GENDER ROLES IN AGROFORESTRY: A SOCIO-ECONOMIC ANALYSIS OF EMBU AND KIRINYAGA DISTRICTS, KENYA.

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ABSTRACT

This study was carried out in an agroforestry system in the Central Highlands of Kenya (Kirinyaga and Embu Districts) with the aim of investigating the gender roles in the agroforestry system and how these affect productivity. The study specifically looked at the characteristics of the system, the gendered division of labour, gendered access to resources, effect of the division of labour and access to resources on productivity and the use of collective action by women as a strategy to reduce their workloads and increase access to resources. Participatory Rural Appraisal, Focus Group Discussions, a cross sectional household survey and time allocation studies were used to collect data intended to answer the objectives of the research. One-way analysis of variance was used to compare farms based on whether they had a male manager, female manager or both. A Cobb-Douglas production function was used to analyse factors affecting Total Value Product and to calculate farm technical efficiency. Both probit and regression analysis were used to identify and assess factors affecting male and female labour, technical efficiency and determinants of women's ability to make decisions on tree planting. The major constraints to the integration of trees into the farming system were found to be farmers' perceptions of the effects of trees on crops and boundary disputes. Lack of information and seeds on appropriate trees and shrubs were identified as a constraint Female labour was found to contribute 60.9%, 77.7%, 68.8%, 77.4%, and 64.3% of the labour in coffee, tea, maize, beans and potatoes respectively. In addition, they contributed 47.6% of the labour in cattle and 93.2% of the labour for all domestic activities. Farm technical efficiency was 64%. The study found no evidence of productivity differences

between male and female farm managers. Inputs and female labour were found to increase the Total Value Product. Both male and female farm managers were found to benefit equally from extension while female managers benefited less from education in farming. Few women were found to have access to extension, land and credit. Collective action played an instrumental role in guaranteeing women rights and access to resources that they would not otherwise have as individuals. Given the importance of farm inputs in raising the value of total products, future policies should be aimed at increasing rural farmers' access to agricultural inputs at an affordable price as a strategy to increase agricultural production. The study recommends the development of more labour saving productivity enhancing technologies and the promotion of agroforestry technologies that will increase soil fertility and make use of available planting niches while at the same time offering other services to farmers such as fodder. The study also recommends the understanding of the gender division of labour and access to resources in any farming system before any new technologies or crop varieties are introduced into that system.

DECLARATION

I, Jemimah Micere Njuki do declare to the SENATE of Sokoine University of Agriculture that this thesis is my own original work and has not been submitted for a higher degree award in any other university.

Signature.....

Date.....22/11/2001.....

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DEDICATION

The women of Africa toil all their lives on land that they do not own, to produce what they do not control and at the end of their marriage through divorce or death, they can be sent away empty-handed.

Mwalimu Julius Kambarage Nyerere (1922-1999)

This work is dedicated to all the toiling women of Africa and to my mother and my sisters who, through their hard work have always been an inspiration to me.

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ABBREVIATIONS AND SYMBOLS

ABLH	Association for Better Land Husbandry
AEZ	Agro Ecological Zone
AFC	Agricultural Finance Corporation
AFRENA	Agroforestry Research Network for Africa
ANAFE	African Network for Agroforestry Education
ANOVA	Analysis of Variance
ASALs	Arid and Semi-Arid Lands
AVP	Average Value Product
CABI	Centre for Agriculture and Bioscience International
CIMMYT	*Centro Internacional de Majeromiento de Maizy Trigo* (International Maize Research Institute)
DDC	District Development Committees
DPM	Directorate of Personnel Management
FAO	Food and Agriculture Organization
FGD	Focus Group Discussions
GAD	Gender and Development
GAF	Gender Analysis Framework
GDP	Gross Domestic Product
GM	Gross margin
GoK	Government of Kenya
HABITAT	United Nations Centre for Human Settlements
HSD	Honestly Significant Difference

ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IDRC	International Development and Research Centre
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
IPM	Integrated Pest Management
KANU	Kenya African National Union
KARI-RRC	Kenya Agricultural Research Institute-Regional Research Centre
KEFRI	Kenya Forestry Research Institute
KTDA	Kenya Tea Development Authority
LTC	Land Tenure Centre
MALD	Ministry of Agriculture and Livestock Development
MOERD	Ministry of Energy and Regional Development
MOPND	Ministry of Planning and National Development
MROCR	Marginal Rate of Opportunity Costs Ratio
MVP	Marginal Value Product
NGO	Non Governmental Organization
PPCSCA	Permanent Presidential Commission for Soil Conservation and Afforestation
PRA	Participatory Rural Appraisal
RAES	Rural Afforestation and Extension Programme
RRA	Rapid Rural Appraisal
ROSCAS	Rotating Savings and Credit Associations

SACCOs	Savings and Credit Co-operatives
Sd	Standard Deviation
SP-PRCA	System wide Project on Property Rights and Collective Action
SPSS	Statistical Package for Social Scientists
SSA	Sub Saharan Africa
SWOL	Strengths, Weaknesses, Opportunities and Limitations
TAS	Time Allocation Studies
TVP	Total Value Product
UK	United Kingdom
UNFPA	United Nations Fund for Population and Development
UNRISD	United Nations Research Institute for Social Development
USA	United States of America
VIF	Variance Inflation Factor
WAD	Women and Development
WAPIA	Women in Agricultural Productivity in Africa
WID	Women in Development

CHAPTER ONE: INTRODUCTION

1.1 Background information

The rapid rate of depletion of the tropical rainforests at the present and recent past has raised worldwide attention (World Bank, 1995). The actual rate of deforestation is hard to estimate. In 1978, the World Bank estimated the rate of deforestation to be 12 million hectares per year (World Bank, 1978). Seiler and Crutzen (1980) estimate the deforestation rate to be 5-6 million hectares annually. The Food and Agriculture Organization of the United Nations (FAO) estimates that 11 million hectares of tropical forest cover are cleared annually (FAO, 1995). The same report by FAO estimated that during the 1980s, global forest, woodland and scrub declined by 2%. In the developing countries, it is estimated that in the three decades between 1960 and 1990, one fifth of all natural tropical forest cover was lost (World Resources Institute, 1996). The state of the world's forests report by FAO gives the deforestation rate in Africa as 3.7 million ha per year and in the tropics as 12.6 million ha per year in the period between 1990-1995 (FAO, 1999).

There is however no divergence of opinion on the consequences of deforestation. It is widely agreed that deforestation causes a decline in the productive capacity of soil, accelerated erosion, siltation of dams and reservoirs, destruction of wildlife habitats and loss of genetic diversity (Sharma, 1992; Grainger, 1993; Nair, 1993; Monela, 1994). It has been estimated that at least 25 million metric tonnes of soil is lost per year in erosion (Dover and Talbot, 1987). The FAO projected a global loss of productivity of rain fed cropland of 29% for the period 1975-2000 (FAO, 1984). On a per capita basis,

Brown and Wolf (1984) estimated a global decline of cropland per person of 19% between 1984 and 2000 and a decline in top soil of 32% per person. The authors argue that the process of soil loss would eventually undermine the world economy if not prevented. Another forceful illustration of deforestation has been the social, economic and environmental cost of fuelwood scarcity to women and their families in terms of increased distance to fuelwood sources and increased expenditures for the purchase of fuelwood (Barraclough and Ghimire. 1990).

Faced with these challenges of environmental degradation and the relative decline in agricultural productivity, people and economic centred approaches have been given support by the donor community and governments in the recent past. Among these approaches are traditional soil conservation methods, farm and community forestry and agroforestry (FAO. 1978, 1985; World Bank, 1995). It is assumed that such measures will not only sustain livelihoods but also reduce environmental degradation.

Literature is available on the role of agriculture in economic development in Africa and on the critical role played by rural women within this sector. In Sub-Saharan Africa (SSA), agriculture accounts for approximately 21% of the continent's Gross Domestic Product (GDP) with as low as 8% in Congo and as high as 50% in Tanzania (FAO, 1995). Employment in agriculture ranges from as low as 40% in Morocco to as high as 85% in Burkina Faso. Women contribute 60-80% of the labour used to produce both for household consumption and for sale (FAO, 1995).

In Kenya, the agricultural sector contributes about 30% of GDP and despite wide annual variations in the sector growth rates, the overall performance has been better than average for SSA. However, further economic progress in Kenya remains fragile due to continued dependency on foreign capital, increasing population growth, pressure on limited resources and fluctuating world prices for major agricultural exports.

According to the National Development Plan for the year 1997 to 2001 (GoK, 1997), the major constraints faced by the agricultural sector are inadequate rural infrastructure, high dependence on rain fed agriculture, inadequate input application, inaccessibility to credit for small holder farmers and especially women, limited application of agricultural research findings, cultural constraints as related to gender discrimination in the ownership, transfer and usage of land with respect to perceived ethnic exclusion and traditional inheritance practices leading to land fragmentation and low budgetary provision to the sector. In view of the difficulties faced in increasing the land area under agriculture, sustained agricultural output will mainly depend on intensified production and increasing agricultural productivity.

