2005; Fabiyi et al 2007; IFAD, 2007). Women's access to productive farm inputs also appears to be low relative to men's (World Bank 2008; Phalane, 2005).

Domestic and international efforts to develop agricultural and food markets for the poor in Africa often take the existing African social template as given. They build upon existing social imbalances when implementing modern marketing institutions (Çagatay, et al., 1995) in Çagatay, 2001) such as contract farming, agribusiness training, and cash-crop-input credit schemes. These schemes often promote marketing of women-produced crops by men without questioning potential social injustices or livelihood implications for families. The result is that women may provide the bulk of the labor for production of certain food crops

without receiving much compensation for their investments in them (Barnett, 1997); Manuh 1998). Various studies indicate that women contribute more labor to the production of food crops, especially those intended for home consumption, than men. In rural Africa, studies have found that women account for 70% to 80% of the food production (Brown et al, 2001;Quisumbuig et al, 1998) and 100 per cent of the processing of cassava (Warren and Erkal,1997; Nweke 1996 in (Timothy and Adeoti, 2006). Women provide about three quarters of the labor in smallholder agriculture, but only receive a third of the income (Lastarria-Conrhiel, 2006).This disparity has resulted in gendered struggles over land, labor, and income (Dolan, 2005).

Gender implications must be of concern to policy makers who seek to reduce rural poverty and social inequities as per Millennium Development Goals or other policy documents that identify development priorities. Inequalities may not be taken seriously because it may be felt that intra household distribution and returns are subjective and best left to family members and community norms. In reality, divergence between efforts and rewards in poor traditional African families can represent economic and social institutional failures at the household and community levels and imply welfare protection systems that may affect incentives and may compromise livelihood and development outcomes. If women are disadvantaged in agriculture, when new technologies are introduced and crops are commercialized, expected livelihood and welfare gains for the poor from investments by national governments and by USAID, DFID, EU, Rockefeller and Bill and Melinda Gates Foundations may not occur.

Empowerment of rural women is key to improving the living conditions of the

impoverished rural communities (Gittinger 1990; Quisumbing et al, 1995), given the strategic role and centrality of African women in African agriculture, and is essential if the goals of introducing new technologies are to be fully realized. The concern is not that improved technologies are necessarily welfare reducing, especially if they raise family income. The concern is that failure to consider who controls and uses the added income, as well as what the new technologies may mean for time and labor allocation within the household, may significantly influence the size of potential gains or even result in losses.

1.3. Objectives

The objectives of this thesis are to:

1. Compare the roles of women and men in the production, processing and farm level marketing of cassava,

2. Identify the use and control of any income that is realized from increased cassava production due to new technologies

   a) Document women's perceptions on their amount, use and control of income generated from increased production due to varietal improvements in cassava.

   b) Assess how spending priorities change with an increase in income generated from a new technology differentiated by gender.

3. Identify potential positive and negative intra-household gender effects of producing insect and disease resistant cassava and cassava with reduced PPD in Nigeria such as effects on food security of women, diversion of women's time from other tasks to cassava production, reduced control of cash and decrease in decision making for women.

1.4. Hypothesis

1. Women provide the bulk of the labor in cassava production.
2. Women provide the bulk of the labor in cassava processing.
3. Women spend more of any incremental income on children's education and household expenditures than do men.
4. a) The adoption of improved cassava varieties increases the amount of labor required from women in cassava production and processing.

   b) Adoption of improved cassava varieties increases the control of cash by men.

   c) Women lose decision making power after introduction of new cassava varieties.

1.5. Methods

Information for this study was obtained from a household survey conducted in Nigeria during summer 2008. Scientists working with farmers and providing the new varieties were also interviewed. The main analytical tools used that are the Gender Analysis Matrix, Decision Making Matrix and Regression analysis (Table 1.1).

Table 1.1 Linkages between Research objectives, research questions, hypotheses and analytical tools used

Research Objective	Research Question	Research Hypothesis	Data Required	Analytical Tools
1. Compare the roles of women and men in the production, processing and farm level marketing of cassava,	What are the roles of women and men in cassava production, processing and marketing of cassava?	a) Women provide the bulk of the labor in cassava production. b) Women provide the bulk of the labor in cassava processing	Roles of women and men in production, processing and marketing	Crosstabs, bar graphs ,frequency tables
2. a) Document women's perceptions on their use and control of income generated from increased production. b) Assess how spending priorities change with increase in income generated from a new technology differentiated by gender	▪ Have the new technologies increased women's income? ▪ Have women's spending priorities changed?	a) Households that adopt new cassava varieties have increased income. b) Women spend more of any incremental income on children's education and household expenditure than do men.	Women's perceptions on new cassava varieties, preferences regarding use of increased income differentiated by gender, before and after	Preference ranking
3. Identify potential positive and negative intra-household gender effects of producing insect and disease resistant cassava and cassava with reduced PPD in Nigeria.	▪ Do gender roles change with the introduction of new cassava varieties? ▪ Does control of resources and decision making change with adoption of new varieties?	a) The adoption of improved cassava varieties increases the amount of labor required from women in cassava production and processing. b) Adoption of new cassava varieties increases the control of cash by men. c) Women loose decision making power after introduction of new cassava varieties	Labor, time allocation to cassava production, decision making power for different tasks, access and control of resources used in cassava production.	Gender analysis matrix , Decision making matrix , multiple regression

1.6. Organization of the thesis

Chapter two provides a comprehensive review of literature on cassava production, recent cassava research and gender implications of introducing new technologies in smallholder agriculture. The theoretical works of other researchers are reviewed in this chapter and then findings by these researchers are compared and synthesized. Chapter 3 outlines the empirical models which will be used for data analysis. Results are discussed in Chapter four. Chapter five presents the conclusion, policy recommendations and areas of further study.

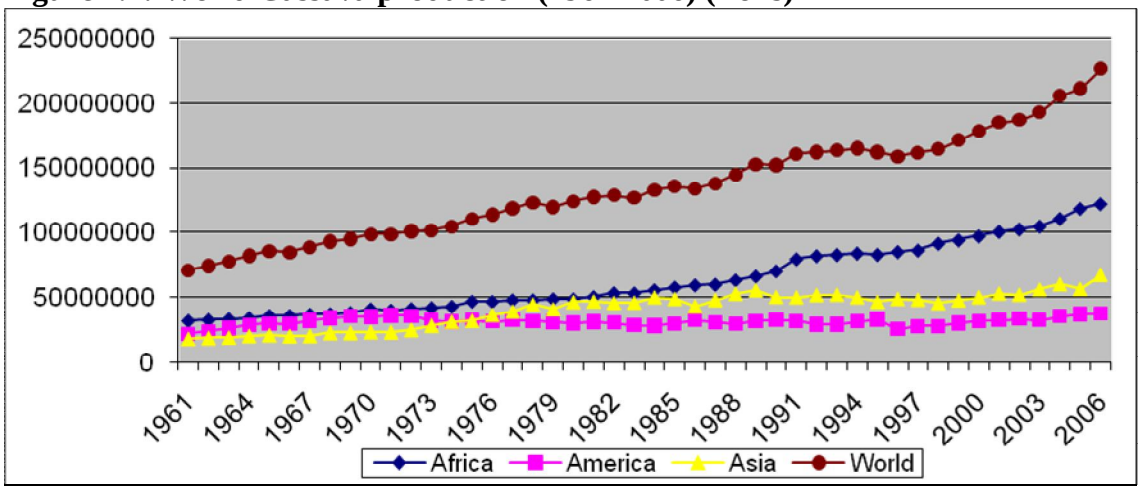
CHAPTER 2: LITERATURE REVIEW

This chapter reviews literature on cassava production, recent cassava research and the gender implications of technological advancements in smallholder agriculture. First a global picture on production is given followed by a summary of the general impacts of introducing new technologies into rural communities in Africa. The chapter then highlights the potential effects of producing disease/insect and PPD resistant cassava on women in Nigeria and Ghana.

2.1. Cassava production globally

According to CIAT, cassava is grown in over ninety countries worldwide and provides food and is a source of livelihood for over 500 million people, mostly in developing countries.

Figure 2.1: World Cassava production (1961-2006) (Tons)



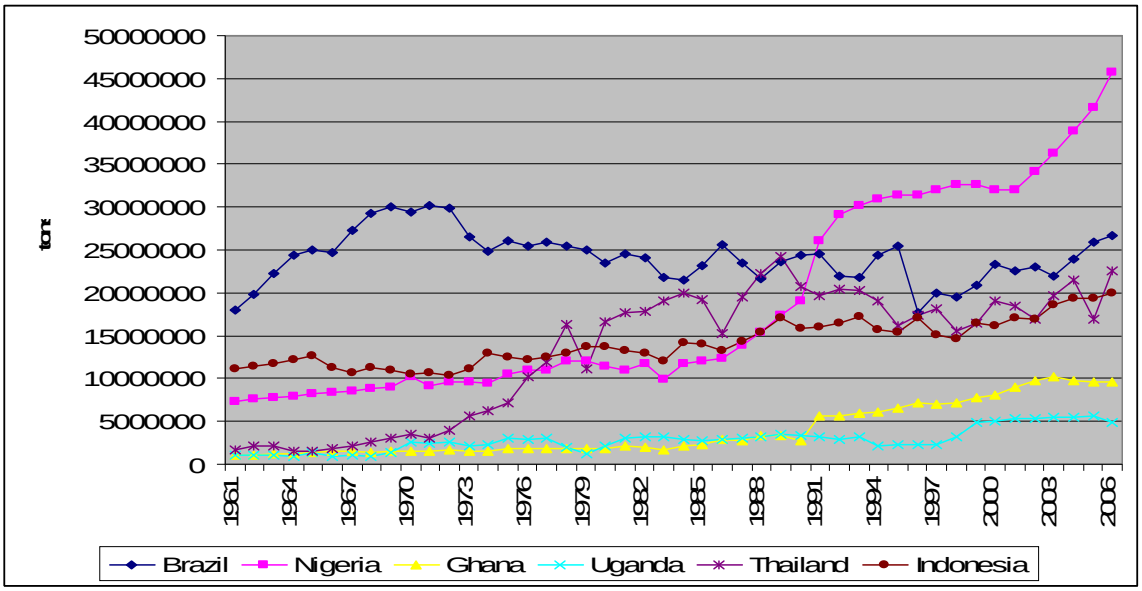
Source: FAOSTAT, 2008

In terms of the total land area that is planted to cassava, 50% is in Africa, 30% in Asia, and the rest in Latin America. FAO estimates the 2007 output to be 212 million tons, 4 million

tons above the figure in 2006 (Figure 2.1). There has been a general increase in production over time, with fluctuations across countries. Global production has been increasing continuously since 1999 (Food Market Exchange).

In the early 1960s, Africa accounted for close to 42 percent of world cassava production. By the early 90s, Africa produced almost half of the world cassava output (Figure 2.2). This increase was attributed to higher production particularly by Ghana and Nigeria which increased production fourfold. The availability of new Tropical Manioc Selection (TMS) cassava varieties by IITA increased cassava production in Africa by 40% without using any fertilizer (Bokanga and Otoo, 1991 in Dada et al 2007).

Figure 2.2: Cassava production in selected countries (tons)



Source: FAOSTAT, 2008

Nigeria is the largest producer in the world followed by Brazil. From 1961 to 1965, Nigeria produced about 7.8 million tons of cassava per year and was the fourth-largest producer in

the world after Brazil, Indonesia, and the D.R. of the Congo (FAOSTAT). This ranking changed in 1995 and since then Nigeria has been the largest producer worldwide.

Table 2.1: Average cassava yield (kg/ha) by year and region

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Africa	8810	9196	9038	9059	9486	9886	10081
Eastern Africa	8166	9247	8435	7857	8254	9800	9515
Middle Africa	8038	8269	8300	8049	8610	8386	8391
Northern Africa	1739	1759	1746	1733	1738	1732	1732
Western Africa	9715	9733	9837	10385	10765	10856	11444
America	12379	12524	12884	12718	12990	12802	13197
Central America	10655	12680	12082	11814	10363	10401	10690
Latin America & Caribbean	12379	12524	12884	12718	12990	12802	13197
Caribbean	4948	5094	5138	6191	5617	5272	5312
Asia	14479	15130	15110	16311	17106	16297	18243
Eastern Asia	15983	16065	16281	16027	16822	16845	16245
Southern Asia	24751	26360	25763	24240	25464	24037	29500
South-Eastern Asia	13473	13992	14004	15705	16455	15585	17459
Western Asia						1000	
Oceania	11488	11174	11259	11298	11185	11266	11184
Melanesia	11266	10889	10990	11057	11022	11179	11179
Micronesia	11000	10909	10909	10909	10909	10909	10727
Polynesia	13964	14239	14127	13801	12486	11689	11689
World	**10491**	**10914**	**10807**	**11008**	**11509**	**11549**	**12163**

Source: FAOSTAT, 2008

In terms of yield, there has been a general increase over the past five years in all regions (Table 2.1). Results from the COCSA studies indicated average yields of between 10 and 15 tons/ha in Côte d'Ivoire, Democratic Republic of the Congo (D.R. of the Congo), Ghana, Nigeria, United Republic of Tanzania, and Uganda. Africa has a lower yield in all

years compared to other regions. This yield difference can be attributed to poor agronomic practices and lack of access to technology.

2.2. Factors affecting cassava production

Cassava is the main staple crop in many countries in Africa. The crop is however prone to attack by a number of insects and diseases. Poor agronomic practices combined with the insects and diseases have contributed to yield losses. Africancrops.net, names the cassava mosaic disease as the biggest biological constraint to cassava production in Africa. The other diseases affecting cassava are cassava bacterial blight, cassava anthracnose, and root rot. The main insects are white flies, cassava green mite, and cassava mealy bugs.

About 91% of the farmers in the Ohaji-Egbema Local Government Area of Imo State, Nigeria indicated that pests were the major constraint affecting production, while 95% mentioned high demand for hired labor (Asinobi et al, 2005). The cassava mosaic disease alone can cause up to 60% percent yield loss (Horna, et al., 2007). Cassava is also a highly perishable root crop. Fresh tubers contain up to 62 to 65 percent of moisture and can dry out in less than 48 hours (Dada et al, 2007). Losses due to PPD combined with insects and diseases cause harvest losses equal to 48 million tons yearly or 30% of total world production valued at US$1.4billion (FAO, 2002). Farmers in Ghana named post harvest loss as a major risk factor in cassava production (Horna, et al., 2007).