A large proportion of Kenya's labour force is based in rural areas. According to the 1989 population census, out of the total labour force of 9.3 million people, 7.6 million, or about 82% were based in rural areas whereas only 1.7 million were in urban areas (GoK, 1997). The smallholder sector in Kenya accounts for 75% of the total value of agricultural output, 47% of marketed production, and 85% of total agricultural employment. Women form the core of this smallholder sector (Bastone, 1988). Because

of the pioneering accounts of the role of women in agriculture dating back from the 1960s and 1970s. the importance of women in rural wage. proprietary, and household sectors has received increased attention. The stereotype of "invisible women" in rural economies is slowly declining in influence (Warren, 1992). Although there are regional variations. women are estimated to head some 30% of the country's smallholder families and this percentage is increasing. These women headed households face particular constraints in terms of resources and available livelihood options.

Agroforestry is considered as a land use system that has great potential in increasing the productivity of smallholder farms. not only in Kenya but also worldwide. Several definitions have been given for the term agroforestry. Rochelcau *et al.* (1988) define agroforestry as all practices that involve a close association of trees or shrubs with crops, animals and/or pasture. This association is both economical and ecological and may involve a combination of practices in the same place at the same time or practices in the same place at different times. The International Centre for Research in Agroforestry (ICRAF) has defined agroforestry as a collective word for all land use systems and practices in which woody perennials are deliberately grown on the same land management unit as crops or animals or both (ICRAF, 1994). To qualify as agroforestry. a given land use system or practice must permit significant economic and ecological interaction between the woody and non-woody components. A definition by Leakey (1996) sees agroforestry as a dynamic, ecologically based natural resource management system that through the integration of trees on farms and in agricultural landscapes. diversifies and sustains production for increased social, economic and

environmental benefits. This is the definition adopted by ICRAF and also adopted by this study.

In Kenya, agroforestry development is relatively new but its growth during the last few decades has been unprecedented. It has also received a lot of support from the government in that, there have been several major government policy interventions enacted between 1971 and 1981 that have had a direct and positive effect on agroforestry development. A list of these policies is given in Appendix 1. ICRAF has also played a significant role with the establishment of agroforestry projects in some parts of the country of which the Agroforestry Research Networks for Africa (AFRENA) program for Eastern and Central African bimodal highlands project based in Embu is one.

Despite the tremendous potential of agroforestry in alleviating soil degradation and improving land productivity, its adoption and success depends on social factors such as land policy and its impact on women and men, land availability and extension services among others. These social factors must be recognised and made favourable if the potential of agroforestry is to be realized (Grossman, 1992). In some regions of Africa and Asia, cultural restrictions prevent women from planting trees such that they are unable to participate in agroforestry activities (Neef and Heidhues, 1994; Fortmann and Rocheleau, 1985). Legal restrictions, some linked to property rights also impede the adoption of agroforestry technologies. However, as a general trend, the majority of scholars and practitioners concerned with development in Africa and in other parts of

the Third World have continued to ignore gender issues in both socio-economic studies and planning (Sorensen and Bulow, 1990). This is also symptomatic of national development plans. There are, however, exceptions and recent signs of change. For example, Kenya's development plan of 1989 - 1993 does deal with gender aspects of development in several chapters including the one on agriculture (GoK, 1989a) and the Kenya Forestry Master plan has also a section on gender issues and it recognises women as a strong force in forestry development in Kenya (Luukkanen, *et al.*, 1996). Internationally, there has been a growing recognition of the need for gender disaggregated agricultural statistics in promoting greater efficiency in rural development policies and programmes with respect to analysis, presentation, identification and targeting of beneficiaries. It has been demonstrated worldwide that agriculture and rural development policies, programmes and projects have often not fully succeeded because rural women and their social, economic, legal, technological and other short term needs and constraints were not adequately assessed.

The interrelationships between women's productive, reproductive and community roles have also often not been perceived due in part to the lack of adequate data, leading rural development experts and planners to underestimate the importance of these relationships. Because the traditional unit of analysis for studying rural communities has been the household, different impacts of the members of the household according to age or gender have often remained hidden. There is, however, increasing recognition that resource allocation within households is rarely equal. Men and women frequently have very distinct rights and responsibilities. They often control and have access to

different resources, perform different tasks in the household, have different legal and traditional rights and have different ways of looking at life (Udry, 1996; Udry *et al.*, 1995). All this makes them have different priorities, preferences and goals and this may be a source of differences in farm productivity and farm technical efficiency.

There has been a tendency to focus on male household heads and male members of the households in research and development ignoring the increasing number of female-headed households. This is based on the misguided assumption that the resources and information channelled to them will trickle across to other members of the household including women. More often than not, this is not the case (Poats *et al.*, 1988). According to FAO (1993) independent consideration of men and women increases the potential for the design, implementation and management of effective, sustainable development activities while understanding that intra household differences also have important implications for policy.

This study adopts a modified form of the Gender Analysis Framework (GAF), which assesses the differential gender roles in agroforestry, and how these impact on the productivity of agroforestry and in general agricultural systems and further makes suggestions on how these can be incorporated in agroforestry and other rural development projects to make them effective, sustainable and more profitable to farmers. Differences in property rights and in access to productive rights between men and women are studied. There may be either conflicts or complementarities in the

interests, roles and uses of resources by women. Gender analysis highlights these complementarities as well as actual and potential conflicts (Meinzen-Dick *et al.*, 1997).

The study looks at agroforestry as encompassing the whole farm system. This is because small farm enterprises encompass multiple activities. which interact. This interaction is the key to understanding management decisions and practices. In addition. the configuration of any given system changes with time in response to both internal and external factors. This holistic, dynamic perspective on small farming enterprises provides an ideal framework within which the family division of labour, differences in property rights by gender and differences in access to other productive resources are a major focus.

Bonnard and Scherr (1994) argue that in designing agroforestry interventions and assessing policy or programme impacts there is need to go beyond simple gender distinctions and look at additional stratifiers such as access to resources, land and property tenure. land policy, access to extension, among others. The social definitions of which tasks would be carried out by men or women vary from one society to another indicating that the variability is not caused by physical but rather by social factors and social definition of social relations between men and women. This study therefore also looks at the socio-economic and socio-cultural as well as the service-related factors that influence gender roles and to what extent these affect productivity of agroforestry systems.

1.2 The research problem

Increasing agricultural productivity involves three sets of issues: policy issues of how to provide an enabling microeconomic environment for farmers, technological issues on how to increase productivity within the confines of the agro-ecological and physical environment and organizational issues of how to improve support services to farmers. Cutting across all these three is gender (World Bank, 1990). Gender concerns must therefore be integrated in the technological, economic and social context of measures to increase agricultural productivity. In relation to this, the way in which gender issues affects the productivity of agricultural and agroforestry systems must be investigated.

Understandably, biophysical sciences have dominated the first two decades of agroforestry research and development mainly because the interest in agroforestry as a land use emerged from observations of the impact of non-sustainable farming systems on tropical soils and forests. Not much has been done on the socio-economic analysis of agroforestry in the world (Mercer and Miller, 1998). In Kenya a few studies have been done on women and agroforestry (Busienei, 1993; Ipara, 1993) and on sex roles in agroforestry (Kerkhof and May, 1988; Rocheleau, 1990) but these studies have not made a link between gender roles and the productivity of agroforestry as well as farm technical efficiency. This study aims to fill this gap.

Gender disaggregated information will provide information and suggestions on the relationship between men, women and agroforestry, what women and men know and their requirements, and the division of labour between them in order to avoid their roles being incorrectly assumed. This is a prerequisite for the achievement of development

objectives. The study assists in pinpointing the different priorities and preferences of men and women and how development projects can work with both men and women in order to increase the adoption and productivity of agroforestry.

1.3 Objectives

1.3.1 General objective

The general objective of this study is to assess the differential gender roles in agroforestry and how they affect productivity in Embu and Kirinyaga Districts of Kenya. The aim is to provide gender disaggregated data that will be useful to the project managers/planners in formulating sustainable, equitable and effective agroforestry programmes and policies.

1.3.2 Specific objectives

Specifically, the study intends to;

1. Identify the strengths and constraints of the agroforestry systems in the study area.
2. Assess the gender-based division of labour, resources and benefits allocation in these agroforestry systems.
3. Identify the socio-cultural and socio-economic factors influencing gender roles in agroforestry.
4. Investigate the effects of gender roles on productivity and the farm technical efficiency of agroforestry systems.

5. Make an assessment of collective action as a strategy by women to improve the gender division of labour, access, decision-making and control over productive resources.

1.4 Organization of the thesis

This first chapter has provided a background to this study by detailing the problems of deforestation and how agroforestry can be used to solve some of these problems. This chapter has also given the role of gender in agriculture and its importance in the development of agroforestry. The statement of the problem and the objectives for this study have also been included in this chapter.