These losses have prompted organizations such as IITA, USAID, and CIAT to fund research focusing on the production of cassava varieties that are resistant to insects and diseases. Molecular assisted breeding using wild varieties of cassava is being used to speed

up production of varieties that are resistant to the diseases and insects affecting cassava and delay post harvest physiological deterioration.

The introduction of these new varieties may have different impacts on men and women in smallholder agriculture. This study will assess the gender implications of introducing such technologies in smallholder agriculture and identify policy implications.

2.3. Gender roles in cassava production, processing and marketing

As mentioned above, women play a pivotal role in smallholder agriculture, providing much of the labor required in agricultural production. Various studies indicate that women devote more labor to the production of food crops, especially those intended for home consumption, than men. Apart from food production, women are often solely responsible for food processing, preservation, and storage (Keller and Mbewe, 1991). Women are the major food providers and participants in the labor force within the communal mode of production. In Nigeria, women perform multiple roles for the survival of their homes and the nation. A significant amount of Nigerian women are farmers, and they provide about 60 to 80 percent of the rural labor input (Adekanye 1988 in Adereti 2005).

Cassava has been labeled as a women's crop (Adekanye 1983, Zweifel 1995, House-Midamba and Ekechi, 1995), but there are conflicting views on this notion. Some researchers feel that the labeling of cassava as a "women's crop" is misleading and a half truth. Studies that have been done in six countries (Uganda, Nigeria, Ghana, Tanzania, Congo and Côte d'Ivoire) conducted by IITA through the Collaborative Study on Cassava in Africa (COSCA) revealed that both men and women contribute significantly to cassava

production, but differ in the tasks that they perform. Men performed mainly the land preparation and planting, while women specialized in weeding, harvesting, transportation and processing. The study also showed that the commercialization of cassava had resulted in an increase in the labor contribution by men in production and processing. Weeding done by men in Nigeria increased as compared to Tanzania. Women were found to contribute less than half of the total labor supply in five of the six countries with the Congo being the exception (Nweke et al, 2002). The studies that have been done by COSCA found that the proportion of the cassava household field area owned by women ranged from 4 percent in the Congo to 24 percent in Côte d'lvoire. Results from the study also indicate that in Côte d'lvoire, Uganda and Nigeria men owned 15, 72 and 81 percent of cassava fields respectively. The balances of the percentages in each country are accounted for by joint ownership (FAO, IFAD 2005).

Zweifel (1995) indicates that women are the main producers of cassava as a food crop in Latin America, Africa and Asia. In Latin America, women decide which variety should be grown and where and when to plant the crop, while the men clear the fields. Results from another study in Nigeria found that in most rural parts of the country, women contribute about 58 percent of the total agricultural labor in the southwest, 67 percent in the southeast and 58 percent in the central zones. They are mainly involved in activities such as hoeing, weeding, harvesting, transporting, storing, processing, and marketing in addition to domestic chores. Rural to urban migration of men into the cities in search of employment increased the labor burden on women who then became involved in land clearing and preparation, tasks which previously had been performed by men (IFAD, 1994).

The COSCA study found that in 67 percent of cases that were examined, cassava processing activities were carried out by women only, compared to 6 percent of cases for men only. Women and children participated in another 19 percent of cases, and in 6 percent of cases women worked alongside men. From the results, Nweke (1994) concluded that women participate in 92 percent of the activities in cassava processing. Cassava can be processed into different forms in order to increase the shelf life of the products, facilitate transportation and marketing, reduce cyanide content, and improve palatability. Processing involves procedures such as peeling, boiling, grating, pressing, fermenting, sifting and roasting. Peeling is done mainly by women and children while grating and pressing is done by both sexes, depending on the machinery being used. If traditional graters are being used, it is the women who do the work, but if equipment is power driven or if a hydraulic presser is available, men do it (Hahn, 1992). The higher the availability of mechanized processing machines, the higher the participation or involvement of men in the processing of cassava. The main end products are flour, *gari* (a fermented dough), and *tapioca* (toasted starch*)* which are popular in Nigeria, Cameroon, Benin, Togo, Ghana, Liberia, and Sierra Leone. Women are also involved in marketing, and they assist their husbands in the marketing process (FAO, IFAD 2005).

2.4. Impact of agricultural technology on rural livelihoods

The introduction of a new technology into an area is likely to have both negative and positive impacts on rural households depending on the type of technology. Increase in the output per unit area is expected. Most studies that have been done indicate positive impacts although there may be challenges associated with adopting the technology and getting it to the people. Technological advancement and commercialization may also have some

adverse consequences for the poorest. Binswanger and Von Braun (1991) discuss potential positive and negative impacts of technological change. Increased income and employment and reduced food prices provide potential positive impacts, while late or no adoption by poor farmers, gender bias, eviction of tenants, and effects on land markets each provide potential for negative impacts.

New technologies have the ability to increase yields if used properly. In the 1970s, output per ha in the developing countries increased by 80% with the introduction of new technologies (Paulino 1986). Scientists working in Uganda since the 1990s at the Namulonge Agricultural and Animal Production Research Institute developed cassava varieties that are resistant to the cassava mosaic virus. These varieties were seen to produce three to four more times per hectare of cassava than the old varieties (Otim-Nape in Crawley 1999).

The increase in productivity due to the new technology can increase employment if the technology is not labor saving. The social standing of a household and community can also increase as there is a higher living standard in terms of health and general welfare due to the increased income. This increase in income may alleviate poverty for the smallholder farmers.

2.5. Potential impacts of new technologies on women

As mentioned above, women, particularly in Africa, are the main producers and processors of agricultural products. They provide 60-80% of the labor force in food production (FAO, 1995). Despite the central role that women play in agricultural production, they are often

deprived of essential inputs such as extension services, access to credit, access to new technology, and access to productive assets such as land (Blackden and Bhanu, 1999). The impact of technological progress can be both positive and negative for women in smallholder agriculture and can have different costs and benefits for men and women farmers, according to local context-related factors such as socio-cultural background and wealth status (FAO).

Technological innovation has the potential impact of exacerbating inequalities. According to Zweifel (1995), the impact will depend on the nature of technology, context in which the technology is developed, the interests of those who introduce it, and the situation of those whom it will affect. Studies have found that when the Green revolution was introduced, men increased the area under cash crop production and took over some of the land that women planted their traditional crops or the gardens to expand their production. In some instances, research has shown that technological advances that that increases income for example new crop or processing equipment, are often taken over by men (Paris, et. al., 2001:6 in Hafkin and Odame, 2002). Studies that have been done in developing countries have shown that women spend more of their individual income on goods and labor time in activities which contribute to security of consumption for the children and other household members while men tend to spend more of their individual income on personal goods (Haddad, 1999). It therefore becomes necessary to assess who controls the income from increased cassava production.

(Shiva, 1988) noted that in Zambia, commercialization of agriculture which is directly linked to the introduction of new technology puts constraints on the amount of land

available for the production of food crops. Women's productivity, particularly of food crops, stagnated and in some cases actually diminished, while cash crop production under male control, led to reduced food availability for the household. According to her, 'The penetration of capitalism and the money economy has led to a market and devastating erosion of the productive power of land and the power of women.' (pp 113)

New technologies are expected to ease burdens on women in smallholder agriculture, but some evidence indicates that introduction of new seed technologies has tended to increase labor burdens for women and has decreased their control over their work. In a case study in the Migori district in Kenya, results indicated that the introduction of pest resistant cassava varieties increased labor burdens for both young men and women. The adult men increased their control over the land and cash with less labor input, while the adult women gained more access to some of the resources, but results are unclear on whether they had more control over the essential assets such as land and cash (Andima et al, 1994).

COCSA studies, however, have conflicting results. Those studies found out that there were no constraints for women related to access to new cassava varieties or essential production inputs. Both sexes were able to plant the varieties. Their results also found that men owned and controlled the cassava processing machines in most of the countries. Anyone who wanted to use the machines whether male or female could rent them.

Stimulated by male bias in agricultural extension and services, introduction of new technology to reduce the cyanide content in cassava for example, saw men taking over more of cassava production, cutting women's income from the sale of processed goods on the local market. This resulted in further marginalization of women in smallholder

agriculture thus undermining women's autonomy (Zweifel, l995). Even if women farmers have control over their output, gender inequalities on the marketing side in the smallholder sector is characterized by male bias. In Nigeria, men and women may face different prices due to transaction costs and/or market imperfections which are skewed in favor of male farmers (Timothy and Adeoti, 2006).

In view of the above, some researchers have suggested that introducing new technologies without the involvement of women is problematic. Zweifel (1995) suggests that, '… exchange among women of technology and knowledge developed by women would be a more sensible step in improving women's autonomy than expensive and risky advanced technologies such as genetic engineering.' Her argument is that if women are involved in the technology improvement process, their interests are taken into consideration thus outside technologies will be successful. Taking into consideration the different roles of men and women will result in a more appropriate technology which is easily adopted (Cassava Biotechnology Network, 1993 in Zweifel, 1995).

Given the potential for both positive and negative impacts of new technologies by gender, it is important to improve our understanding of the context into which the new CMB/green mite resistant and PPD resistant varieties will be introduced, to maximize the positive and minimize any negative impacts.

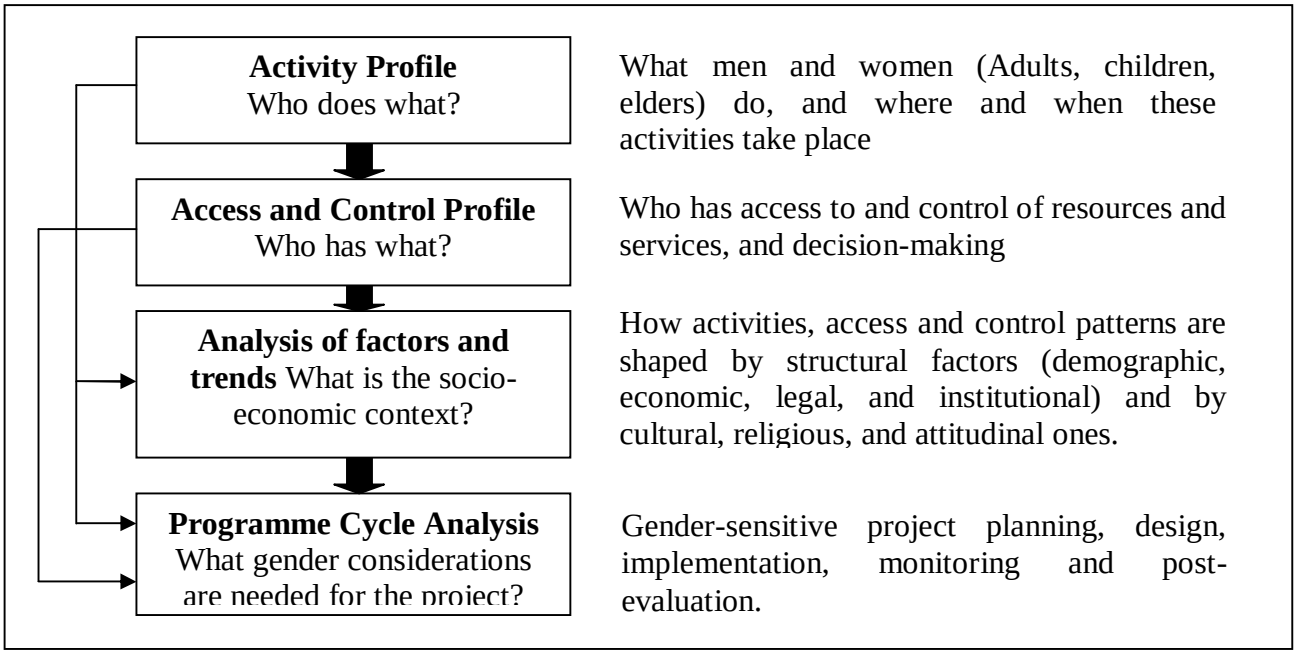
2.6. Gender analysis

Gender can be defined as the differences between women and men within the same household and within and between cultures that are socially and culturally constructed and

change over time. These differences are reflected in: roles, responsibilities, access to resources, constraints, opportunities, needs, perceptions, views, etc. held by both women and men. Thus, gender is not a synonym for women, but considers both women and men and their interdependent relationships (Moser, 1993).

Gender analysis is important in development planning and policy making as it provides information that can be used to , "ensure that men and women are not disadvantaged by development activities, to enhance the sustainability and effectiveness of activities, or to identify priority areas for action to promote equality between women and men" (Hunt, 2004:100).

Figure 2.3: Gender Analysis of Projects



[used with permission]
Adopted from the Asian Development Bank (2002) "Gender Checklist: Agriculture"

The flow diagram in Fig 2.3 summarizes information that can be gathered from gender analysis. This study will assess the gender impact of producing insect and disease resistant

cassava with the hope that the information will be useful to project planners for them to produce a gender sensitive planning, design, implementation and monitoring when the new cassava varieties are available for everyone.

❖ Gender analysis matrix

The Gender Analysis Framework (GAM) was developed by Parker (1993). It identifies and analyses the gender differences brought about by a particular activity. In this case the activity will be the introduction of insect and disease resistant cassava. The analysis will comparatively analyze the impacts of introducing new cassava varieties on women and men. The matrix is divided into objectives, different categories and different stakeholders (Table 2.2). Changes brought about as a result of the introduction of the new cassava varieties will be reported as either negative or positive amongst the different stakeholders.

One assumption is that the introduction of the new varieties has demands that are different from the previous varieties which require decisions on input use and production activities and these affect women and men differently (Andima, et al., 1994).

Table 2.2: Illustration of the Gender Analysis Matrix

Project Objectives:					
Stated Gender Objectives:					
Level of Analysis	Categories of Analysis				
	Labor	Time	Resources	Culture	Others
Stakeholder #1					
Stakeholder #2					
Stakeholder #3					

[used with permission]

Source: Parker, Rani, "Another Point of View: A Manual on Gender Analysis Training for Grassroots Workers" UNIFEM

Labor: This refers to changes in tasks, level of skill required (skilled versus unskilled, formal education, training) and labor capacity (how many people and how much they can do; do people need to be hired or can members of the household do it?)

Time: This refers to changes in the amount of time (3 hours, 4 days, and so on) it takes to carry out the task associated with the project or activity.

Resources: This refers to the changes in access to capital (income, land, credit) as a consequence of the project, and the extent of control over changes in resources (more or less) for each level of analysis.

Culture: Cultural factors refer to changes in social aspects of the participants' lives (changes in gender roles or status) as a result of the project.

Stakeholders are the different levels of analysis i.e. women, men, household, community etc (Parker, 1993).

A study that was done in the Migori District in Kenya using the GAM included eight aspects of cassava production mainly; labor, time, tools, land, cash, funds, food and social standing. The main weaknesses that Andima noted from that study included the possibility of an overlap on the labor and time. The suggestion was to specify labor as requiring new skills, doing heavier, and more dirty work. The categories to include in the matrix were provided by the researchers before interviewing the farmers. She argues that what the researcher perceive may not necessarily be relevant for comparison for the farmers for example some of the categories like land and tools where minor changes were expected. The suggestion was that it will be better if the farmers are given the priority to give from their own criteria for appreciating new technologies. This study will use the GAM as a

framework of analysis in order to determine the roles played by women and men and time they put in the production, processing and marketing of cassava.

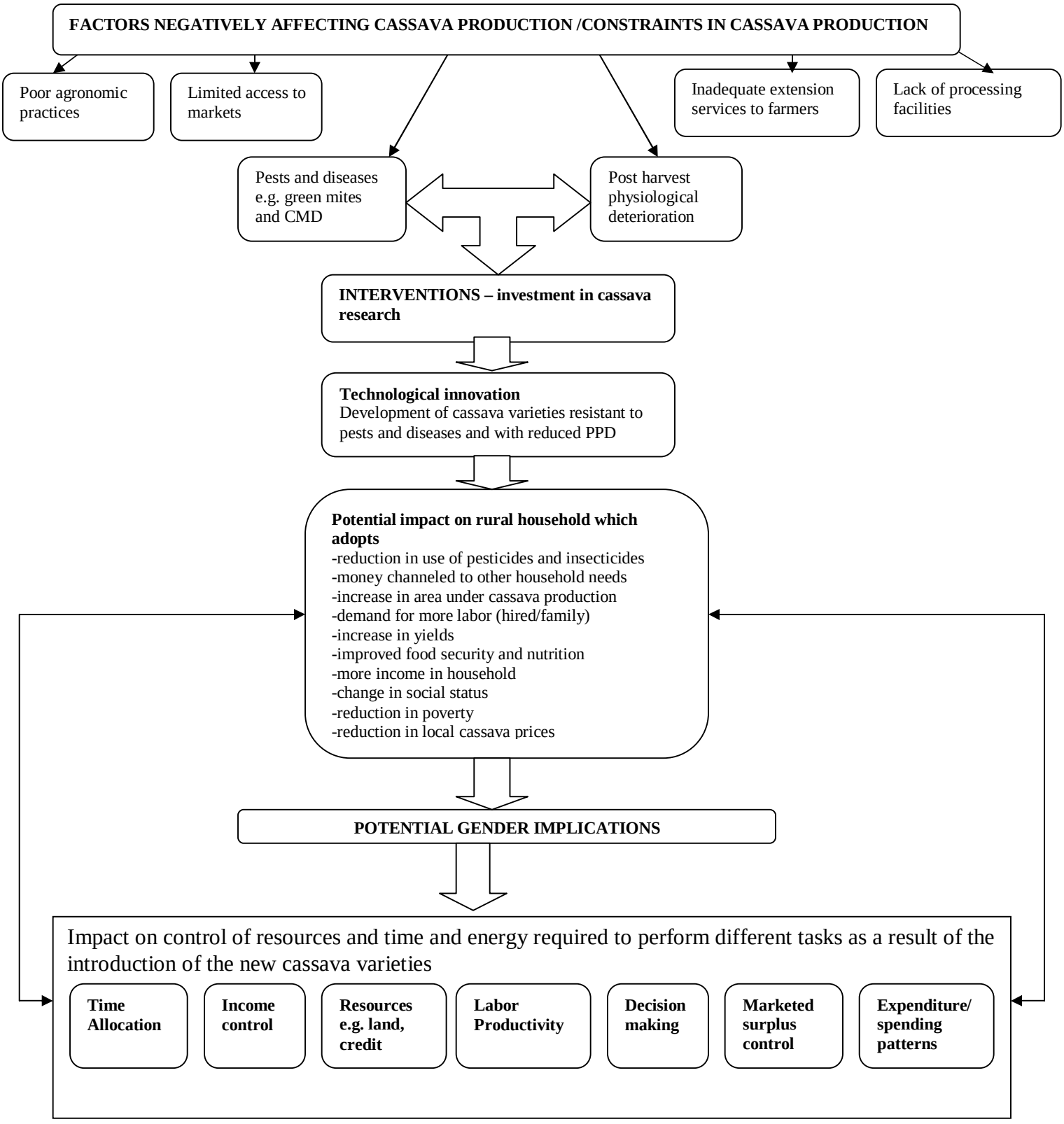
CHAPTER 3: METHODOLOGY

This chapter will highlight the theoretical concepts and analytical tools that will be used. The conceptual framework was developed after a detailed review of literature surrounding the gender implications of introducing new varieties in smallholder agriculture. The objectives and hypothesis will guide the analysis. Data collection methods will also be outlined as directed by the requirements of the conceptual framework.

3.1. Conceptual Framework

The conceptual framework can be defined as a set of relationships that are related which show the causes, effects and impacts of a certain phenomenon; in this case it will be the relationship between the introduction of new cassava varieties and impacts differentiated by gender. Very few studies that have been done have focused on the gender implications of introducing new cassava varieties in an area. Figure 3.1 illustrates the potential impacts of introducing new technologies on the overall household and also the different impacts on men and women. This figure is just a simplified diagram and there are a complex set of issues and linkages that have not been included that are required to evaluate the gender implications of introducing new cassava varieties. From the figure it can be seen that cassava production is constrained by a number of factors and among those are insects, diseases, and PPD, and interventions to reduce the mentioned challenges are the core of this study. There are potential negative and positive impacts when households adopt the new technologies which include women losing control of the crop they once controlled with adverse impacts on the household as a whole.

Figure 3.1: Illustration of the Conceptual Framework



Data collection from both male and female respondents separately is essential to better understand the linkages and factors that may affect the two gender groups following introduction of new varieties.

3.2. Data collection instruments

A detailed household questionnaire was administered to both male and female respondents. The household was the unit of analysis. Both male and female respondents from households that have adopted improved cassava varieties and also that have not adopted were asked the same questions separately in order to get views from both sexes. The questionnaire solicited information on general household characteristics, level of income, income control, who does what in cassava production, processing and marketing, and so forth. There are women's groups in the study area which meet to discuss issues related to farming and other challenges. Focus group discussions targeted these groups to gather information on how they operate; gains women get from the group discussions, if they play any role in technology dissemination, and challenges they face as women farmers. Data was also collected from researchers and scientists involved in the development of new cassava disease and insect resistant varieties. Some improved varieties were introduced five to ten years ago and obtaining accurate information from households using the improved varieties about the period before adoption would be difficult. Therefore information from non adopters and adopters can be compared using information on variables other than adoption to control for systematic differences. The respondents were asked how much cassava they produce with and without adoption of improved cassava varieties. The amount was separated into cassava used for food consumption in the household versus what was sold for cash. Categories of expenditure were differentiated by gender and ranked. Focus

group discussions with key informants were used to determine the categories. Categories are school fees, alcohol, health expenditure, hired labor, inputs, funerals and others.

3.3. Description of the study area

The study was conducted in four states in southeastern Nigeria: Abia, Imo, Akwa Ibom and Cross River.

Abia state produces both food and cash crops. It is made up of seventeen local government areas (L.G.As). The main food crops that are produced are cassava, yam, rice, plantain, banana, maize and cocoyam. The main cash crops are palm, cocoa and rubber. Agriculture is the main occupation of the people of Abia State.

Imo state has twenty seven LGAs. Imo has a population of about 2.9 million and agriculture is the mainstay of the economy and people of Imo state. The main cash crops grown are oil palm, raffia palm, rice, groundnut, melon, cotton, cocoa, rubber and maize, while food crops such as yam, cassava, cocoyam and maize are produced. Livestock such as goats and sheep is also part of the agriculture sector in the state.

Akwa Ibom State has a population of about 3.9 million people and 85% of them live in the rural areas. Most of the land in Akwa Ibom is fairly suitable for traditional crops (CRBDA, 1982 in Ekpenyong, 2008). It is located between latitude $4^{0}30^{0}$ and $5^{0}30^{0}$N and longitude $7^{0}30^{0}$ and $8^{0}15^{0}$E (Ekpenyong, 2008). Akwa Ibom is an oil producing state. The rich arable land and climate make it possible for the production of food and tree crops such

as cassava, yam, plantain, banana, mango, leafy vegetable, okra and oil palm also livestock rearing.

Cross River is a coastal state. The economy of the state is primarily supported by agriculture. The main crops grown are cassava, yams, rice, plantain, banana, cocoyam, maize, cocoa, rubber, groundnut and palm produce. Local farmers also keep cattle, goats and sheep. Commercially, poultry, pigs, rabbits and turkeys are produced in some parts of the State. The population of the state is approximately 2.9 million (2006 estimate). There are also a number of tourist places in the state.

3.4. Sampling method and research design

Approximately 200 questionnaires were administered in the four states. Sampling was done so as to include both households that adopted the new cassava varieties and those that did not. This allowed the later group to be used as a control once other systematic differences were controlled for, allowing comparison with and without adoption of new improved cassava varieties. Participants from different socioeconomic backgrounds were included in the random sample. Multi stage sampling was used to select the respondents for use in the study. The sampling units at each stage were sub sampled from the previous larger unit. Advantages of this technique are that it is economical, efficient and convenient. The main disadvantage is lower accuracy due to higher sampling error (Australian Bureau of Statistics). The units were agricultural zones, communities, villages in that order starting from the largest unit for the four states. All the states are divided into three agricultural zones. In the first stage two agricultural zones were randomly selected from each state. The goal was to get 25 respondents from each of the selected zones, for a total of 200

respondents. In the second stage a certain number of communities were randomly selected. From each community, farming villages were purposely selected. Extension agents who know where the improved cassava varieties were disseminated helped in choosing the villages. From each village, respondents were randomly picked for the study.

3.5. Tools for data analysis

3.5.1. Descriptive analysis

Descriptive analysis on the general household characteristics will be completed first. The analysis will also differentiate the roles that men and women play in cassava production processing and marketing. Frequency tables will be used to describe data in numbers and percentages. Cross tabulations also known as contingency tables will be used to summarize categorical variables. Chi squared tests in conjunction with the crosstabs will assess if there is any relationship between the sex of the respondent and various socio economic factors such as income, education level, and household size and so forth. The disadvantage of the tests is that though it shows the association between two variables, it does not show the direction and degree of the association. Use of chi squared tests alone will thus not be sufficient for analysis.

3.5.2. Decision making matrix

To assess resource control in cassava production, the decision making matrix will be used. The decision making matrix is formed in order to assess how the decision making power is distributed in the household and what decisions the husband and the wife makes. The

matrix will be used to evaluate decision making power in cassava production, processing and marketing with and without adoption of improved varieties (Table 3.1).

Table 3.1: Example of a decision-making matrix

	Male	Decisions Male/female member jointly			Female	Comments/ explanations
		Male dominates	Equal influence	Female dominates		
Inputs:						
Who decide(s) how the available family labor will be used						
Who decide(s) what inputs to buy						
Who decide(s) to hire additional labor						
Production:						
Who decide(s) whether the cassava will be processed or stored?						
Who decided that the household should adopt improved varieties?						
Marketing:						
Who decide(s) what quantity/ how the cassava harvest is sold?						
Investments:						
Who decide(s) to take a loan?						
Who decide(s) to buy or rent additional land						

[public domain]

Adapted from Wilde, V. (2001) *Field level handbook Socio-economic and Gender Analysis (SEAGA) Programme.* Rome: FAO.

3.5.3. Preference ranking

Preference ranking will be used to obtain the spending priorities for the two gender groups from an increase in income. It is preferred to use participants with the same socio economic backgrounds. The main objectives of preference ranking will be to:

- determine the main preferences of the two gender groups within a set of spending items.
- compare spending priorities of men and women given the same amount of income

3.5.4. T- Tests

❖ **Independent samples t tests**

Independent samples t tests are used to compare the means of two different groups. In the study, the two independent categories will be women and men. Different socioeconomic factors will be analyzed using the T-tests differentiated by the sexes where 1=male and 0=female. Specifically the independent samples t-test will be used to investigate the existence of significant differences in the number of hours or labor days spent by men and women in cassava production, processing and marketing. Other significant variables that will be tested are: age of respondent, total land area and yields.

The hypotheses that will be tested are

$H_{o:}\ \mu_{mi} - \mu_{fi} = 0$

$H_1:\ \mu_{mi} - \mu_{fi} \neq 0$

Where i is the variable that will be tested, m and f denotes males and females respectively.

The null and alternative hypothesis will be tested and the null hypothesis will be rejected if the p value is greater than α and it will be concluded that the means between the males and the females are significantly different at the α% level of significance.

3.5.5. Econometric Analysis

❖ **Multiple linear regression**

Regression analysis examines the relationship between a dependent variable and independent variables**.** Regression models will be run to see if the introduction of improved cassava varieties is statistically significant with respect to labor required from women in cassava production. The dependent variable in this case will be the total female labor in

cassava production measured in person days. Multiple linear regression analysis will be done using STATA. A discussion of the model that will be estimated including the required data follows.

$FLS = \beta_0 + \alpha_i A_i + \sum \delta_i D_i + \sum \gamma_i E_i + \sum \theta_i S_i + ui$

Where: FLS= Female labor supply in cassava production measured in person days per year

A_i = area variables e.g. area under improved cassava varieties, total land area

D_i = demographic variables e.g. number of children, percent of women in household providing labor

E_i = economic variables e.g. wage rate per day

S_i = social variables e.g. membership to an association, distance to market

u_i = error term

Table 3.2 Description of variables used in the analyses

Variable	Type	Description
Total female labor allocation	Continuous	Total time women allocate for cassava production, processing and marketing (person days)
Adoption	Dummy	1= Household is using improved cassava varieties, 0 =Otherwise
Area under improved cassava production	Continuous	Total land area cultivated for cassava production (ha)
Total land area	Continuous	Total land area the household has (owned+ rented +leased)
Percent of adult females providing labor in household	Continuous	Total number of females providing labor/total number of people providing labor in household
Number of children	Continuous	
Wage rate	Continuous	Wage paid to hired labor (naira per day)
Membership to an association	Dummy	Whether or not respondent belongs to an organization(1 =Yes, 0= No)
Distance to the market	Continuous	Distance from home to the nearest market (km)
If household borrowed or not for cassava production	Dummy	1= Household borrowed, 0= Household did not borrow for cassava production
Male	Dummy	Gender of respondent(1= Male, 0= Female)

Table 3.3: Expected relationships between the dependent variable (total female labor allocation) and variables that will be considered in the econometric models

Variable	Expected relationship	Explanation
Area under improved cassava production	+	If the land area under improved cassava varieties increases, the amount of labor supplied by women is also expected to increase. Women supply most of the labor in smallholder agriculture hence the relationship will be positive.
Total land area	- or +	The greater the land area means spreading scarce labor on a larger area, and hence the relationship is expected to be negative. However if more of the land is allocated to cassava production, the relationship is expected to be positive.
Percent of adult females providing labor in household	+	The higher the number of females in the household, the more person days women can provide, hence the relationship should be positive
Number of children	-	The more children, the less the time available for labor participation of women.
Wage rate	- or +	The higher the wage rate, the greater the incentive to work off the farm and earn more money, but women as food providers would rather make sure that their households are food secure before working outside the household farm. A higher wage rate will also mean that more of the men will go and work outside the farm and leave the women to work on farm.
Membership to an association	+	If the association gives advice to farmers on the best cassava farming practices, it is expected it will increase area under cassava production and hence more female labor will be required.
Distance to the market	-	If the cassava market is far from the household, it might discourage females from devoting a lot of time to its production, and hence the relationship is expected to be negative.
If household borrowed or not for cassava production	+	If a household borrowed, it means it invested more in cassava production, and hence more female labor might be required.