Chapter two gives a critical analysis of the available literature both in the areas of gender and agroforestry. The concept of gender and the theories of gender are given and how these have been applied to agricultural production and agroforestry. In addition, the historical development of agroforestry in Kenya is also given in this chapter and a critical review of studies in gender and agroforestry detailing what has been done and what remains to be done and the knowledge gaps that this study has attempted to fill.

Chapter three is the methods chapter and starts with a description of the physical and social characteristics of the study area including location, soil type, rainfall and temperature data, population statistics and the farming system before moving on to the methodology that was used in obtaining data for this thesis. Major limitations encountered during the course of this study are also given in this chapter.

Chapter four contains major findings of this study and a critical discussion of these findings in terms of what has been found in other areas and regions. Chapter five. which is the last chapter in this thesis, makes some conclusions based on the results as well as policy and research recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.0 Overview

This chapter gives a literature review of the concepts of gender and agroforestry and details what has been done and what the knowledge gaps are in these two areas. It starts with the definitions of gender and why it is important in agroforestry. It critically looks at the gender division of labour, gender differences in access to resources, and gender issues in agricultural productivity and the theories of the household. The last section of the chapter gives a review of literature on gender and collective action.

2.1 The concept of gender

Gender has been defined in various ways by different authors. Lorber (1994) defines gender as an institution that establishes patterns of expressions and expectations for individuals, orders the everyday social life, is embedded in major organizations of society such as the economy, ideology, family and politics. Gender has also been defined as socially constructed and culturally variable roles that women and men play in their daily lives. It refers to a structural relationship of inequalities between men and women and is manifested in labour markets and in political structures, as well as in the household. Custom, law and specific development policies all act to reinforce gender roles (United Nations office, Division for the Advancement of Women, 1992).

Mosse (1994) defines gender as a set of roles, which like costumes or masks in a theatre communicate to other people that we are feminine or masculine. This set

of particular behaviour which embraces our appearance, dress, attitude, personalities and works both within and outside the household, sexuality, family commitment etc make up our gender roles. The study adopts the definitions of gender by Lober (1994) and the United Nations (United Nations Office. Division for the Advancement of Women. 1992)

There are three basic premises of these gender definitions. First is the distinction between gender and sex whereby sex is attributed to biological differences and gender refers to social differences. Like any social institution. gender exhibits universal features. chronological and cross-cultural variations that affect individual lives as well as social interaction in major ways. This view is supported by Meena (1992) who argues that sex is biological while gender is acquired and constructed by society. While our biological sex is given. that is, we are either born male or female. the way in which we become masculine or feminine is, a combination of these basic biological building blocks and the interpretation of our biology by our culture. However, while every society uses biological sex as a starting point for describing gender. no two cultures would agree completely on what distinguishes one gender from another.

Second, is the distinction between gender and patriarchy. Lorber (1994) argues that gender is not synonymous with patriarchy or men's domination of women but is a more general term encompassing all social relations that separate people into different social statuses. Engels (1942) however says that women's' subordination

is a form of oppression resulting from the institution of class society and maintained because it serves the interests of capital. Stircher and Parpat (1988) define the patriarchal mode as characterized by an ideologically defined division of labour by sex, age, and family position, which entails the performance of surplus labour by the subordinate class. The patriarchal class struggles to maintain control over the social definition of labour and responsibilities. It retains exclusive authority to decide upon the ultimate distribution of products from dependants' labour.

The third premise is the dynamic nature of gender. Lorber (1994) sees gender as changing but without deliberate restructuring, it will not necessarily change in the direction of greater equality between men and women. As a social institution, gender is one of the major ways that human beings organize themselves. Human society depends on a predictable division of labour, a designated allocation of scarce goods and assigned responsibility for children and others. The process of gendering, and its outcome are legitimated by religion, law, science, and the society's entire set of values. As these values change, so do the gender roles.

2.2 Theories of gender stratification

There are many different explanations for gender stratification. These are grouped into micro type theories and macro type theories.

2.2.1 Micro type theories

Micro type theories explain gender differences from the individual perspective. They start with the individual as the source of gender differences rather than the society (Nielsen, 1990). These theories are of two types.

2.2.1.1 Biological theories

Biological theories stress that there are aspects of human biology that are qualitatively different in males and females and these are the causes of gender differences. The basis of these theories is that gender has a biological determinant and the common assumption is that sex linked genetic mechanisms trigger different hormonal activity in the two sexes, which in turn produce sex linked social behaviour as shown in Fig 2.1.

Figure 2.1. Hormonal explanations of gender stratification

Source: Masters (1984)

2.2.1.2 Social learning explanations

The basic premise of social learning explanations is that from the very beginning of life, the world acts as though sex makes a difference. At birth names are given according to sex, presents bought depending on whether a baby is a girl or a boy. Being raised as a boy or a girl may therefore be one explanation for the status

differences between the sexes. Theories that explain gender from this perspective include; a) Freud's theory (Freud, 1933) which emphasizes the importance of early learning as a decisive factor in personality development; b) Chodorow's reproduction of mothering (Chodorow, 1978) which attributes gender status to the fact that at birth, the girls' first interaction is with someone of the same sex while with the boys, it is with someone of the opposite sex; c) the cognitive-developmental theory (Kohlberg, 1966) whereby the child first perceives the gendered nature of the world in terms of sex and associates different activities to one sex or another: d) Bem's gender schema theory (Bem, 1983) which emphasizes gender schematic behaviour, defined as a generalized readiness by the child to encode and organize information according to a culture's definition of maleness and femaleness.

2.2.2 Macro type theories

Macro type theories see gender differences as arising from society rather than from the individual.

2.2.2.1 Functional theories

The underlying assumption of functional theories is that the causes of social patterns can be found in their consequences for the society as a whole. Functionalists suggest that sex stratification was and perhaps is still necessary for the ongoing operation and survival of human society. One of the functional

theories is Harris' ecological determinism, which is based on anthropological studies of male dominance in pre industrial societies (Harris, 1977).

2.2.2.2 Ideological theories

Ideological theories see sex statuses as being determined by factors pertaining to values. Ideology refers to a culture's expressive system i e. its members' values, beliefs, opinions and attitudes. Ideological theories include: a) De Beauvoir's "the second sex", which states that since the definitions and distinctions of gender have been made by men, they have defined women as the "other sex" or the "second sex" (De Beauvoir, 1952); b) The woman-nature, man-culture theory (Ortner, 1974) which sees culture as the human made component of life and more superior to nature and links women to nature thus making them less superior; c) Sanday's female power and male dominance (Sanday, 1981) which illustrates the importance of symbolical cultural configurations in the construction and maintenance of society's sex role plan including a gendered division of labour, ideas and beliefs about the nature of men and women.

2.2.2.3 Materialist theories

Materialist theories take a different view of gender stratification from both functional and ideological theories. These theories argue that ideologies develop to provide justification for the existing distribution of material rewards (Nielsen, 1990). The assumption is that ideologies follow rather than precede gender stratification. Majority of these theories argue that the two sexes are tied to the

economic structure in different ways and this difference explains their statuses. The origin of male dominance according to these theories is located in the transition from subsistence to surplus production, specifically the development of land and animals as private property in combination with the discovery of issues of paternity and inheritance.

Materialist theories include; a) Collins's conflict theory (Collins, 1971) which is based on the fact that resources determine sex status; b) Blumberg's general theory of gender stratification (Blumberg. 1984) which sees the major determinant of women's relative status as their relative economic power or control over the means of production; c) Chafetz's comparative, macro structural theory of sex stratification (Chafetz, 1984) which attributes the degree of gender stratification to environmental. technological and demographic variables that determine how a society's productive activities are structured.

2.2.2.4 Feminist theories

Feminist theories include liberal feminism. Marxist feminism, radical feminism and socialist feminism. Liberal feminism is characterized simply as the application to women of the policy that all men are equal and the safeguarding of this policy by the government. Liberal feminists acknowledge the psychological differences between men and women but they see them as resulting from different life experiences (Nielsen. 1990). Marxist feminists on the other hand emphasize the importance of capitalism in maintaining sex stratification while radical

feminists attribute this sex stratification and women's subordination to reproductivity (Jaggar. 1983). While other theories see the solution for subordination as women being more like men or state intervention, radical feminists see women as great and what needs to be changed is the global-cultural general attitude toward female. Socialist feminists agree with the Marxists and the radicals that there is a need to focus on social change and social structural issues as well as individual rights in eliminating women's subordination (Jaggar, 1983).

2.2.3 A conclusion on theories of gender stratification

Theories of gender stratification are becoming increasingly complex and at the same time no one theory can explain the origin and continuation of gender stratification. The realization of the extent to which gender stratification is deep rooted has led to the use of multi-causal versus mono-causal theories. There has also been a tendency to link general and gender stratification theories because of the realization that the more stratified a society is, the more marked is the gender inequality.

Two theories, both materialist, Collins' conflict theory (Collins, 1971) and Blumberg's general theory (Blumberg. 1984) are closely linked to the situation in the study area. Collins' conflict theory is based on the fact that resources determine sex status, that different groups in this case men, and women are always competing to control resources. Blumberg's theory. on the other hand sees women's relative economic power as the major determinant of their relative

status. Participation of women in productive activities is seen as a necessary but not sufficient condition for women's economic empowerment.