A priori expectations are shown in Table 3.3. Factors will be measured that affect the labor supplied by women in smallholder agriculture. This analysis will seek to ascertain which factors affect female labor supply, including the introduction of new cassava varieties with improved pest and disease resistance. Demographic variables will be included mainly to control for differences in the human resource base available in the household. Economic

variables, for example prices of crops, will also be included in the model. It is also essential to include variables on improved varieties such as size of the land area allocated to an improved variety as these variables are likely to affect the female labor being supplied by the household in the production of the cassava.

❖ **Probit regression**

Probit models will be run to assess the determinants of decision making in the household. The dependent variable is binary (0= husband makes the decision or 1= wife makes the decision) hence the use of the probit instead of ordinary least squares. Either the logit or probit can be used for analyses as they are statistically similar. The respondents were asked to identify who made the decisions regarding different activities in cassava production and processing and who controlled income from improved and traditional cassava. Their responses were either, the respondent made the decision, their spouse made it, it was predominantly their spouse or it was joint decision making.

The probit model assumes that the observed dependent variable (Y) is generated by the unobserved latent variable Y^* such that $Y^* = X\beta + \varepsilon$, where ε follows a normal distribution with mean 0 and variance 1. Empirically, Y =1 if $Y^* > 0$; and Y<=0, which follows that:

$Pr(Y=1|X) = \Phi (X\beta)$, where Φ is the standard cumulative normal probability distribution and $X\beta$ is the probit index.

This model will be used to estimate if women are involved or lose decision making power in households that adopt improved cassava varieties, and to determine the factors affecting decision making. The independent variables will include socioeconomic variables such as

the market distance and the adoption variable (whether or not a household adopted). More specifically, the explanatory variables to be included in the model are adoption(whether or not the household adopted), area under improved cassava, total land area, number of children in the household, percent of females providing labor in the household, market distance, membership in an organization and gender of the respondent.

Marginal effects can be computed to interpret the coefficients on the independent variables more easily. The impact of the explanatory variables on the probability of the wife making the decision (Y=1) can be evaluated by taking the partial derivatives on the probability equations. The marginal effect of the one of the independent variables for example area under improved cassava varieties (*cassA*) on the probability of the wife making the decision is:

$$\partial \Pr[Y = 1] / \partial cassA = -\phi(\boldsymbol{\beta}'\mathbf{x}) * (\hat{\beta}_1)$$

Where ϕ the normal density is function and $\hat{\beta}_1$ is the coefficient on *cassA*. The interpretation is that a one hectare increase in area under improved cassava varieties increases/ decreases the probability of the wife making the decision by the calculated amount. Results from the analysis will be presented and discussed in Chapter 4.

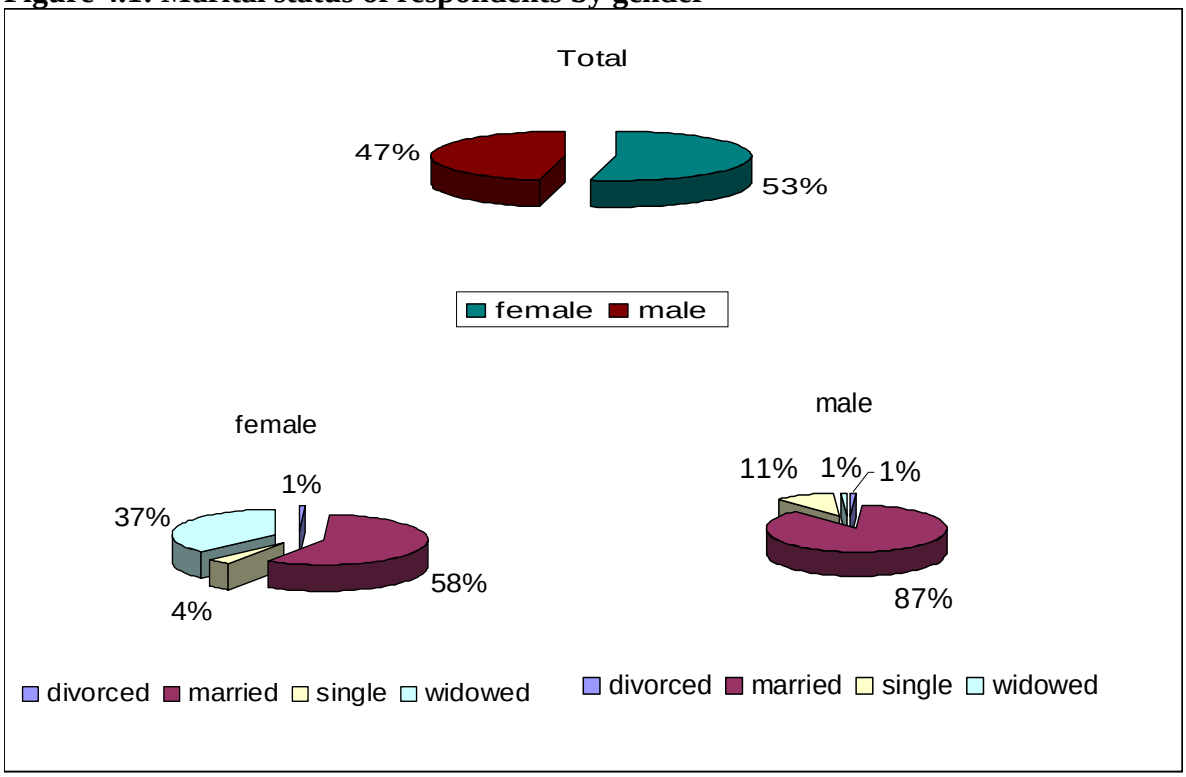
CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents and discusses the results of the study. The chapter is divided into five main sections: descriptive analysis of the households used in analyses, income control, decision making by households, determinants of female labor supply and spending priorities for men and women with and without adoption of improved cassava varieties.

4.1. Descriptive analysis

A total of 198 respondents provided the data that was used for analysis. Fifty three percent were females and 47% were males. Amongst the total respondents, 142 were married, 40 widowed and the rest were either single or divorced ((Figure 4.1).

Figure 4.1: Marital status of respondents by gender



Source: Survey data

Forty three percent of the married respondents were females. Very few of the respondents were either divorced or single with both of them combined contributing only about 8% of the respondents. Of the 40 respondents that were widowed, only 1 is male. This maybe because when husbands lose their wives they usually remarry unlike their female counterparts.

The mean ages were 47 for the males and 48 for the females. The number of years males and females spend at school was significantly different at the 5% level of significance. The males have two more years in school compared to the females. The average household size was 10 with close to half being children. More than half of the household members provide family labor on the farm. Tables 4.1 and 4.2 summarize some of the variables differentiated by gender for all the respondents.

The average number of men and women providing on farm labor per household is almost the same (1.87 for the females and 1.83 for the males). There are significant differences in the total land area and total land area cultivated at the 5% and 10% levels respectively that were reported by the males and females. Households own more than half of their land. Most of the respondents have attended school with only 20% and 8.6% of the females and males respectively having no formal education. Forty- four percent of the females and 35.5% of the males have attended primary school. As the level of education increases, there is a higher percentage of males compared to females. The results indicate that there is an association between gender and education level at the 5% level of significance ($p< 0.05$). Most often, because of cultural factors men have more access to education compared to women in the rural areas.

Table 4.1: Summary statistics for continuous variables

	Total(N=198)	Female (N=105)	Male (N=93)	t
	Mean	Mean	Mean	
Age (years)	47.74	47.30	48.24	-0.494
Education (years)	8.60	7.70	9.61	-2.699**
Household size	10.20	9.95	10.47	-0.633
Number of children	4.60	4.33	4.90	-1.427
Number of adults	5.60	5.62	5.57	0.076
Family labor	5.89	5.41	6.44	-1.387
Female labor	1.87	1.73	2.02	-1.050
Male labor	1.83	1.57	2.13	-1.940
Child labor	2.21	2.13	2.31	-0.483
Market distance (km)	2.50	2.39	2.62	-0.808
School distance (km)	1.17	1.12	1.24	-0.705
Farming experience (years)	23.51	22.73	24.38	-0.877
Total land area (ha)	2.31	1.68	3.03	-2.396**
Total land: Owned (ha)	1.82	1.45	2.24	-2.569**
Rented (ha)	0.31	0.18	0.46	-1.310
Leased (ha)	0.19	0.06	0.33	-0.909
Cultivated: Owned (ha)	1.26	1.12	1.42	-1.678
Rented (ha)	0.21	0.15	0.27	-1.051
Leased (ha)	0.03	0.04	0.01	1.121
Total cultivated (ha)	1.49	1.31	1.70	-2.055*

Source: Survey data
*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

More than half of the females and 68.9% of the males indicated that they had contact with an extension agent. There is no association between gender and source of capital for use on the farm. A significant number of both females (80%) and males (87%) indicated that their source of capital was personal savings usually from crop sales and trading. Only 1.9% of the females and 4.3% of the males said they borrowed from the bank. This may be due to lack of access to credit, high interest rates or lack of collateral. About a quarter of the females and 18% of the males indicate that they borrowed form an ‘isusu’. The ‘isusu’ financial system is a form of Rotating Savings and Credit Associations (ROSCAs), which is common in most African countries because of the low interest and default rate. Almost

all the households hire labor for most of the activities involved in cassava production. A significant proportion of females (41%) and males (39%) said they borrowed to fund cassava production.

Table 4.2: Chi squared tests for non continuous variables

	Female(N=105)	Male (N=93)	chi	pr
	Yes (%)	Yes (%)		
No formal education	20.00	8.60		
Primary Education	43.81	35.48	9.9652	0.019
Secondary Education	20.95	36.56		
Tertiary Education	15.24	19.35		
Contact with extension agent	56.91	68.82	3.3416	0.068
Membership to organization	85.71	80.65	0.9124	0.339
Source of capital : Savings	80.00	87.10	1.7884	0.181
Bank	1.90	4.30	0.9638	0.326
Isusu	26.67	18.28	1.9754	0.160
Lender	2.86	5.38	0.8073	0.369
Did household hire labor	97.14	98.92	0.7911	0.374
Borrowed loan for cassava production	40.95	39.10	0.1034	0.748
Purchased land for cassava production	38.10	32.35	0.7352	0.391

Source: Survey data

Table 4.3 gives a summary of area allocated by crop and the percentage of respondents who are actually growing the crops. Eighty–seven percent of the respondents grow improved cassava varieties on an average area of 0.98 ha. About 66% of the total cultivated area is dedicated to improved cassava production followed by the traditional cassava which gets 51% of the area. Cassava is the main staple crop for people in Nigeria and hence most of the land area is allocated to the crop. Households however still plant the traditional cassava varieties despite having access to the new and improved ones. Around three-quarters of the households using improved cassava still produce the traditional varieties on an area ranging from 0.01ha to 8 ha. Some of the reasons respondents gave for sticking to the traditional varieties are that roots of most of the improved varieties rot easily and, hence

they will not be able to store them for a long time and they have less starch compared to the traditional varieties. Most of the households practice intercropping and hence the area allocated for some of the crops is similar. Okra has the least area with only 9% of the respondents growing the crop.

Table 4.3: Summary statistics of crop production

Crop	% growing crop	Mean area(ha) (N=198)
Improved cassava	86.87	0.98
Traditional cassava	78.79	0.76
Yam	52.53	0.52
Maize	50.00	0.67
Melon	19.70	0.12
Okra	9.09	0.05
Vegetables	25.25	0.18
Cocoyam	18.18	0.13

Source: Survey data

Table 4.4: Perceptions on increased income, satisfaction, happiness and changed priorities for households using improved varieties

	Female		Male		chi	pr
	(%) yes	N	(%) yes	N		
Is there increased income	98.84	86	100	81	0.9475	0.330
Happy with income	96.55	87	93.83	81	0.6866	0.407
Satisfied with amount of income controlled	35.63	87	42.50	80	0.8269	0.363
Changes in spending priorities	82.46	57	83.93	56	0.0438	0.834
		df=1				

Source: Survey data

The summary results in Table 4.4 indicate that almost all the households say that they have increased income ever since they started using improved cassava varieties. A significant proportion of both men and women (97% and 94%) are happy with the amount of income that they have now. However, less than half of both the men and women are satisfied with

the amount of income that they are controlling as individuals in the household. There is however no significant association between the gender of the respondent and responses.

4.2. Income control from crop sales

None of the income control variables show significant association at the 5% level ($p<0.05$) between gender and who controls the income except income control for traditional cassava. More than half of the respondents indicated that both the husband and the wife control the income from the sale of all the crops in Table 4.5 except for vegetables.

Table 4.5: Income control for crops that are sold (% of respondents)

		N	Wife	Husband	Both	df	chi	pr
Traditional cassava	female	38	28.95	2.63	68.42	2	14.939	0.001
	male	52	11.54	34.62	53.85			
Improved cassava	female	29	31.03	13.79	55.17	2	4.358	0.113
	male	49	12.24	22.45	65.31			
Yam	female	16	31.25	18.75	50.00	2	5.267	0.072
	male	37	8.11	37.84	54.05			
Maize	female	23	17.39	8.70	73.91	2	4.642	0.098
	male	47	10.64	31.91	57.45			
Melon	female	12	25.00	0.00	75.00	2	5.539	0.063
	male	6	0.00	33.33	66.67			
Vegetables	female	12	41.67	16.67	41.67	2	3.178	0.204
	male	10	10.00	40.00	50.00			
Cocoyam	female	6	0.00	-	100.00	1	2.215	0.137
	male	10	30.00	-	70.00			

Source: Survey data

Sixty-five percent of the males compared to 55% of the females said that both the husband and the wife control the income from improved cassava. Thirty-one percent of the women say they control the income while only 14% of the women say the husband controls the income

Without adoption, around 76% of the respondents indicate that both the husband and wife control income from traditional cassava (Table 4.6). The proportion of respondents, who say both, decreases to 57% for those who adopt the new cassava varieties. There is an increase in the number of respondents who say that the wife controls the income from traditional cassava from 15.4% to 22%. The number of respondents who say that the husband controls the income is almost half of those indicating it is the wife, without adoption.