Households play a fundamental role in shaping gender relations since many of life's basic decisions are made at the household level. The household also serves as a media for transferring gender norms from one generation to another. Intra household decision-making affects investments in male and female members of households. These decisions are at the same time made against a backdrop of a broader institutional environment.

2.3 Gender and development

2.3.1 Gender and development policies

Gender and development is a relatively new concept but one that continues to evolve as new knowledge is gained. In the late 1960s. the policies of major development agencies still maintained the logic of frontier economics, an approach, which equated development with increased economic production. The environment was seen as a source of raw materials for this production and a sink for waste products. This approach confined its attention to short term remedies aimed at the physical environment ignoring the social. cultural and political factors which all interact to determine the achievement of development. In this entire debate. the crucial role of women was ignored (Jiggins, 1984). This approach negatively impacted on the lives of the poor women and their dependants.

In many respects. this approach characterized development issues affecting women. The majority of development policies and prescriptions interpreted women projects as synonymous with nutrition, home economics and family planning. These projects addressed symptoms such as malnutrition and child maternal health ignoring the fundamental underlying social, economic, political and even cultural causes, which generated and sustained these problems.

By the start of the women's decade in 1976, it was apparent that different directions in the women's debate *vis-à-vis* development were evolving. Specifically, the term Women in Development (WID) became associated with the framework adopted by major donor agencies. This approach focused on the identification and integration of women's productive roles in the development process. WID theorists found that they needed women in development in order to make both development and women more efficient. In order to achieve these developments, mainstream development emphasized the quantification and maximization of women's productive roles. However, the process of development into which women were being integrated remained fundamentally the same (Moser, 1986).

The Women and Development concept (WAD) which was promoted almost the same time with WID grew out of the awareness of non-participation by women within the socio-economic realm of development. Inequalities between men and

women reinforced by a Northern-dominated, profit-oriented development process were still not addressed in this approach (Moser, 1986).

According to Beneira and Sen (1982), both WID and WAD policies concentrated on women's production, securing women more tightly in a process of development associated with capital accumulation, pursuit of economic profits, the extension of the market and the sexual division of labour. This added to the women's already excessive workload without changing the inequalities that denied them access to the benefits of their work.

Since the late 1980s, research employing a Gender and Development (GAD) approach has challenged the WID and WAD approach to development. This approach looks at women not as separate from society but in relation to men. It is concerned with integrating men and women in the development process. The GAD approach sees the problem as that of unequal relations and inequitable distribution of power and control, with women at a disadvantage. The goal of GAD is to challenge these imbalances and to ensure that both men and women are able to make decisions, hold positions and benefit from development on the basis of personal ability. The approach addresses women's strategic needs and assumes that the practical needs will be met. Another feature of this approach is that it recognizes that gender relations cross-cut and interact with other social aspects such as age, class, race and ethnicity and these generate inequitable and structured powered relations.

Bonnard and Scherr (1994) have loosely divided the literature on gender into three orientations. The first focuses on women as an appropriate target group because they have been marginalized, the second on women as productive contributors to development who have constraints different and distinct from men while the third addresses women's requirements as reproducers of the household.

2.3.2 Why gender is a development issue

Despite considerable progress in recent decades, gender inequalities are still pervasive across many dimensions of life worldwide. The nature and extent of gender discrimination varies considerably across countries and regions, as does the pace of progress. In no region of the developing world do women experience equality with men in legal, social, and economic rights. Gender gaps remain widespread in access to and control of resources, in economic participation, power and political voice. While women and girls bear the largest and most direct costs of these inequalities, gender disparities detrimentally affect the welfare of everyone in society. Gender inequalities have been shown to reduce economic growth, which in turn has an effect on the well being of the whole society (Klasen, 1999).

Gender inequality has adverse impacts on a number of valuable development goals (Klasen, 1999). First, gender inequality in education and access to resources may prevent a reduction of child mortality, of fertility and expansion of education to the next generation as well as prevent an increase in agricultural productivity. Gender

inequality also reduces economic growth (Barro and Lee, 1994; Barro and Sala-i-Martin, 1995; King and Hill, 1995). An analysis by Klasen (1999) concludes that if South Asia and SSA had done more to reduce gender inequality in education, their economic growth could have been up to 0.9% per year faster than it is. The author further states that gender inequality in employment has reduced economic growth by 0.3% in SSA.

For these reasons, gender equality is a core development issue and a development objective in its own right. Gender equality also enhances development by strengthening the ability of countries to grow, reduce poverty and govern effectively. It is thus an integral part of an inclusive development strategy that seeks to enable all people, women and men alike, to escape poverty and improve their standards of living.

2.4 Agroforestry

2.4.1 Deforestation: causes and effects

In developing countries, deforestation is a debatable issue because it is done to increase agricultural production to meet human needs, which is a justifiable requirement. Tropical countries also regard their forest areas as a major economic resource that should be exploited to foster economic growth and development. The ecological importance of forest ecosystems has been a very low priority issue in developing countries. In these countries, the disappearance of trees at an alarming rate is attributed to several causes; land needed for food production, wood needed for a variety of purposes including fuel and human settlement.

The three immediate causes of deforestation are: clearing the forestland for farming, demand for fuelwood and fodder, excessive commercial logging and human settlement. These factors are aggravated by population growth, infrastructure and industrial development. Deforestation has far-reaching ecological consequences on the local, regional and global scale. It carries many penalties for local populations such as loss of soil due to erosion, destruction of water balance and loss of genetic and biological diversity (Postel and Heise, 1988).

In most cases forests have been the only reserves for land and wood. Agroforestry holds great potential for systematically developing land use systems and practices where there is positive interaction between forest and agricultural components. It also has potential for meeting the local needs for fuelwood and fodder as well as increasing agricultural productivity.

In 1987, fuelwood accounted for 73% of the domestic energy in Kenya and the present trends in wood harvesting indicate a considerable increase in demand and excess depletion over reforestation in highly populated areas (Lumasia, 1996). Indeed, Omosa and Khasian (1992) point out that in Kenya, firewood is the main source of energy accounting for over 95% of domestic energy generation.

2.4.2 An overview of agroforestry and its development in Kenya

Agroforestry development and the systematic attempt by the government and donor organizations to understand it and its possible role as a strategy for sustainable development is relatively new although agroforestry has been practiced for a long time in Kenya (Getahun *et al.*, 1990). The Kikuyu of Central Kenya have long devised agroforestry practices such as selective cutting, protection of woodlands and intercropping in response to competing pressures for retaking and removing tree cover (Castro *et al.*, 1993).

It is argued that indigenous agroforestry techniques and strategies mitigated the impact of deforestation by incorporating valued multipurpose trees in local production systems. A silvo-pastoral system of agroforestry also existed in the large arid and semi arid part of Kenya. Within the broad definition of agroforestry, those traditional systems that are still in existence include windbreaks and boundary planting, mixed intercropping and enriched fallows, home gardens and fruit orchards.

Kenya's total area under agroforestry is estimated at 3 million hectares largely based in the medium and high potential areas (Energy Development International, 1985). The initial interest in agroforestry as a potential technology and farm practice was based on biomass energy supply shortfalls and the observed environmental degradation resulting from deforestation to meet increasing demands for wood, feed, and food for a rapidly growing population (Getahun *et*

al., 1990). Agroforestry as a multiple land use system was thought to enable the production of agricultural crops, tree products, and livestock from the same unit of land thereby replacing less efficient systems of farming

The growth of agroforestry in Kenya can be attributed to various factors: reduced access to government and gazetted forests and natural bush for firewood and fodder and the motivation for cash. Coupled with these are the efforts by the government shown in various policy papers and national campaigns and the efforts of Non Governmental Organizations (NGOs) and international organizations. By 1985, there were 13 major national organizations and 63 others active in agroforestry and general tree planting activities (Getahun *et al.*, 1990)

2.5 Gender and agroforestry

As with any technical "package", agroforestry as a land use system has complex economic, social and cultural ramifications and although there are a few exceptions, there has been little concentrated study of gender issues in agroforestry. There is a growing understanding that production and use of tree products at local level is embedded in complex resource use and social systems within which most of the factors that affect researcher abilities to intervene with technical solutions are non-technical in nature. They are primarily human factors connected with the ways in which people organize their land and other resources (Arnold, 1983).

The link between trees and the economic, cultural and environmental aspects of people's lives is seen in three ways: trees have an impact on rural women and men by providing products which satisfy basic needs of the family, trees affect the economic lives of rural people by providing income and jobs, and trees have an important role in protecting and enriching the environment (FAO, 1989). The way trees perform these functions depends on a person's socio-economic status, gender, age and socio-cultural environment.