Table 4.6: Cassava income control

	Traditional cassava		Improved cassava
	Without adoption (%)* N=13	With adoption (%) N=77	(%) N=78
Both	76.92	57.14	61.54
Wife	15.38	22.08	19.23
Husband	7.69	20.78	19.23

***% of respondents**

The proportion of respondents who say that the husband or the wife controls the income from improved cassava sales is the same. The control of income from improved cassava varieties is mainly by both the husband and the wife, with over half of the respondents stating this.

4.3. Decision making in cassava production, processing and marketing and on spending

Tables 4.7 and 4.8 show results of analyses on decision making for the married respondents. All the decision making variables except family labor allocation, whether the cassava will be processed or stored, and decision to borrow for cassava production, show that there is a significant association between the gender and the decisions to be made. The

results indicate that both genders claim that they are the ones who make the decisions concerning cassava production. Overall, the analysis indicates that the married couples both make the decisions. Thirty-seven percent of the married females said that they made the decision on whether or not the household should adopt the improved cassava varieties while 16% said that it was their husbands who decided. On the male side, 46% said that it was their decision while only 12.5% said their wives made the decision.

Table 4.7: Decision making matrix for cassava production, processing and marketing

Decision to:		N	Wife (%)	Husband (%)	Both Equally (%)	Predominantly husband (%)	Predominantly wife (%)	df	chi	pr
Adopt	female	51	37.25	15.69	47.06	-	0	3	17.2031	0.001
	male	72	12.50	45.83	40.28	-	1.39			
Family labor allocation	female	61	26.23	21.31	39.34	3.28	1.64	5	5.6493	0.342
	male	81	38.27	18.52	35.80	4.94	0			
Hire labor	female	59	38.98	10.17	47.46	3.39	-	3	29.7035	0.000
	male	80	6.25	33.75	60.00	0.00	-			
Farm inputs	female	61	44.26	8.20	42.62	3.28	1.64	4	31.636	0.000
	male	81	7.41	34.57	51.85	4.94	1.23			
Process/Store	female	60	51.67	11.67	35.00	1.67	-	3	6.2649	0.099
	male	79	34.18	20.25	45.57	0.00	-			
Sell	female	61	44.26	21.31	31.15	3.28	-	3	12.2038	0.007
	male	79	18.99	26.58	53.16	1.27	-			
Borrow	female	18	27.78	16.67	50.00	5.56	-	3	5.0575	0.168
	male	31	6.45	35.48	51.61	6.45	-			
Purchase land	female	23	34.78	21.74	39.13	4.35	-	3	16.0695	0.001
	male	29	0.00	62.07	37.93	0.00	-			

Source: Survey data

Decisions on how much to spend on what are being made by both the husband and wife as shown in Table 4.8. More than half of the respondents whether, male or female indicated that they made the decisions jointly except for alcohol. None of the men said that the wife makes the decision regarding how much to spend on school fees, health, inputs and at funerals. Men are mostly the ones who drink alcohol and hence the reason why 83% of the

women and 70% of the men said it was the husband who made that decision. About 30% of the men and 17% of the women said that they both made the decision on how much to spend on alcohol.

Table 4.8: Decision making on spending

		N	Wife (%)	Husband (%)	Both (%)	df	chi	pr
School Fees	female	47	21.28	12.77	65.96	2	19.4789	0.000
	male	70	0.00	32.86	67.14			
Food	female	45	22.22	13.33	64.44	2	12.4229	0.002
	male	57	1.75	28.07	70.18			
Health	female	45	22.22	13.33	64.44	2	18.0654	0.000
	male	66	0.00	30.30	69.70			
Hired Labor	female	44	22.73	6.82	70.45	2	18.9376	0.000
	male	68	1.47	29.41	69.12			
Inputs	female	43	23.26	6.98	69.77	2	21.5812	0.000
	male	67	0.00	28.36	71.64			
Death	female	26	7.69	3.85	88.46	2	7.7666	0.021
	male	39	0.00	25.64	74.36			
Alcohol	female	6		83.33	16.67	1	0.4431	0.506
	male	30		70.00	30.00			

Source: Survey data

Only 22% of wives said that they make the decision on health expenditure while none of the men supported that view. A significant amount of the men (70%) said that both the husband and wife made the decision. Spending decisions for the farm such as hired labor and inputs are mostly made by both the husband and the wife. The results show significant differences between household decision making and gender of the respondents ($p < 0.05$) for all the decision making variables on spending except for alcohol.

4.2.1. Comparison of decision making with and without adoption

Chi squared tests on those who adopted improved cassava varieties and those who did not were done to compare differences with and without adoption (Tables 4.9 to 4.11). Without adoption, 78% of the males and 33% of the females indicated that it was the decision of the wife to allocate family labor (Table 4.9). However with adoption of the improved varieties only 33% of the males indicate that it is the wife's decision to allocate family labor (Table 4.10). Hence, there may be less decision making power for the women regarding family labor allocation.

Table 4.9: Decision making without adoption of improved varieties (% of respondents)

	*	N	Wife	Husband	Both	Predominantly husband	Predominantly wife	Other	df	chi	pr
Family labor allocation	f	9	33.33	11.11	44.44	-	-	11.11	3	4.400	0.221
	m	9	77.78	11.11	11.11	-	-	0.00			
Farm inputs	f	9	33.33	0.00	55.56	11.11	-	-	4	4.0909	0.252
	m	9	11.11	22.22	66.67	0.00	-	-			
Hired labor	f	7	28.57	14.29	57.14	-	-	0.00	3	1.2134	0.545
	m	9	11.11	33.33	55.56	-	-	9.09			
Cassava processing/storing	f	9	44.44	0.00	55.56	-	-	0.00	3	4.800	0.091
	m	9	11.11	33.33	55.56	-	-	9.09			
Sales	f	9	44.44	0.00	55.56	-	-	0.00	3	9.1111	0.011
	m	9	0.00	55.56	44.44	-	-	9.09			
Loan	f	2	50.00	0.00	50.00	-	-	-	2	2.2222	0.329
	m	3	66.67	33.33	0.00	-	-	-			
Purchase land	f	3	33.33	33.33	33.33	-	-	-	2	1.3333	0.513
	m	3	0.00	66.67	33.33	-	-	-			
SPENDING											
School fees	f	8	25.00	12.5	62.5	-	-	0.00	3	3.2813	0.194
	m	7	0.00	0.00	100	-	-	11.11			
Food	f	8	25.00	0.00	75.00	-	-	0.00	3	2.9464	0.229
	m	7	0.00	14.29	85.71	-	-	11.11			
Health	f	7	28.57	14.29	57.14	-	-	0.00	3	2.8571	0.240
	m	5	0.00	0.00	100	-	-	14.29			
Hired labor	F	6	16.67	-	83.33	-	-	0.00	2	1.0909	0.296
	m	6	0.00	-	100	-	-	12.50			
Inputs	F	7	28.57	0.00	71.43	-	-	0.00	3	2.9405	0.230
	m	6	0.00	16.67	83.33	-	-	12.50			
Death	F	4	25.00	-	75.00	-	-	0.00	2	0.600	0.439
	m	2	0.00	-	100	-	-	25.00			
Alcohol	F	-	-	-		-	-				
	m	2	-	-	100	-	-	25.00			

*f and m denote female and male respectively

There is a higher percentage of women saying the husband makes the labor allocation decision from 11.1% to 23.1%.

Table 4.10: Decision making with adoption of improved varieties (% of respondents)

		N	wife	husband	both	Predominantly husband	Predominantly wife	Other	df	chi	pr
Family labor allocation	f	52	25.00	23.08	38.46	3.85	1.92	7.69	5	4.9541	0.422
	m	72	33.33	19.44	38.89	5.56	0.00	2.78			
Farm inputs	f	52	46.15	9.62	40.38	3.85	0.00	-	5	65.5742	0.000
	m	72	6.94	36.11	50.00	5.56	1.39	-			
Hired labor	f	52	40.38	9.62	46.15	3.85	-	-	4	66.8989	0.000
	m	71	5.63	33.80	60.56	0.00	-	-			
Cassava processing/selling	f	51	52.94	13.73	31.37	1.96	-	-	4	21.7237	0.000
	m	70	37.14	18.57	44.29	0.00	-	-			
Sales	f	52	44.23	25.00	26.92	3.85	-	-	4	37.3630	0.000
	m	70	21.43	22.86	54.29	1.43	-	-			
Loan	f	16	25.00	18.75	50.00	6.25	-	-	4	29.3240	0.000
	m	28	0.00	35.71	57.14	7.14	-	-			
Purchase land	f	20	35.00	20.00	40.00	5.00	-	-	3	28.6746	0.000
	m	26	0.00	61.54	38.46	0.00	-	-			
SPENDING											
School fees	f	39	20.51	12.82	66.67	-	-	-	3	44.8013	0.000
	m	63	0.00	36.51	63.49	-	-	-			
Food	f	37	21.62	16.22	62.16	-	-	-	3	7.8077	0.050
	m	50	2.00	30.00	68.00	-	-	-			
Health	f	38	21.05	13.16	65.79	-	-	-	3	48.3643	0.000
	m	61	0.00	32.79	67.21	-	-	-			
Hired labor	f	38	23.68	7.89	68.42	-	-	-	3	48.5581	0.000
	m	62	1.61	32.26	66.13	-	-	-			
Inputs	f	36	22.22	8.33	69.44	-	-	-	3	50.8045	0.000
	m	61	0.00	29.51	70.49	-	-	-			
Death	f	22	4.55	4.55	90.91	-	-	-	3	19.4475	0.000
	m	37	0.00	27.03	72.97	-	-	-			
Alcohol	f	6	-	83.33	16.67	-	-	-	4	11.9179	0.018
	m	28	-	67.86	32.14	-	-	-			

*f and m denote female and male respectively

In terms of inputs such as cassava stems, for adopters there is a greater percentage of females who say that the wife makes the decision, while there is a smaller number of males who say so. There is also a decrease in the proportion of both the males and the females who say that the decision is made jointly by the husband and wife (Table 4.11). The association between gender and decision on farm inputs is significant with adoption ($p< 0.05$).

Women provide more labor in cassava processing and marketing. Forty- four percent of women say that they make the decision on how much cassava is processed or stored without adoption. If they do adopt, 37% of the men indicate that their wives make the decision.

Table 4.11: Decision making with and without adoption by gender (%of respondents)

Decision on:			With	Without		Spending on:		With	Without	
		a	33.33	25.00	↓			25.00	20.51	↓
	female	b	11.11	23.08	↑		Female	12.50	12.82	↑
		c	44.44	38.46	↓	**School fees**		62.50	66.67	↑
Family labor allocation		a	77.78	33.33	↓			0.00	0.00	nc
	male	b	11.11	19.44	↑		Male	0.00	36.51	↑
		c	11.11	38.89	↑			100.00	63.49	↓
		a	33.33	46.15	↑			25.00	21.62	↓
	female	b	0.00	9.62	↑		Female	0.00	16.22	↑
		c	55.56	40.38	↓	**Food**		75.00	62.16	↓
Inputs		a	11.11	6.94	↓			0.00	2.00	↑
	male	b	22.22	36.11	↑		Male	14.29	30.00	↑
		c	66.67	50.00	↓			85.71	68.00	↓
		a	28.57	40.38	↑			28.57	21.05	↓
	female	b	14.29	9.62	↓		Female	14.29	13.16	↓
		c	57.14	46.15	↓	**Health**		57.14	65.79	↑
Hired labor		a	11.11	5.63	↓			0.00	0.00	nc
	male	b	33.33	33.80	↑		Male	0.00	32.79	↑
		c	55.56	60.56	↑			100.00	67.21	↓
		a	44.44	52.94	↑			16.67	23.68	↑
	female	b	0.00	13.73	↑		Female	-	7.89	↑
		c	55.56	31.37	↓	**Hired labor**		83.33	68.42	↓
Processing/storing		a	11.11	37.14	↑			0.00	1.61	↑
	male	b	33.33	18.57	↓		Male	-	32.26	↑
		c	55.56	44.29	↓			100.00	66.13	↓
		a	44.44	44.23	↓			28.57	22.22	↓
	female	b	0.00	25.00	↑		Female	0.00	8.33	↑
		c	55.56	26.92	↓			71.43	69.44	↓
Sales		a	0.00	21.43	↑	**Inputs**		0.00	0.00	nc
	male	b	55.56	22.86	↓		Male	16.67	29.51	↓
		c	44.44	54.29	↑			83.33	70.49	↓
		a	50.00	25.00	↓			25.00	4.55	↓
	female	b	0.00	18.75	↑		Female	-	4.55	↑
		c	50.00	50.00	nc			75.00	90.91	↑
Loan		a	66.67	0.00	↓	**Death**		0.00	0.00	nc
	male	b	33.33	35.71	↑		Male	-	27.03	↑
		c	0.00	57.14	↑			100.00	72.97	↓
		a	33.33	35.00	↓			-	-	nc
	female	b	33.33	20.00	↓		Female	-	83.33	↑
		c	33.33	40.00	↑			-	16.67	↑
Purchase land		a	0.00	0.00	nc	**Alcohol**		-	-	nc
	male	b	66.67	61.54	↓		Male	-	67.86	↑
		c	33.33	38.46	↑			100.00	32.14	↓

Source: Survey data
↑, ↓ and nc denotes higher, lower and no difference respectively in the percentage of people
a=wife, b=husband, c= both

Fifty-six percent of the women compared to 44.4% of men indicate that both the husband and the wife make the decision regarding how much cassava should be processed or stored

if they are non adopters, while with adoption, it is only 27% of the women and more than half of the men. Forty four percent of women say that the wife makes the decision. The results show a significant relationship between gender and the decision on how much cassava should be processed or stored, both with and without adoption at the 5% level of significance.