Agroforestry, like other agricultural systems in Africa reflects the prevailing sexual division of labour, skill, responsibility and control within the larger society. According to Rocheleau (1987), gender based differences in legal status, use of and access to space, type of activities, and control over labour and resources, all have a direct bearing on what kind of plants can be planted, managed, used and harvested, in terms of place, person, purpose, and benefit. The author further points out that the problems and opportunities inherent in the gender division of access to land, labour, cultivated and wild plants presents a special challenge to agroforesters.

While the gender differences may limit the scope and nature of agroforestry technology and project design, there are also distinct advantages and opportunities for agroforestry within women's separate domains of space, time, activities, interests and skills. Among the explicit gender issues of relevance to women's

participation in agroforestry are women's legal status and access to productive resources and the division of space, time, knowledge and decision-making.

Agroforestry as a farming system with a diverse product mix creates much opportunity for all members of the household to be gainfully employed in the farming activities and contribute to the productivity of the whole farm system. In Zambia, Rocheleau (1988) reported that both men and women reported several important roles from trees in woodlands. For women, wild leafy vegetables were reported as major sources of family protein and cash income. Timber, which is men's responsibility, fuelwood (women's responsibility) and wild fruits were cited as important products.

Agroforestry may however cause conflicting uses of individual trees or parts of trees with both men and women using the same tree or the same tree product for different purposes. According to Nwonwu (1996), the divisibility and multi-disciplinarity of agroforestry practices offers immense opportunities to diverse categories of workers, the aged males and females, and the young males and females in the family. Crop ownership patterns, product use and marketing all experience serious gender sensitivity as shown in Table 2.1.

Table 2.1. Some gender implications of choice of agroforestry

Elements of agroforestry	Technical specification	Gender specifications
Functions or uses Soil fertility Tree products Mulch, Fodder, Fuelwood,	• Improved crop production • Rate of production	• Who determines priority use?
Location	• Soil conditions • Water availability • Landscape niche (valley, slope)	• Whose space? Available for desired use? • Private or public? • Conditions? • Diastance
Arrangements	• Spacing between crop rows, spacing within rows, effect of each on crop production • Proportionality of species • Orientation to sun and crops	• Will differ according to whose field or crop is at issue as well as land tenure system.
Species	• What characteristics are required? • How well do the species achieve these benefits	• Determined by dominant decision maker about field and tree functions • Access to and availability of desired species and cultural prohibitions.
Management	• Effect of different cutting practices, frequency, method of cutting-on desired tree output, on fertility, on nearby crops (shade) • Mulching-depth for fertility effects	• Who has the responsibility for plant establishment? • Who has harvest or cutting rights? • What do they imply in terms of frequency and nature of cutting? • Whose labour is required?

Source: Feldstein and Poats (1989)

However some cultural and social norms exist in many communities in Africa that have not only created a division of labour along gender lines, but have institutionalised some prohibitions to ownership, access and management of resources among members of the household based on their sex. In some cultures, tree planting signifies land ownership and this may hinder women's participation in tree planting activities. Women's access to credit is also limited because women have little collateral to secure credit and are often considered credit risks.

2.6 Gender analysis

Gender is often a useful distinction for analysis and project design but it is in some cases too narrowly applied to capture some of the fundamental differences among female and male producers. In analysis, it is therefore important to include additional stratifiers such as the individual producers access to resources including user rights and control over the benefits from and use of a particular resource (Bonnard and Scherr, 1994). The focus on the gender relations within which resources are controlled and used is crucial both for understanding local resource management. practices and innovations. and for assessing policies to support or supplement them. Both conventional gender blind approaches and those. which isolate women's roles for analysis. tend to obscure gender relations (Leach, 1991).

The gender analysis framework was first introduced in 1985 (Overholt *et al.*, 1985) with the realization that development planning had failed to recognize fully or systematically women's contribution to the development process. The cornerstone of the framework they proposed was an adequate database which considers what women. men and children do and why.

Wilde and Mattila (1995a) modified the gender analysis framework in order to make it suitable for the analysis of forestry projects. The gender analysis and forestry framework is a step by step tool for carrying out analysis and it contains four steps concerned with the development context. women's and men's activities and roles. men's and women's access to and control over resources and the programme actions needed in order to close the gap between men and women. This framework is designed on the

assumption that what people do, what they have, and what their priorities and needs are, provide the starting point for development.

2.6.1 Gender and household division of labour

Information on the predominance of women cultivators in most of Africa has long been available. Baumann's map (Baumann, 1928) was published before cash cropping or migration to urban areas was significant. The map, which shows Baumann's survey of 140 SSA ethnic groups, can serve as a minimum baseline. It shows that women do all the work except clearing of land in 40% of societies and do most of the work in another 45% (mixed male/female systems). Men do most of the work in only 15% of the societies.

There is a general agreement that, there are five patterns of gender responsibility (Cloud 1985). These are separate enterprises, separate fields, separate tasks, shared tasks and lastly women managed farms. They further point out that all women are not the same in all households but are further differentiated by such factors as marital status, age and class.

Gender and household division of labour, content and distribution of gendered knowledge influences and is influenced by the gender division of rights and responsibilities in national, regional and local context (Rocheleau, 1991). This division of labour has important implications even for extension services, which in many countries are the conduits not only for advice but also inputs.

In the Gambia, a study by Bastone (1988) found that women were responsible for most of the agricultural and domestic work, 53% and 73% respectively while men did only 32% of the agricultural work and 6% of the domestic work. Children did the remaining 21% and 15% of domestic and agricultural work respectively. These figures support other literature on the importance of women as agricultural producers and primary maintainers of household well being. FAO has reported labour force contribution in agriculture by women of 48% in Burkina Faso, 73% in Congo, 57% in Morocco, 59% in Namibia, 80% in Sudan and 70% in Zimbabwe (FAO, 1990).

In Taiwan, the number of hours worked by females in crop production was 54% of the total recorded time while men took up the other 46% with only a few crops taking up more male labour than female labour (Gleason, 1988). The author points out that most of the work formerly done has become mechanized and as agriculture in this part of the world becomes mechanized, more women than men will be forced out of agriculture into other sectors of the economy. This is quite contrary to common belief that as agriculture becomes mechanized, women's workload increases as cultivated land is increased. However, as activities become mechanized, crops, which were in the hands of women, may turn into cash crops and men tend to take up control of such crops.

In India, an average man and a woman of ages between 15 and 50 spent an average of about 9.47 hours and 9.53 hours per day on all activities except rest and recreation. In West Bengal, female participation in fieldwork is only 10% with the rest of the labour coming from men (Ghosh and Mukhopadhyay, 1988). The proportion of female labour

is highest in rice processing which takes place within the household premises. Weeding was also found to be an important activity for women, while seedbed preparation, irrigation and application of fertilisers is the responsibility of men. Men were found to be more involved in field activities than women in West Bengal due to caste and religion. This underscores the influence of other social factors in the household gender division of labour.

In the Philippines, some crops are fully controlled by women. Women plant, weed, harvest, thresh and make marketing decisions on cowpeas and other vegetables (Paris, 1988). In livestock, although women assist with feeding, gathering forage and cleaning the shelter, men make the shelter, buy and sell the larger livestock while women are considered responsible for small livestock such as pigs and poultry.

In North-western Australia, Rassam and Tully (1988) demonstrated the division of labour according to crops. This study found men to contribute 56% of the labour in cereal crops, only 30% in legume crops and 71% in tree crops. An activity-by-activity analysis of the labour contribution for the tree crops found that, 100% of labour used for tillage operations came from men, 66% of the labour for planting came from women as well as 79% of the labour for weeding. Seventy per cent of the pruning labour was from men.

Similar studies in Tanzania showed women to contribute 59% of the labour used in beans and 48% in maize production respectively. Activity analysis of maize showed a

labour contribution by women of 44% in land preparation. 52% in planting. 51% in weeding, 54% in harvesting and 17% in marketing while in beans they contributed 55% for land preparation, 60% for planting. 59% for weeding and 69% for harvesting. Marketing of beans was done exclusively by men (Due, 1988).

In Cameroon. a striking contrast was found between men's and women's labour hours with men and women's total weekly labour averaging 32 and 64 hours respectively (Henn, 1988). A large part of the female labour, over 16 hours was used to produce food for family consumption while men used only 4 hours for the same. Women also spent considerably more time than men producing food for the market. These are in agreement with Due's results in Tanzania (Due, 1988) where females contributed 8.5 hours per day compared to men's contribution of 7.4 hours per day in agriculture and 5.0 hours and 1.1 hours for women and men respectively in non-agricultural tasks.

In some parts of tropical Africa, men and women farm fields jointly while in some parts women have separate plots and farm other fields jointly with men. In some situations, labour is allocated by crop with men taking primary responsibility for the export/non-consumable crops while women take primary responsibility for food crops. This exclusion of women from the cash economy tends to lower their social position *vis-à-vis* men. Cultural beliefs and norms tend to reinforce this division of labour. For example in Morogoro, Tanzania, Mtoi (1988) reports that some families expressed some cultural restrictions on female labour mobility from food crop production to cash crop production and marketing. However, male labour on other activities such as

fetching water, collecting firewood, and cooking was considered completely taboo. Even in families that were flexible enough to change these roles societal restrictions and expectations of a "proper man" or a "proper woman" restrained them.