On the decision about how much cassava to sell, without adoption none of the males indicate that the wife makes the decision and vice versa. With adoption however, there is an increase in the proportion to 21.5% and 25% of the males and females respectively indicating that their spouses make the decision. There is a significant relationship between the gender and the decision on cassava sales with and without adoption at the 5% level of significance. There is an increase in the proportion of males that say that both the husband and the wife make the decision while there is a decrease in the proportion of females saying that.

The results on the decision to hire labor for cassava production show a significant association with gender at the 1% level with adoption of improved cassava varieties. There is an increase in the demand for labor with adoption and more than half of the males (56%) say that both the husband and the wife make the decision without adoption. With adoption, 60.6% of the males and 46% of the females say they both make the decision.

Investment decisions such as borrowing or purchasing land for use in cassava production are normally made by men assuming they control the income in the household. A significant number of both men and women (50% and 66.7%) indicated that it was the wife

who made the decision on whether or not to borrow without adoption, while 33% of the males said it was the husband who made the decision. For users of improved varieties none of the males said that their wives make the decision on land purchase or borrowing. The percent of females who said that the wife makes the decisions also is lower for adopters. The number of men who said both husband and wife for the two decisions however was higher while it remained unchanged for the women. The results for the non adopters are not significant at the higher levels of significance, while for the adopters there is significant association between gender and land purchase decision at the 1% level ($p<0.01$), and for borrowing at the 5% level. Not a single man said his wife makes the decision regarding land purchase, and this is as is expected. They could however be jointly making the decision in the household.

Spending decisions with and without adoption of improved cassava varieties were also analyzed. Without adoption, more than half of both males and females indicated that they jointly made the spending decisions regarding school fees, food, health, hired labor, inputs and funeral costs. With adoption, fewer of the females said that both the husband and the wife make some of the decisions (83% versus 68% for hired labor, 71% versus 69% for inputs). Without adoption, none of the males indicated that the wives made all the spending decisions. The same results were obtained with adoption except for the food and hired labor spending decision where only 2% and 1.6% of the males respectively said that their wives made the decision. These results show significant association between gender and who makes the decision at the 1% level of significance with adoption ($p<0.01$).

From the results, it is difficult to conclusively say whether or not women lose decision making control. For both males and females, there is an increase in the proportion of either of them who say that they make the decision for four of the decisions. Further analysis using an ordered probit model will be used to determine whether or not adoption of improved varieties decreases women's decision making power. Results are in section 4.4.

4.4. Probit analysis for decision making

Probit models were used to assess if there is less decision making power for women in households that adopt improved cassava varieties. A probit model was used because the dependent variable is binomial (y=0 if husband makes the decision and y=1 if the wife makes the decision). Analysis that was done before using chi-squared tests showed an association between gender of the respondent and decision making, but could not conclude if there was a more, less or no change in women's decision making power within the household due to the adoption of improved cassava varieties.

For all the decision making variables on cassava production, processing and marketing, and spending, the percent of females providing labor in the household has no significant impact on female decision making except on the decision on sales and school fees spending (Tables 4.12 and 4.13). Spending decisions for inputs, food and school fees borrowing for cassava production show a decrease in women involvement in decision making at the 10% level with adoption of improved cassava varieties. The negative sign on area under improved cassava varieties for improved cassava income control indicates that there is a decrease in income control for women with an increase in the area allocated to improved

varieties. This result is the same for the decision on processing/storing and on how much cassava should be sold.

Table 4.12: Probit analysis for decision making in cassava production, processing and marketing

	Inputs	Family labor	Processing/ storing	Sales	Hire labor	Borrow
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Constant	0.943	0.514	0.324	0.111	0.066	1.517*
Adoption	-0.741	-0.605	0.065	0.201	-0.005	-1.417*
Area under improved cassava	-0.118	0.037	-0.223	-0.186	-0.035	0.234
Total land	0.005	-0.063	-0.004	-0.012	0.075	0.136
Number of children	0.119**	-0.012	0.162***	0.104***	0.002*	0.028
Percent of female labor	0.005	-0.003	0.008	0.009*	0.000	0.013
Market distance	-0.001	0.060	-0.077	-0.083	0.293	-0.019
Membership to organization	0.756**	0.787***	0.553**	0.428	-1.090	-
Male	-1.349***	0.342	-0.684***	-0.454**	0.767***	-1.260***
N	180	180	176	178	176	66
Pseudo R-squared	0.240	0.082	0.182	0.126	0.158	0.209

*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

Table 4.13: Probit results for cassava income control and spending decisions

	Income control		**Spending decisions**				
	Improved cassava	**Traditional cassava**	**Hired labor**	**Inputs**	**Food**	**School fees**	**Health**
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Constant	-0.291	2.498***	1.069	2.380***	2.064***	2.735***	2.316***
Adoption	-	-0.776	-	-1.258*	-1.082*	-0.920*	-0.840
Area under improved cassava	-0.183	0.076	0.203	0.316	-0.135	0.105	0.261
Total land	0.038	-0.056	-0.012	0.023	0.154	-0.006	-0.022
Number of children	0.128	0.128*	0.121**	0.112*	0.081	0.011	0.048
Percent of female labor	0.015	0.010	0.003	-0.004	-0.002	-0.009*	-0.007
Market distance	0.013	-0.035	0.013	0.053	0.159*	0.048	0.074
Membership to organization	0.819**	-0.382	-0.207	-0.158	-0.645	-0.372	-0.305
Male	-0.722*	-1.981***	-1.517***	-1.498***	-0.867***	-1.105***	-1.235***
N	90	115	127	141	130	148	143
Pseudo R^2	0.192	0.313	0.216	0.247	0.171	0.159	0.190

*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

The number of children is a significant variable for the decision on: what inputs to buy, processing/storage, sales, hiring labor, traditional cassava income control and spending decisions on hired labor and inputs. There is more female decision making for these decisions with an increase in number of children. Decisions about family labor allocation, what inputs to buy, processing/storing, cassava sales and improved cassava income control

have a significant positive impact on female decision making power with respect to membership in an organization.

4.4.1. Marginal effects from probit analyses

The probit results only showed the relationship between greater female decision making power (dependent variable) and the explanatory variables but not the magnitude of the negative/positive effects. Marginal analysis was completed for all the decision making variables from the probit analysis. Results are shown in Table 4.14a and b. Marginal effects were computed for the probability that the decision is made by the woman that is: pr(y=1) at the mean values for all the independent variables.

Table 4.14a: Marginal effects on decision making in cassava production, processing and marketing

	Family labor allocation		Inputs		Processing/ Storing		Sales		Hire labor		Borrow	
	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.
Adoption	-15.75	0.042	-14.34	0.023	1.37	0.881	5.99	0.601	1.78	0.864	-23.93	0.002
Area under improved cassava	1.15	0.766	-3.02	0.396	-4.57	0.139	-5.23	0.168	-0.15	0.968	6.80	0.436
Total land	-1.96	0.112	0.14	0.877	-0.08	0.925	-0.33	0.773	-0.92	0.343	3.95	0.389
Number of children	-0.37	0.772	3.06	0.016	3.30	0.002	2.94	0.022	1.99	0.099	0.82	0.701
% of female labor	-0.09	0.526	0.12	0.392	0.15	0.172	0.24	0.086	0.06	0.661	0.36	0.276
Market distance	1.87	0.291	-0.04	0.983	-1.57	0.254	-2.33	0.146	0.01	0.997	-0.55	0.890
Membership to organization	27.94	0.008	23.59	0.024	13.75	0.121	13.44	0.174	8.42	0.360	-	-
Male	10.66	0.116	-35.07	0.000	-14.31	0.009	-12.90	0.045	-28.98	0.000	-36.16	0.001

Table 4.14b: Marginal effects on spending decisions and income control

	Traditional cassava income control		Improved cassava income control		Spending on hired labor		Spending on Inputs		Spending on food		Spending on education		Spending on health	
	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.	% Change in probability	Sig.
Adoption	-8.32	0.075	-	-	-	-	-11.98	0.002	-16.47	0.002	-15.20	0.006	-12.90	0.019
Area under improved cassava	1.19	0.690	-3.95	0.347	4.75	0.179	5.57	0.151	- 3.16	0.440	2.50	0.473	5.80	0.148
Total land	-0.88	0.438	0.82	0.497	-0.27	0.790	0.40	0.857	3.58	0.216	-0.14	0.875	-0.50	0.631
Number of children	2.01	0.078	2.76	0.149	2.82	0.043	1.98	0.078	1.89	0.162	0.27	0.837	1.06	0.397
% of female labor	0.16	0.248	0.33	0.091	0.06	0.675	-0.07	0.555	-0.04	0.783	-0.21	0.090	-0.16	0.205
Market distance	-0.56	0.702	0.29	0.896	0.31	0.881	0.94	0.558	3.71	0.065	1.16	0.497	1.65	0.366
Membership to organization	-5.00	0.340	22.48	0.072	-4.47	0.597	-2.59	0.697	-11.60	0.109	-7.74	0.294	-6.03	0.410
Male	-35.33	0.000	-14.98	0.047	-34.24	0.000	-26.92	0.000	20.37	0.003	-26.41	0.000	-27.80	0.000

For those households that adopted, there is a significantly lower probability that the wife makes the decision by 16%, 14% and 24% on the decision with respect to family labor allocation, what inputs to buy and borrowing for cassava production respectively. The probability that the wife is involved in the decision making process for spending on inputs, food and education decreases by 12% , 15%, and 16% respectively with adoption at the 5% level of significance.

If the respondent is a male, there is a smaller probability that the wife makes the decision at the 5% and 10% levels of significance for all the decision making variables except for food spending decision where there is an increase in the probability. The highest decrease in probability is for the decision to borrow, which is 36%, indicating that the males make the investment decisions.

A 1% increase in the females providing labor in the household increases the probability that the wife is involved in the decision making process by 0.24% and 0.32% for the decision on sales and improved cassava income control. Membership in an organization increases the probability that the wife is involved in the decision making process for family labor allocation and for improved cassava income control.

4.5. Labor allocation with and without adoption of improved cassava for production, processing, and marketing

In the household, men and women allocate different times for different activities. In this section, independent samples t-tests were used to assess labor allocation for men and women in cassava production, processing and marketing for adopters and non adopters of

improved cassava varieties and time allocation for household chores. The activities that were analyzed are; clearing, plowing, planting, fertilizer application, weeding, harvesting, processing and marketing.

T- Tests assume random selection of samples, independence between the samples and that the population is normally distributed. Tests for equal variance were done in order to conclude whether to use the independent samples test with equal or unequal variance (H_0:$\sigma_1=\sigma_2$). The Levene F- test was used to assess if there were significant differences in the variances with and without adoption. For all the variables $p< 0.05$, hence the null hypothesis that the variances were equal was rejected and it was concluded that there were significant differences in the variances with and without adoption. Thus the independent samples t-test assuming unequal variances was used.

There are significant differences in the total female labor and total hired female labor with and without adoption (Table 4.15). Results show that women allocate on average higher total person days to cassava production, processing, and marketing with adoption compared to without (65 vs. 35 person days). The null hypothesis that female labor without adoption is equal to female labor in cassava production, processing and marketing with adoption is rejected and it is concluded that there are statistically significant differences with and without adoption at the 5% level of significance for both family and hired labor. The results might be due to systematic differences between the two groups. Regression analysis in the next section will be used to determine if the increase in labor allocation is due to adoption of new varieties.

Table 4.15: T-tests for labor with and without adoption

	Total(N=198)	Without adoption(N=26)	With adoption (N=172)	t-value
	Mean	Mean	Mean	
total female	61.09	35.23	65.00	-2.056**
total male	41.75	31.38	43.32	-1.074
hired female	65.38	32.28	70.39	-2.694**
hired male	82.62	58.33	86.29	-1.462
child labor	28.75	31.12	28.40	0.181
adult male clearing	2.70	4.15	2.48	0.964
adult female clearing	1.67	3.23	1.44	1.006
adult male plowing	3.16	3.77	3.07	0.313
adult female plowing	1.37	2.27	1.24	0.788
adult male planting	3.75	2.77	3.90	-0.801
adult female planting	5.50	1.85	6.05	-3.689***
adult male fertilizer	1.71	0.38	1.91	-2.465**
adult female fertilizer	2.06	0.12	2.35	-4.188***
adult male weeding	4.70	3.04	4.95	-0.932
adult female weeding	9.57	4.12	10.39	-1.856*
adult male harvesting	6.60	5.38	6.78	-0.696
adult female harvesting	10.35	4.77	11.19	-2.572**
adult male processing	14.97	8.81	15.90	-1.617
adult female processing	22.82	14.65	24.06	-1.182
adult male marketing	4.11	2.96	4.28	-0.856
adult female marketing	7.59	3.31	8.24	-3.432***

Source: Survey data

*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

There is a potential increase in yields and land area allocated to cassava production, and since women are the major labor providers, it is expected that the amount of time they put into cassava production will increase. The t test for hired males shows no statistically significant differences without and with adoption at the higher levels of significance. There is more hired labor allocated to all the activities from planting to marketing for adopting households as compared to households without adoption. These increases can be attributed to a greater number of hired workers; hence less family labor is used. Households choose to hire more labor during clearing and plowing since these activities are more labor intensive.

However men usually do the clearing and plowing, and hence results indicate gender differences in terms of labor allocation.

The total family male labor provided by the households using improved cassava varieties is higher than the non adopters, but this increase is not statistically significant at higher levels of significance. The family labor that men provide is less than that of women with and without adoption, with a total mean of 42 person days compared to 61 person days for women. Children provide less total average person days for cassava production, processing and marketing for households that adopted compared to the households not using the improved cassava varieties

Women do most of the harvesting, with the men putting in less than half of the labor that women do (mean = 10.4 and 5 person days for the females and males respectively). There are statistically significant differences in the mean female person days for weeding at the 10% level of significance.

Women provide less labor than men for harvesting without the adoption of improved cassava varieties, but with adoption women double their average share of harvesting labor while for men labor allocation is higher by just about 1.4 person days. Cassava processing is mostly done by women both with and without adoption of improved cassava varieties. Women allocate more person days into processing in households that are using improved cassava varieties while they allocate less for non adopting households (24.1 vs. 14.7 person days. Women allocate more labor compared to men in both households using and not using improved cassava varieties. These results are similar to what other researchers have found.

Cassava is processed into flour which can be used to make ‘gari’ or ‘fufu’, and women are mostly responsible for this process.

Labor allocation for marketing of cassava is higher for both men and women in the households that adopted due to the increase in yields. Women provide more labor for cassava marketing than men. There are significant differences in the means for the labor provided by females for households with and without adoption. Going to the market normally requires use of a motorbike or a car, and households hire labor for this. Women can also carry the cassava bags on their heads to the market.