In Kenya, control over the product of labour and of labour itself, is intertwined with struggles over land and other resources. This is especially true among the Gikuyu community. In contemporary Muranga, with increasing pressure of land, one source of tension within households concerned the production of food crops primarily for use *vis-à-vis* production of cash crops. Given the greater control over the latter exercised by men, favouring cash crops has commonly prevailed (McKenzie, 1986) until a few years ago when coffee prices fell and there were irregular payments for the crop. As a form of resistance to this, women pulled out their labour from their husband's crops to work on nearby coffee and tea estates.

Although historically women tended to focus on food crops and men on cash crops, increasing male migration is forcing women to shoulder additional responsibility for a variety of crop and livestock activities. Major economic and social transformations are occurring which are changing household formations and patterns of obligation rapidly and substantially. The indices of the magnitude of these changes are the differential female and male migration, the proportion of families headed by women and the concentration of single adult households headed by women among poorer income classes (Jiggins, 1984).

2.6.2 Gender and allocation of resources

Traditionally, economists and policy analysts tended to view the household as a unit that pools resources and allocates them for production, consumption and investments as if it had a single set of preferences. However, a growing body of empirical evidence from both developing and developed countries now indicates that allocation decisions within households are commonly not consistent with the unitary household model. Allocation decisions appear to reflect both different preferences among different household members by gender, age and differences in resource control including income, assets and education as well as factors that are external to the households such as laws, norms and economic institutions. Power relations within the household and the community also affect household allocation choices (Udry. 1996; Udry *et al.*, 1995; Haddad *et al.*, 1997).

The distribution of resources within households and not just their total levels matter to intra-household allocations and investments. More specifically, increasing female command of resources plays an important role in improving the relative status of women as well as enhancing child and family welfare. Improving the equity of resource distribution is a strong explicit and implicit theme in the analysis of gender and property rights (Meinzen-Dick *et al.*, 1997). Different definitions of equity have been advanced (Engel, 1988; Farmer and Tiefenthaler. 1995) for example the fairness literature's "proportional split" which is equivalent to the intra household "contributions rule" which implies that resources should be distributed in proportion to the individual's contributions to the household. Another example is the "equal

outcomes" concept, which corresponds to "Engel's rule" where more resources are given to the more disadvantaged members of the household to bring them up to the level of other members. In some countries, formal legal equity has been achieved with the titling of land to women, land inheritance by wives and children upon the death of the husband or father and family laws that protect women (Awusabo-Asare, 1990). These changes have also been at community level such as the inheritance of land by unmarried daughters in some parts of Kenya.

According to Meinzen-Dick *et al.* (1997) the success of any policies whether to prevent depletion of natural resources, or to enhance the resource base, or to ensure sustainable resource utilization, or to improve household welfare, depends on the ability to successfully anticipate the responses of individuals. In majority of cases the responses are not as anticipated because the focus on property rights has often been on the household and the *de facto* and *de jure* male household heads without recognition of how these are differentiated between individuals based on gender, age, or other intra household characteristics. Gender as a determinant of household property rights has been studied by several authors (Poats, 1991; Moser, 1986; Thomas-Slayter and Rocheleau, 1995).

2.6.2.1 Land and land tenure

> "...As pressure on the land increases, and efforts to improve agricultural productivity are intensified, it will be even more important to ensure that women have access to and control over adequate amounts of land.

> Without the expansion of legal measures and government policies designed to meet women's need for land security, women's ability to sustain food production may be compromised...." (Bastone, 1988 pp. 39)

The pressure on land is not the only risk to insecure land tenure for women. According to the United Nations Centre for Human Settlements (HABITAT) women's rights in, access to and control over land and property are also a determining factor in women's overall living conditions, particularly in developing countries (HABITAT, 1999). It is the most critical factor in women's empowerment by virtue of owning the resource and their struggle for equity in gender relations. Their reliance on land and property for economic security and survival is only deepening as the number of *de facto* and *de jure* women headed households increases due to male migration and other factors.

Women's lack of security of tenure is the overriding feature on women's relationship to land and property. This is as a result of the economic and social discrimination against women, more particularly gender biased laws, policies and traditions that prevent women from renting, leasing, owning and inheriting land independently and leaves them dependent on their link to a man. This dependency leaves women destitute in the case of divorce, desertion, separation or widowhood.

In Kenya, rural women produce about 80% of food crops and contribute a lot to the production of cash crops and yet they only own about 5% of the land (Davison, 1987).

To peasant women, land is a vital resource, prompting one Gikuyu woman to remark, "Without land, we are nothing." Land ownership conveys the right to manage the resource and is a major source of collateral for credit. Extension agents often favour landowners, thereby giving them preferential access to information (Argawal, 1994). Without title to land, women may therefore be constrained from investing, whether through lack of knowledge or through inability to secure credit.

According to Meinzen-Dick *et al.* (1997), there are six pathways for acquiring and transmitting property rights (a) market purchase; (b) inheritance; (c) labour or other investment in improving the resource; (d) use over a certain period; (e) receiving rights from the state and (f) membership in a community. These pathways have different gender implications and barriers to women. For example, the pattern of inheritance for most communities in Kenya is generally male, whether the system is patrilineal through sons, or matrilineal through nephews. Official rights on the other hand may range from favouring men to giving preference to women and women groups.

The shift from customary tenure to more formalized private property system is a strong trend and cuts across many resources including land and trees. Consequently, the resource becomes a commodity and develops a market price. A transfer of the land accompanies the privatisation of land from either the community or state to an individual single holder. The implications for this is that, although this transfer may reduce transaction costs and facilitate market exchange, it cuts off many people who

formally had customary access and user rights to the land for the production of goods and services. In these transfers, many women and marginal users lose out.

In Kenya and indeed much of Africa, much of the policy prescriptions have argued for the need to replace community based land tenure institutions with free hold tenure backed by formal titles as exemplified in the Swynerton plan in Kenya. However, subsequent research (Besley, 1995; Bruce, 1993; Place and Hazell, 1993) has revealed that title and privatisation of land are not always necessary to secure tenure security and may even in some cases weaken it. This research casts considerable doubt on the linkage between land title and agricultural investment, indicating that land titling is unlikely to induce enhanced tenure security. This in part is due to the inequity in distribution of rights within households even in cases where these households have titles. The household head holds the title and user rights. The rights of other members of the household may be compromised and this may compromise agricultural productivity and household investment in agriculture.

Rocheleau and Edmunds (1997) point out that rights to trees are embedded in the question of land ownership. In traditional systems that recognize multiple users and rights, specific rights to or ownership of trees are accommodated. When land ownership is privatised and land becomes exchangeable, the traditional rights to trees and their products may be jeopardized as part of the reduction to unitary ownership.

According to Moore (1990), property rights involved in agroforestry are often more complex than in annual crop agriculture because property rights in trees may differ from property rights in land. One can have secure tree tenure without secure land tenure and in some situations secure land tenure without secure tree tenure. The author further points out that the distribution of *de facto* and *de jure* property rights affects who can and will use and benefit from an agroforestry system. The adoption of agroforestry may therefore affect the distribution of property rights.

Another important aspect when looking at land issues is the legal pluralism which recognizes that it is not only one legal system that applies in issues of land rights and rights to other property nor a simple division between *de jure* (statutory) and *de facto* (locally practiced) rules, but rather there are overlapping legal and normative frameworks related to property rights (Knox-McCulloch *et al.*, 1998). There are statutory, customary and religious laws and even unwritten local norms which users and potential users can base their claims on. The overlap and inconsistencies in these laws and norms give scope for negotiation and evolution of property rights.

To understand the present situation in land matters in the study area and the way they have affected women, it is important to trace land policies before and after independence especially among the Gikuyu and Wa Embu. Among the Gikuyu, land was sacred and belonged to the ancestors and according to the Gikuyu customary law of land tenure every family unit had a right of one form or another (Kenyatta, 1937). Land was held by the *mbari* (lineage or clan) and administered by a *Muramati* (guardian of

the lineage's land). The *muramati* allotted portions of land to male heads of households according to need and availability. The power to allocate land was however not synonymous with the power to sell land. The outright sale of land was not practiced. Men had obligations to ensure that all their wives and grown up sons had sufficient land to cultivate. Sons were given land upon marriage while daughters were given land to cultivate until they got married (Davison. 1987).

Trans-generational rights for land use followed the male line since it was assumed that all the daughters would get married and therefore make use of land given to their husbands in their *mbari*. Gikuyu men who did not hold land through *mbari* affiliation were given land to use by *mbari* members and were known as *ahoi*. Muriuki (1974) describes the *ahoi* as tenants while others (*ndungata*) stayed on the land of large landholders as servants. Davison (1987) sums up this traditional system as one based on principles of obligation and responsibility, which ensured that land held was cultivated within a certain period and that all members of the society, regardless of gender or social status, had access to land.