4.5.1 Time allocation for other household chores

In view of the fact that women spent time doing household chores in addition to the on farm activities, data were collected to assess if there are significant differences in the time that men and women spend doing certain chores (Table 4.16). There are significant differences in the time that is spent cooking, cleaning the house, washing clothes and rearing livestock between the two genders. Women spend more time compared to the males for all the activities that were analyzed except for fetching water, looking after children, feeding small livestock and rearing livestock.

The time women spend, cooking, cleaning the house, collecting firewood and washing clothes is higher than that for men. Men spend more time fetching water, collecting firewood, looking after children, feeding small livestock and rearing livestock compared to women. The time spent cooking and cleaning the house is statistically significant at the 1% level with differences between the means for males and females.

Table 4.16: Time allocation for other chores in the household by gender

Time spent:	Total (N=198)	Female (N=105)	Male(N=93)	t
	Mean	Mean	Mean	
Cooking	1.32	1.58	1.04	3.689***
Fetching water	0.66	0.67	0.68	-0.100
Cleaning the house	0.79	0.96	0.60	3.360***
Collecting firewood	1.73	1.97	1.47	1.857
Looking after children	1.93	1.87	2.01	-0.365
Washing clothes	1.32	1.47	1.15	2.372**
Feeding small livestock	0.47	0.38	0.56	-1.382
Livestock rearing	0.40	0.31	0.51	-1.989*

Source: Survey data
*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

There are statistically significant differences in the means for men and women for washing clothes and rearing livestock at the 5% and 10% level respectively. Contrary to belief, men reported that they spend 2 hours looking after children while women spend 1.87 hours. These results can be attributed to the fact that during the surveys the respondents were reporting time their spouses spent as opposed to theirs. This difference is however not statistically significant at the 10% level.

Table 4.17: Perceptions on time allocation with adoption

	Female		Male			
	N	Yes (%)	N	Yes (%)	Chi	P
Are household chores getting less time?	84	20.24	73	42.47	9.0912	0.003
Are income generating activities getting less time?	55	18.18	45	42.22	6.9471	0.008
			df=1			

The results show a significant association ($p<0.05$) between gender of the respondent and whether or not the household chores or income generating activities were getting less time

with adoption of improved cassava varieties (Table 4.17). Twenty percent of the women compared to 42.5% of the men reported that the household chores were getting less time with adoption. Only 18% of the women indicated that less time was being allocated to income generating activities with adoption. More than half of the women respondents are traders.

4.6. Determinants of female labor allocation in cassava production, processing and marketing

The T tests revealed that there are differences in the female labor allocation for cassava production, processing and marketing for households with and without adoption, however the tests were not enough to conclude that that the differences or the higher labor with adoption were due to improved cassava varieties. Multiple linear regression analyses were used to assess if the higher total female labor allocation with adoption is due to improved varieties. The factors that are significant determinants of female labor allocation in cassava production, processing and marketing are number of children in the household, percent of females providing labor on the farm, total land area and area under improved cassava varieties (Table 4.18).

There is a positive relationship between the total female labor allocation and number of children. It is expected that as the number of children increase the labor hours women put into cassava production decrease as women devote part of their time to care for them. However this is not the case. The unlikely relationship in which addition of one child to the family increases female labor allocation by 6.8 person days per year, all other factors constant, might be because increase in family size means more food will be required in the

household and therefore more time will be devoted to cassava production. The ages of the children also affect how much time is required for their care. If the children are able to provide labor on the farm and can take care of themselves without much supervision, then the females do not have to reduce the time they spend in cassava production, processing and marketing.

Table 4.18: Determinants of total female labor allocation in cassava production, processing and marketing

	Coefficients	T-values
(Constant)	-38.049	-1.05
Number of children	7.653	2.53**
Percent of female labor	0.771	2.37**
Total land	-7.473	-2.99***
Area under improved cassava	40.609	4.65***
Wage	0.014	0.40
Membership to organization	-0.680	-0.03
Market distance	-2.203	-0.53
Whether or not loan was borrowed	-3.406	-0.20
Male	24.306	1.48
F(10, 177) = 3.76		
R Square	0.159	
Adjusted R square	0.117	
N	189	

Source: Survey data
*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

Total land and area under improved cassava varieties both have significant impacts on total female labor supply at the 1% level of significance, with the later having a positive relationship while the former has a negative one. As expected, as the total land area increases, more female labor is needed for other crops as well, so less labor will be devoted to cassava production, processing and marketing. One more hectare of total land will decrease the total female person days by 7.5 person days per year, all things constant, while adding another hectare under improved cassava varieties will increase total female labor by

41 person days. If the land area under improved cassava varieties is increased, there is a potential increase in yield and hence more female labor will be required to work in the field and for harvesting and processing. Women provide most of the labor in cassava production hence total female labor allocation is expected to increase.

There is an expected significant positive relationship between the percent of females in the household providing on farm labor and the total female labor allocation at the 10% level of significance. As the percentage of females in the household increases, the more labor they will provide for cassava production, processing and marketing. A one percent increase in the proportion of females providing family labor on the farm increases total female labor allocation in cassava production processing and marketing by 0.77 person days per year, all things constant. The results indicate a negative relationship between the number of males providing labor and total female labor supply, but result is not significant. The wage rate has an expected positive impact on female labor allocation, but the coefficient is very small and not significant.

Multiple linear regression analysis was also done to assess factors determining female labor allocation at different levels in the production and marketing chain for the individual and combined activities and factors affecting male: female labor ratio and vice versa (Table 4.19 and 4.20). The area under improved cassava varieties has a positive significant relationship with all the dependent variables except for the female: male labor ratio.

Table 4.19: Determinants of female labor allocation for planting, weeding, harvesting, processing and marketing

	Planting		Weeding		Harvesting		Processing		Marketing	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
(Constant)	-2.142	-0.56	-24.253	-2.05**	2.772	0.31	2.688	2.13**	2.106	0.58
Number of children	0.718	2.25**	2.550	2.58**	0.061	0.08	0.228	1.68*	0.448	1.48
Percent of female labor	0.087	2.53**	0.290	2.73***	0.066	0.81	-2.752	-2.63***	0.025	0.78
Total land	-0.725	-2.75***	-2.321	-2.83***	-0.641	-1.03	14.374	3.94***	-0.484	-1.93**
Area under improved cassava	3.511	3.81***	12.698	4.44***	4.491	2.06**	0.008	0.58	2.749	3.14***
Wage	-0.001	-0.37	-0.002	-0.15	0.000	0.05	-4.518	-0.47	0.008	2.18**
Membership to organization	-0.694	-0.28	2.392	0.32	-0.556	-0.10	-0.891	-0.51	-2.742	-1.18
Market distance	-0.061	-0.14	-0.591	-0.43	0.333	0.32	2.103	0.30	-0.105	-0.25
Whether or not loan was borrowed	-1.142	-0.64	-1.101	-0.20	3.021	0.71	7.350	1.07	-2.883	-1.69*
Male	2.696	1.56	9.572	1.78*	0.695	0.17	-8.709	-0.58	-0.069	-0.04
N	189		189		189		189		189	
Prob > F	0.003		0.000		0.701		0.001		0.023	
R-squared	0.129		0.161		0.034		0.117		0.101	
Adjusted R-squared	0.085		0.119		-0.015		0.073		0.056	

*, ** and *** denotes significance at the 10%, 5% and 1% levels respectively

Table 4.20: Determinants for female labor allocation for cassava harvesting, processing and marketing and female: male labor ratio

	Harvesting, processing and marketing		Harvesting and processing		Processing and marketing		Female/Male labor	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
(Constant)	-3.830	-0.17	-5.936	-0.29	-6.603	-0.38	5.363	2.26**
Number of children	3.198	1.66	2.749	1.58	3.136	2.13	0.009	0.05
Percent of female labor	0.319	1.54	0.294	1.58	0.254	1.60	-0.033	-1.32
Total land	-3.877	-2.43**	-3.393	-2.36**	-3.236	-2.65***	0.203	1.18
Area under improved cassava	21.615	3.88***	18.865	3.76***	17.124	4.02***	-0.793	-1.33
Wage	0.016	0.74	0.009	0.44	0.016	0.94	0.000	0.03
Membership to organization	-7.817	-0.53	-5.074	-0.38	-7.260	-0.64	-1.363	-0.91
Market distance	-0.662	-0.25	-0.557	-0.23	-0.995	-0.49	0.819	2.70***
Whether or not loan was borrowed	2.242	0.21	5.125	0.53	-0.779	-0.09	-0.765	-0.67
Male	7.976	0.76	8.045	0.85	7.282	0.91	-3.568	-3.27***
N	189		189		189		144	
Prob > F	0.017		0.022		0.006		0.008	
R-squared	0.104		0.101		0.119		0.148	
Adjusted R-squared	0.059		0.056		0.074		0.091	

The number of children is statistically significant at the 5% levels for planting and weeding and at the 10% level for processing. All the variables that were significant in the model with total female labor supply as the dependent variable are also significant for planting and weeding and have the same signs on the coefficients and, hence the explanations that were given above for the determinants of the total female labor are the same for these models. The gender of the respondent is significant at the 10% level for weeding. The men are reporting 1.78 more person days per year for the time spent by women weeding.

Two new explanatory variables, wage and whether or not the household borrowed are significant for female labor allocation in marketing. If a household invested in cassava production by borrowing for production, female labor supply for marketing is 1.69 person days less per year. The relationship is however expected to be positive. If a household can invest and borrow, they might use the funds to hire additional labor for marketing the cassava, and hence the negative relationship.

The first three models for the combined activities in Table 4.20 have the same significant variables. The total land area and area under improved cassava varieties are negatively and positively statistically significant respectively and the explanation is the same as was given for the first model when total female labor allocation was the dependent variable. When the dependent variable is changed to be the ratio of female/ male total person days in cassava production, significant factors are percent of female providing labor, market distance and male. One more person day by men coupled by an increase in the market distance of one kilometer will increase the amount of female labor supply in cassava

production processing and marketing by 0.82 person days per year. The coefficient on the male variable indicates that for every one person day increase in male labor, total female labor will decrease by 4 person days for the male respondents compared to the female, holding all the other factors constant.

4.7. Analysis of spending priorities by gender

Table 4.21 show rankings of spending priorities differentiated by gender. These results are from the respondents who indicated that their spending priorities had changed with the increase in the income for improved cassava sales. More than half of women rank food as the number one priority compared to around 40 % of the men.

Table 4.21: Spending priority ranks by gender

rank	1		2		3	
	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)
School fees	38.30	38.30	27.66	40.43	21.28	12.77
Food	51.06	40.43	27.66	29.79	6.38	12.77
Health	6.38	17.02	29.79	23.40	27.66	40.43
Hired labor	0	4.26	6.38	4.26	29.79	25.53
Inputs	0	2.13	2.13	0	4.26	2.13
Deaths	0	2.13	0	0	0	0
Alcohol	0	0	0	6.38	0	0

Number of male respondents=47, number of female respondents=47
Source: Survey data

School fees follow, with the percentage of males and females who ranked it number one the same. A lot of emphasis is placed on education and making sure children attend school by households in the study areas. 30% of the women rank health as the third spending priority, while 23% of the men rank it third. Only two percent of the males rank

funeral expenses as the first priority and none of the women rank funeral expenses in the top three priorities. The hypothesis that women spend more on goods and services that benefit the household holds, but results show that men are also prioritizing services that contribute to overall household welfare.

CHAPTER 5: DISCUSSION AND CONCLUSIONS

This chapter highlights the major findings of this study and states the conclusions. The study was centered on a number of hypotheses and these provided the basis of the research project. The conclusions from the results of the hypotheses that were tested will be discussed, policy recommendations will be given, and areas of further study will be highlighted.

5.1. Summary of results for each hypothesis

a) Women provide the bulk of the labor in cassava production.

b) Women provide the bulk of the labor in cassava processing

The results of the analysis indicate that women provide most of the labor in cassava production. In terms of the total female person days per year for cassava production, processing and marketing, the total female labor is significantly higher than the total male labor at the 5% level of significance. The men are mostly involved in labor intensive activities such as plowing and clearing at the beginning of the production, while women take care of most of the other activities up to marketing. These results are similar to other studies that compared the roles of men and women in cassava production, processing and marketing.

c) The adoption of improved cassava varieties increases the amount of labor required from women in cassava production and processing.

For those households that adopted new cassava varieties there is a significant difference in the labor provided by women in households with and without adoption. The total

female family labor is higher with adoption of new improved cassava varieties than without it. Results show that labor input for both men and women is higher with adoption of improved cassava varieties than without (Table 5.1). There may be an increase in the average total person days per year that men put into cassava production, processing and marketing, but the results are not statistically significant. There is however less family labor input from both men and women for clearing and plowing, tasks which are normally done by men. This shows that more labor is being hired for these activities and men in the households have less work.

Higher labor input for both women and men for planting, fertilizer application, weeding, harvesting processing and marketing were also found, with women having statistically significant more labor hours than men except for fertilizer application. This higher labor amount may be attributed to the greater land area for cassava production. Significant determinants of female labor supply from the regression analysis were number of children in the household, percent of females providing family labor in the household, total land area and, area under improved cassava varieties. Unexpected results for number of children were found as there was expected to be a negative relationship with female labor supply. Increase in area under improved cassava varieties and investing into cassava production increases the amount of labor by women in cassava production, processing and marketing.

Table 5.1: Summary of changes in time allocated for cassava production, processing and marketing, labor and income control for households that use improved varieties

	Men	Women	Children
Time for :			
Clearing	L	L	L
Plowing	L	L	L
Planting*	M	M	M
Fertilizer application	M	M	M
Weeding*	M	M	L
Harvesting*	M	M	M
Processing	M	M	L
Marketing *	M	M	L
Total family labor	M	M	L
Total hired labor	M	M	-
Cash control	M	L	-

L= less, M= more
* female labor is more than double with adoption

d) Adoption of new cassava varieties increases the control of cash by men.

All households using improved cassava varieties acknowledge that there is increased income in the household. There is an increase in the joint control of cash by the husband and wife. More than half of the households indicated that both the husband and wife control income from the improved cassava varieties. More than half of the male and female respondents indicated that both the husband and wife jointly control the income from improved cassava varieties. Probit results indicate a decrease in improved cassava income control of women with increase in the area under improved cassava.

e) Women lose decision making power after introduction of new cassava varieties

All the decision making variables showed that there is a significant association between the gender of the spouse and who makes the decision except for the decision on family labor allocation. From this analysis, the overall conclusion is that both the husband and wife jointly make the decisions in cassava production, processing, and marketing.