What was the woman's role in this set up? A woman's ability to act with authority was related in part to her structurally significant position in the society (Obbo, 1976). As head of a "matricentric unit", the *nyumba* (literally house or hut), of a frequently polygamous household, her usufruct rights were guaranteed by the *mbari* in recognition of her role as a prime agriculturalist. Further, she was the medium through which inheritance rights passed to her sons (Pala-Okeyo, 1978). "A man could only get land

when he married and so without a woman, there was no land!" Such was the women's feeling of their importance in the traditional tenure system.

Private ownership of land by individual registration was introduced during colonialism under the Swynerton Plan and this directly and indirectly affected women's access to land. The initial purpose of this plan was to encourage African farmers to consolidate land holdings under individual rather than collective ownership (Davison, 1987). Title was granted to men as the assumed heads of households and they were encouraged to grow cash crops by the colonial administration. Land registration effectively converted men's land rights into absolute ownership as titleholders and they had the right to mortgage or sell land without the consent of other members of the family. Evidence from Kiambu, Muranga and Embu Districts indicated that although the new system of land tenure did not pre-empt other rights to land, the resulting insecurity in land rights worked to the particular disadvantage of women (McKenzie, 1986).

Land registration has however in some cases been found to have a positive influence on women's access to land. Quisumbing *et al.* (1999) report that among the Akan of Western Ghana, the evolution towards individualized land tenure systems has strengthened women's access to land because of the practice of husbands giving gifts to their wives in return for planting cocoa. With the introduction of interstate succession law, these gifts can become the legal property of wives, a right traditionally denied them by customary law.

Some studies however indicate that attempts to strengthen land rights solely through statutory laws such as through land titling and registration have often worsened women's access to land (Kevane and Gray, 1996). According to Leo (1984), the Swynerton plan had a far-reaching effect because it set bad precedent for postcolonial policies that legitimised differential access to land and paved the way for economic disparities among the Kenyan peasantry. By 1976 for example, 7.6 million hectares had been registered mainly to male farmers (Davison, 1987) and an estimate in the early 1980s found that except in certain matrilineal areas, women comprised less than 5% of registered landholders.

Davison (1987) contends that whereas other colonial land policies such as The Crown Lands Act had detrimental effect on both men and women, the Swynerton plan particularly undermined women's relative economic stability in rural areas for three reasons; first, it gave precedence to individual ownership invested in male heads of households and in turn marginalized the usufruct rights of women formerly guaranteed under lineage tenure. Second, because land as collateral was required for credit, the plan created disadvantages in women's ability to secure credit and thirdly it fostered the capitalization of agriculture by encouraging cash crop production for the first time which further marginalized the labour of women in food production. To a very real extent, there was contradiction between women as producers/non-land owners and men as non-producers/land owners and this became pronounced with the agricultural intensification, which relied on increased labour.

Under the customary law, women had clearly defined rights to land based on their position within a kinship group and in particular, by virtue of their relationship to a man (father, brother or husband). To avoid loss of land on the death of their husbands, Gikuyu women manipulated the customary law by marrying other 'wives' thus becoming female husbands.

With land registration, there was continuation of the practice of 'customary inheritance' along lines of patrilineality. So, what happened to the women? This was dependent on the marital status of the women (Davison, 1987). An unmarried woman had and still has the right to remain in her father's homestead where she cultivated with her mother or was given a temporary plot with the assumption that she would marry away. Although it is now legal under statutory law for daughters or sons to inherit land, in practice fathers continue to transfer land to their sons. A woman who is separated is usually in a similar position to a single woman. In case of widows, whereas the normative pattern in pre-colonial Kenya was for a younger brother to inherit the widow (Potash, 1985), there is currently no such guarantee. A widow may find her access threatened by the deceased husband's male relatives or in some cases by her husband's grown up sons, who have inheritance rights where she has none. While many widows, particularly in old age are respected and treated kindly by their sons, a growing land market adds a new dimension to intergenerational gender relations within the family.

In parts of Latin America, land reforms undertaken in the 1980s and 1990s have strengthened women's legal rights to land by including provisions for joint titling and

titles for women (Deere and Leon, 1997). Women's secure land tenure and land rights may therefore be weakened or strengthened by statutory laws and procedures such as land titling and land registration.

2.6.2.2 Education

Investing in human capital is one of the most effective means of reducing poverty and encouraging sustainable development. One study on agricultural productivity showed that four years of primary education increased farmers' productivity by up to 10% (FAO, 1993). Yet women in developing countries usually receive less education than men. Increased education for women is not only a matter of justice but would yield exceptional results in terms of world food security. There is however considerable evidence that when household incomes are low, families are forced to ration spending on children's schooling, health and nutrition, often at the expense of girls.

A World Bank study, (World Bank, 1999) concluded that if women received the same amount of education as men, farm yields would rise by between 7 and 22 %. Increasing women's primary education alone could increase agricultural output by 24%. Yet in precisely those regions where hunger and malnutrition are most widespread, girls' access to education remains severely limited with the level of school attendance by girls amounting to only 68% of that of boys in the whole of Africa.

A multivariate study in Kenya showed that, if women had one to three years of schooling and the same quantities of other inputs as men, women's yield would

increase by 19% to 24% over men's yields (Moock, 1973). Higher levels of education are also positively correlated with farmers receiving and using more advice from extension agents. Farmers' literacy affects their access to extension materials. However, the higher the level of education, the less likely that both men and women will be full time farmers. A study carried out by the Women's Agricultural Productivity in Africa (WAPIA) in Kakamega, Muranga and Kilifi in 1990 under the auspices of the World Bank (World Bank, 1990) showed that the more years of schooling of both men and women, the fewer hours they spend farming their plots. Women with no formal education were found to spend almost 50% more time farming than men with no formal education. As women's years of schooling increase, the number of hours spent on farming decreases at a much faster rate than men, such that men and women with 12 and 9 years of schooling respectively spend a similar number of hours farming.

In Kenya since independence, government and parental investment in education has raised literacy levels and increased school enrolment. Female access to education has increased and their educational levels have improved. Fewer than one in three women over 40 years of age ever went to school, whereas over 60% of women aged 25 or younger have at least five years of education (Bastone, 1988). Although primary enrolment is high, about one half of the country's children fail to complete primary school and less than half the primary school leavers enter secondary school. Girls' enrolment declines and dropout rates increase more sharply than boys in later primary school and in secondary school.

2.6.2.3 Extension services

Extension programs can increase agricultural productivity and rural incomes by bridging the gap between new technical knowledge and farmers own knowledge and practices. Changing the input output ratios or farming practices increases productivity. Measurement of the effect of extension on productivity is difficult, but studies generally show that extension has a significant positive impact on farm productivity (Saito and Spurling, 1992). However, in the developing countries it is common practice to direct extension and training services primarily toward men.

A FAO survey (FAO, 1981) showed that female farmers receive only 5% of all agricultural extension services worldwide and that only 15% of the world's extension agents are women. In Egypt, women account for 53% of agricultural labour but only 1% of Egypt's extension officers are women. In regions where men are not allowed to interact with women, the resulting lack of information undermines women's productivity as well as their ability to safeguard the environment by using natural resources in a sustainable way.

In a World Bank survey in Kenya (World Bank, 1990), only 13% of farmers surveyed were in contact with the extension service with fewer female than male headed households. In the same survey, 60% of the female farmers compared to 50% of the male farmers cited unavailability of extension as their main problem in accessing agricultural information followed by infrequency of visits (30% of male and 20% of female farmers respectively). However, according to the Ministry of

Agriculture. women contact farmers have increased from 10% in 1986 to one half of the total contact farmers (GoK, 1997). Studies have shown a relationship between extension and the level of education, age and size of the land holding (Bindlish and Evenson, 1993). Being older and having a smaller holding and less income increased the probability of receiving advice; and so did being a group member. Twice the number of farmers in households headed by someone with more than eight years of schooling received advice than did farmers in households headed by someone with no schooling.

The implications of the sex of the extension agent are a complex issue in extension studies. In some parts of Kenya such as the study area, social norms do not prohibit a male agent contacting female farmers. Extension agents work with both male and female farmers and the farmers meet with both male and female agents. However, although this interaction is common, some studies have shown that it presents some problems.

A study in Muranga and Machakos found that 67% of both men and women were comfortable with either male or female extension agents and 75% of the agents had no problems with the sex of their target audience. Forty two per cent of the agents however indicated problems working with individual women farmers, and perceived women farmers as having more difficulties than men in terms of access to capital, tools and equipment, general interest and shyness (World Bank, 1990)

Fernandez (1988) argues that extension agents face the risk of making the situation of women worse. In areas where women are responsible for certain activities, advice on these activities is given to the men. This reinforces the rights of men to give information and make decisions concerning the particular activities. They also face the risk of not tapping the indigenous knowledge held by women in certain activities. Alberti (1988) cautions that when information is channelled through male information networks and from male to female within the households, women are clearly disadvantaged in learning about new technologies. These findings suggest that while male extension agents can and do work with women farmers on a one-to-one basis, more attention must be paid to improving this interaction. In the 1990 World Bank survey, it was found that most extension messages were in food crop storage and processing, home economics, fertilizer and pesticide use, improved seeds, land use and livestock. Conspicuously missing were any messages on tree planting and soil conservation.