Further analysis using probit models reveal a decrease in the probability that women make the decisions regarding family labor allocation, what inputs to buy, borrowing for cassava production and traditional cassava income control. From the men's perspective, none say that the wife makes the investment decisions. It can be concluded that because women have less access to cash and land, this decision will be made by the husband as has been indicted in previous studies. None of the men said that the wife makes the decisions regarding how much to spend on school fees, health, inputs, and funerals. On spending decisions for inputs, food education and health, there is a decrease in the probability that the wife makes the decision. Increase in area under improved cassava is however not a significant determinant of the spending decisions.

f) Households that adopt new cassava varieties have increased income.

Almost all the households that adopted improved cassava varieties admit that there is an increase in income in the household and are happy with the income they are getting from cassava sales. Fewer women compared to the men are, however, satisfied with the amount of income that they are controlling as individuals in the household.

g) Women spend more of any incremental income on children's education and household expenditure than do men.

From the results it can be concluded that both men and women are spending their income on services directly linked to the household's welfare. More than half of the women ranked food as their number one spending priority.

5.2. Policy implications

The results support what other researchers have found for the most part. Women are at the helm of cassava production, processing and marketing and they provide more labor compared to men. The adoption of improved cassava varieties increases the labor of women in cassava production; processing and marketing. Men put in less labor days into plowing and clearing, and hire more people to do the activities, while for women there is an increase in their labor for cassava production activities. Policy interventions might be in the form of gender sensitive labor saving technologies for activities such as weeding and processing which are normally done by women.

There was no significant relationship between female labor supply and membership in an organization; hence the information that households are getting from the organizations might not be related to cassava production. Organizations might help disseminate information on improved cassava varieties, and therefore education targeted at women organizations may be necessary to promote the use of improved cassava varieties in order to ensure food security.

A significant number of the respondents indicated that their source of income was personal savings. However, very few could afford to buy some of the inputs required for cassava production, for example fertilizer and cassava stems, and hence they produced lower yields. There is need for credit to be made available to smallholder cassava farmers in order for them to maximize fully the land area they have.

There is a decrease in the likelihood that women make the decisions on family labor allocation, what inputs to buy, borrowing for cassava production and traditional cassava income control. Development planners should focus their attention on gender targeting service delivery programs that will empower women in Nigeria for example meetings and extension services with both men and women farmers.

Research institutions producing the improved cassava varieties should consider the negative effects of some of the varieties which were indicated by the respondents. Some of the respondents said that the improved cassava varieties roots rot easily and could not be stored for a longer period of time and had less starch compared to the traditional cassava varieties. These are reasons why they still produce the traditional cassava varieties. There is room for MAB to produce improved cassava varieties that still have the desired characteristics and are resistant to pests and diseases.

Family planning interventions to reduce the number of children in the households may decrease the total female labor supplied by women for cassava production. This labor reduction may be necessary as it will allow the women to focus on other income generating activities that will bring in more money into the household. There is a negative relationship between female labor supply and market distance. Ensuring that cassava markets are nearby the households will increase cassava production thus improving the income and social status of the households.

Spending priorities for both men and women are progressive for the household. Policies to ensure that education and health remain the priorities for the smallholder farmers should continue.

5.3. Areas of further study

Further research on the distributional effects of the introduction of new cassava varieties in the households is necessary. A study can be done that focuses on the gender impact for households with different resource endowments to identify how they are affected differentially. Assessing the nutritional impact of improved cassava varieties becomes important since some of the respondents noted that some of the improved cassava varieties had less starch compared to the traditional varieties.

An assessment of whether or not the introduction of improved cassava varieties reduces poverty in the study areas and by how much could provide further results to support policy interventions. An ex-ante evaluation of the impact of introducing gender sensitive labor saving technologies in the study areas could provide information on the expected gains and results, and would indicate if the different projects are worthwhile or not.

There is an increase in the labor burden for women with the adoption of improved cassava varieties, and hence it becomes necessary to conduct research on the impact of labor saving technologies. Further analysis on decision making using variables such as age of the spouse, education level of the spouse and other factors related to the spouse can provide more accurate results for decision making as these variables are important in intra-household decision making.

5.4 Limitations and general discussion

Some of the results from this study are similar to what other researchers have found out. There is room for improvement in the amount, type and how data was collected for the study. More data for use in the probit models for decision making for example related to the spouse for example the age and education level of the spouse would have been handy in the models as they definitely influence decision making power in the household. Due to time and resource constraints the questionnaire had to be short hence leaving out vital information. The way that some of the questions were asked led to misunderstanding by some of the respondents thus some of the answers were misleading. The analysis of the decision making and income control questions produced results that indicated both the husband and the wife claiming they make the decision or controlled the income though the respondents were asked separately in the absence of their spouses. It was therefore difficult to come to a conclusion from the analyses.

Households had to recall information in their heads for activities they had done in the previous seasons hence, there was some bias in the information given by respondents for example the time they allocated to some of the activities or the number of people hired for cassava production, processing and marketing. There was no means to physically measure for example the total land area or the area under improved cassava varieties as this is expensive hence estimation and measurement was done using visual verification. The estimates were however reasonable.

In terms of access to new improved cassava varieties, most of the households that were interviewed had access to the varieties and there were no constraints for women regarding access. 85% of the households headed by widows were using the improved

cassava varieties. These results are consistent with the COCSA studies as mentioned in the literature. Challenges that were motioned by all the households included the high cost of hired labor, high cost of fertilizer and lack of access of processing equipment. The women's groups in particular mentioned the need for processing equipment in order to generate more income to take care of their families especially for those that relied on agriculture as a source of income. The marketing distance was also a constraint for cassava production and most of the markets were far from the homesteads. Cassava is bulky hence households have to end up hiring transport to the market thus reducing the amount of their potential income from improved cassava sales. There was no discrimination for women in terms of transportation and prices offered for both men and women was the same, but most of them had to hire men with motorbikes to carry their produce to their market or carry the sacks on their heads.

Results on the spending priorities indicate that contrary to other studies that have been done, men are prioritizing goods and services that benefit the household and not using the income from improved cassava sales for their own benefit. Most of the households that were interviewed are Christians, thus maybe explaining these results. The study thus contributes to literature particularly on household decision making, although there is room for further analyses. Instead of asking questions about spending priorities by means of a questionnaire, more accurate information would have been collected using other more physically involving, interactive and participatory methods like use of card games, charts and tools like stones and have respondents specify where they use most of their income. Time allocation for some of the activities could have been measured from a daily basis using for example a daily calendar of activities. Respondents would outline how

they spend their time and how they allocate their time between the household chores and the farm work. However these methodologies are time consuming and require more resources. Very little literature was available that looked at the gender implications of improved varieties particularly on decision making in the household.

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APPENDIX A: QUESTIONNAIRE

GENDER IMPACTS OF IMPROVED CASSAVA VARIETIES IN NIGERIA

Questionnaire Number…….....

Enumerator's Name……

Date…… ……

State/LGA……..

Village/Community name …….

We would like your participation in a study to gather information on the impacts of improved cassava varieties on men and women and on households as a whole. You are being invited to take part in this study by answering a set of questions, which will take up to 30 minutes of your time. The information we gather will be used by scientists to determine ways to improve technology development and dissemination so that all members of the household benefit from improved varieties. Your responses will remain anonymous and there is no cost to you for participating in the study.

Would you like to participate in the study by answering our questions?

Yes_____ No _____

If yes do you have any questions for us before we start?

Yes_____ No _____

Feel free to ask us if there is anything that is not clear or if you need more information at any time during the interview.

A) Household demographics and socioeconomics

1. Gender of respondent (circle) **M** **F**
2. Marital status (tick one)

—— *Single* —— *married* —— *widow* —— *divorced*

3. *What is your age? (yrs) _____
4. What is the highest level of education you reached ?(tick)

_____a) No education
_____b) Primary
_____c) Secondary (high school)
_____d) Tertiary (college/university)
_____e) Other (specify)

5. How many family members are in the household? _____
6. How many children are in the household? _____
7. Specify the number of family members who do work on the farm
   i) number of adult female family members providing labor on the farm_____
   ii) number of adult male family members providing labor on farm_____
   iii) number of children providing labor on farm _____
8. How far is your home from the nearest market (km)_____
9. How far is your home from the nearest school (km)_____
10. Do you have contact with extension agents? **Y** **N**
11. Farming experience(years)_____
12. Membership of association/organization **Y** **N**
13. Source of capital

a) ____personal savings b) _____banks c) _____isusu d) _____money lenders_____ e) other (specify)

B) Household farming system

14. Land ownership

	Land area (acres)			
	Owned	Rented	Leased	Other (Specify)
a) Total land				
b) Arable land under cultivation				

15. Crops produced last year

Crop	Total area grown(ha)	Total Output (kgs)	Output consumed (kgs)	Output sold(kgs)	Output donated for e.g. funerals	Other Uses For output	Price (naira)	Who controls income from sales (wife, husband, both , other (specify
a) Cassava T*								
b) Cassava I*								
c) Yams								
d) Maize								
e)								
f)								

T*=traditional I* =improved [* Bags (50kg), basins, head pans (25kg)]

C) Impact of improved cassava varieties on roles and time allocation for the different household members

16. Is the household using improved cassava varieties (circle one) **Y** **N**

17. If yes which improved varieties is the household using?

    (names)_____

18. Who decided that household should adopt improved varieties?
    _____ a) wife
    _____b) Husband
    _____c) Both husband and wife equally
    _____d) predominantly husband
    _____e) predominantly wife
    _____d) Other (specify)

19. What motivated the household to start using improved varieties? (Tick all that apply)
    _____a) Need for food security
    _____b) Need to earn more income
    _____c) Need to acquire additional assets
    _____d) For increased output
    _____e) For children education
    _____f) To get resistant varieties
    _____g) Others (please specify)

20. Have the roles for men, women and children in cassava production processing and marketing changed due to the introduction of the improved varieties? (circle one) **Y** **N**

If yes how have they changed?
_____ a) Increase in workload
_____ b) Decrease in decision making power
_____ c) Decrease in leisure time
_____ d) other (specify)

21. What is the time allocation for the following activities in cassava production for men, women, children (in the household) and hired labor?

	Time allocation (person days)				
	Adult male	Adult female	Children	Male hired labor	Female Hired labor
a)Clearing					
b)Ploughing/Ridging					
c)Planting					
d)Mulching					
e)Fertilizer application					
f)Weeding					
g)Harvesting					
h)Processing					
i)Marketing					

22. Scientists are working to develop a new cassava variety that would delay deterioration of the cassava root for up to two weeks after harvest. What effect might this new cassava variety have on:

a)Your time allocation_____
b) Your income_____
c) Yield _____
d) Color/taste _____
e) Other effects (specify)_____

D) <u>Decision making in the household for cassava production</u>

23. Who decide(s) how the available family labor will be used in cassava production? (tick)
_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

24. Who decide(s) what inputs to buy?(tick)

_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

25. Did the household hire any additional labor for cassava production?(Circle one)**Y** **N**

i) If yes, who decide(s) to hire additional labor for production? (Tick)

_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

ii) How many people were hired last year in your cassava farm?_____
iii) How much were they paid? (naira/ha)_____or naira/day _____

26. Who decide(s) whether the cassava will be processed or stored?(tick)

_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

27. Who decide(s) what quantity /how the cassava harvest is sold? (tick)

_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

28. Did the household borrow any loan for cassava production? (Circle one) **Y N**

    i) If yes who decide(s) taking of loan? (Tick)

_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

29. Did the household buy/rent additional land for cassava production (Circle one) **Y N**

    i) If yes who decide(s) to buying /renting additional land for cassava production? (Tick)

_____a) wife
_____b) Husband
_____c) Both husband and wife equally
_____d) predominantly husband
_____e) predominantly wife
_____f) Other (specify)

E) <u>Effects of improved cassava varieties on income and spending priorities</u>

30. If you have adopted improved varieties does the household now have more income than with the old varieties? (Circle one) **Y N**
31. Are you happy with the amount of income that you are getting? **Y N**
32. Are you satisfied with the amount of income you are controlling? **Y N**
33. Did the increased income from cassava change your priorities on how to spend money? (Circle one) **Y N**

    i) If yes rank where you spend most of the increased income and specify who decides how much should be spent?
    ii) If no or if household did not adopt, rank where you spend most of your income.

	Who decides on how much to spend * a) wife b) Husband c) Both husband and wife equally d) predominantly husband e) predominantly wife f) Other (specify)	rank
a) Food		
b) School fees		
c) Health expenditure		
d) Hired labor		
e) Inputs		
f) Funerals		
g) Others? (specify)		

34. What are the benefits of using of using improved cassava varieties? (Rank**,** 1 = most important)

Benefit type	**Rank**
a) increased income	
b) food security	
c) increased output/yield	
d) disease resistance	
e) education opportunities	
f) asset acquisition	
g) access to new technologies	
h) enhanced decision making power	
i) higher self sufficiency	
j) fulfill household needs	
k) others(specify)	
l)	

35. What are the negative effects of using improved cassava varieties? (**Rank,** 1 = most important**)**

Effects	**Rank**
a) increased workload	
b) decrease in decision making power	
c) increase in costs of production	
d) decrease in leisure time	
e) change in taste and color	
f) Others(specify)	

ii) What can be done to reduce the negative effects?

_____

_____

_____

_____

_____

36. Is the household or you a member of any association/organization in the community? (Circle one) **Y** **N**

(i) If yes, to which of the following association/organization do you or your household belong to?

	Specify if its women's, men's or household group	What are the benefits of belonging to group?
a) Farmers cooperative		
b) Church or mosque		
c) Credit union		
d) Social club		
e) Village council		
f) Women's association		
Others (please specify)		

F) <u>Time allocation for activities other than farming</u>

Off farm work

37. What are the off farm income generating activities that you are involved in, time spent and wage?

Income generating activity	Days allocated (Per /month)	wage earned (Naira/day)
a) _____	_____	_____
b) _____	_____	_____
c) _____	_____	_____
d) _____	_____	_____

38. Are these income generating activities getting lesser time than before the adoption of the improved cassava varieties? (Circle one) **Y** **N**

39. How much time is spent doing the following activities?(per day)

a) Cooking _____
b) Fetching water _____
c) Cleaning the house _____
d) Gathering firewood _____
e) Looking after the children _____
f) Washing clothes _____
g) Feeding small livestock _____
h) Livestock rearing _____
i) Other (specify) _____

40. Are these activities getting lesser time than before the adoption of improved cassava varieties? (Circle one) **Y** **N**

THANK YOU