2.6.2.4 Agricultural credit

Small farmers in general face severe cash problems. The agricultural sector as a whole receives inadequate formal credit. The Kenya government has tried to provide credit to the agricultural sector through credit quotas, interest rate regulations, and specialized credit institutions. However, most small holders still have no access to credit and rural women represent less than 10% of the borrowers. Late, uncertain, and irregular payments for cash crops create liquidity problems for farmers (World Bank, 1990).

The capacity to adopt innovations, increase agricultural productivity and undertake viable economic activities is thus compromised. Money lending institutions such as the Agricultural Finance Corporation (AFC) prefer channelling their credit to large and medium scale farmers who are considered less risky. Other formal institutions and especially co-operatives extend credit to their members against the future crop.

Women in particular have less access to credit than men due to their lack of control of assets, which they can use as collateral. Most lending agencies consider women high credit risks, and local practices and customs militate against their access to credit resources. Women's lower educational and literacy levels compound their difficulties in dealing with formal institutions

One of the stereotypes of women is that they are more concerned with stabilizing household subsistence needs than with cash income (Warren, 1992). The empowerment of women in some countries has been accompanied by their increased participation in the cash economy and a growing number of organisations and women's co-operatives that give loans to women at affordable interest rates.

A study in Muranga, Kakamega and Kilili in Kenya found that although more females than males in absolute numbers use credit, substantially more male than female-headed households used credit (Bastone, 1988). Even when women have access to credit, this is from informal sources such as relatives, friends and moneylenders where collateral is not required. The lack of access to credit by women is despite the potential impact of

female borrowing on households. Evidence from micro credit programmes in Bangladesh indicates that access to credit is empowering to women (Khandker, 1998). Female borrowing is associated not only with increased earning capacity and improved command over assets for women but also with increased autonomy and greater decision making capacity within the home.

2.6.2.5 Agricultural technology

The adoption of improved farming technologies such as fertilizers, high yielding varieties of crops, agroforestry and others can increase agricultural productivity. Investigation of technology transfer in Kenya found women to be more frequent adopters than men of recommended practices that required little or no cash outlay such as spacing or planting. When individual technologies requiring cash outlay were considered, the adoption rates by women were lower than men with tractor cultivation showing the largest gender differences (Bastone, 1988).

Gender is clearly an important factor to be considered in designing and disseminating technology. This is because certain technologies are more likely to be used by women than men. A central question according to Garret and Espinosa (1988) is whether the technology has been developed for traditionally male or female enterprises.

2.7 Gender and productivity

The issue of separate returns and incentives is important in understanding relative productivity by gender. There have been few rigorous econometric studies of men's versus women's agricultural productivity and these have used different

methodologies. If the same technology is available to both male and female farmers, and if they are producing the same crop, then it is appropriate to estimate one production function, and to allow for sex differences by using a sex dummy. This approach has been commonly used to estimate differences in technical efficiency between male and female managers or household heads.

Moock's work was carried out in 1973 and 1976 and measured output from a sample of 152 Kenyan farmers including 51 female heads of households (Moock, 1976). Moock estimated Cobb-Douglas yield functions for all farms, with a female manager dummy and for male and female managed farms separately. His regression results indicated that if differential access to the factors of production - credit, fertilizer extension, fertile soils were statistically controlled. women farmers raised about 7% more maize than men farmers. In reality, women raised about 4% less.

There are other studies that have obtained almost similar results. Staudt (1978, 1985) found out that where neither men nor women had much access to inputs and credit, women tended to adopt improved maize earlier and grew more diversified crops. Ram and Singh (1988) in an econometric study in Burkina Faso found women to be 60% more productive than men in agricultural production. Another study in Burkina Faso by Bindlish *et al.* (1993) offers an interesting contrast to the above results. Regression results showed that female heads of households are less productive than men in most crops and have total values of outputs that are 15% lower.

Jacoby (1991) studied households in the Peruvian Sierra and used both Cobb-Douglas and sequentially restricted translog production functions to estimate marginal products and test for the substitutability of male and female labour. The author estimated two Cobb-Douglas functions for crops and livestock and found that while adult female labour did not have a significantly positive effect on crop output, it was highly significant in the livestock equation. Adult males had about the same coefficient in both crops and livestock. According to Jacoby (*op. cit.*), a sexual division of labour implies that labour productivity of men and women will be differently affected by the presence of other outputs.

Another approach to estimating sex differences in technical efficiency involves performing regressions on plot-level observations either for the pooled sample of male and female managed plots or for male and female plots only. This method has been used by Saito *et al.* (1994) in their study of three districts in Kenya. In this study, the Cobb-Douglas functions with the gross value of maize, beans and cowpeas per hectare as the dependent variable were estimated using plot level observations, further disaggregated by the sex of the plot manager. In this study the plot manager dummy and land rights dummy were not significant for both men and women, while capital was a positive and significant determinant of the gross value of output per hectare.

Udry *et al.* (1995) regressed plot yields on plot characteristics and individual characteristics including the sex of the plot manager. The study suggests that

asymmetric roles and obligations within the household have serious implications on allocative efficiency of resources. Under the null hypothesis of Pareto efficiency, conditional on plot size and land quality, yields on plots planted with the same crops in the same year should be equal, even if different members of the household control them. The author identifies two sources of resource misallocation within households (a) individuals' greater incentive to achieve higher output on their own plots than on others and (b) imperfection in the intra household labour allocation process. This is consistent with the argument of anthropologists and feminist economics literature that gender differences lead to allocative inefficiencies within the household.

Kumar and Hotchkiss (1988) estimated translog production functions for various crops and tested for separability between male and female labour in Nepal. Separability implies that the marginal rates of return between pairs of factors in the separated group are independent of the levels of factors outside that group. The separability test indicated that except for the dry season crops, men's and women's labour are weakly separable. This suggests that for some crops, there is little justification for aggregating men and women's labour.

In summarizing the methodologies used in estimating sex differences, Quisumbing (1996) argues that using a dummy variable for female or male head of household masks the details of household composition and intra household decision making and suggests that it may be more appropriate to disaggregate by

sex of the plot manager. This distinction is particularly important in households where the husband is the titular head but the wife makes majority of the farm decisions. This is especially true if the husband is absent for prolonged periods due to migration for wage work or if the wife in a polygamous marriage has her own farm. The author further states that insights into household decision making processes are limited not only by the lack of gender disaggregated data but also by conceptual difficulties in defining what to measure. Some agricultural decisions may also be simultaneous and may involve non-unitary preferences and even uncooperative behaviour within the household.

2.8 Measuring differences in technical efficiency

The current interest in efficiency measurements finds its origins in a paper published by Farrell (1957). The approach proposed by Farrell distinguishes between technical and allocative efficiency, where the former refers to the ability of producing a given level of output with a minimum quantity of inputs, given technology and the latter refers to the choice of the optimal input proportions given relative prices.

Several methodologies have been used in the determination of technical efficiency. Farrell uses a deterministic non-parametric approach, which attributes any deviation from the production frontier to inefficiency. This approach has been used by Forsund *et al.* (1980) and Amara *et al.* (1999) among others. This method measures technical efficiency by comparing observed (actual) input coefficient points for a firm with the efficiency frontier input coefficients for the same factor

proportions. Bravo-Ureta and Rieger (1991) point out that a deficiency characterizing these deterministic frontier models is their sensitivity to extreme observations.

The stochastic frontier model developed by Aigner, Lovel and Shimdt (Aigner *et al* 1977) ameliorates the extreme observation problem in deterministic models by including two components, one a random factor component and another, which captures the effects of inefficiency on the model. Yao and Liu (1998), Bravo-Ureta and Rieger (1991) and Dawson (1985) have used the stochastic model.

One of the methodological issues that have arisen over the use of these methods is the appropriateness of using cross sectional data. Dawson (1985) has cast doubt on the usefulness of technical efficiency measures based on cross sectional survey data as they can be influenced by particular events in that period. The author further argues that estimates of technical efficiency, which are systematic over time, are of more value than those based on a one years data since they are less susceptible to spurious errors. The estimates are however still abstract since they do not take into account technological change. Ekanayake and Jayasuriya (1987) take this argument further and conclude that the long-term true value of technical efficiency may not be what is important. What is important according to the authors is analysis and identification of the determinants of technical efficiency over time.

From an applied perspective, measuring efficiency is important because this is the first step in a process that might lead to substantial resource savings and this has important implications for both policy formulation and farm management.

The literature on technical efficiency is deficient of studies in Africa as well as the comparison of technical efficiency based on farm management. The analysis in this study contributes to the literature on farm level efficiency measurement by comparing the technical efficiency based on farm management and makes an evaluation of the relationships.

2.9 Using time allocation in productivity studies

Time is a resource that individuals must make decisions on how to manage. These decisions reflect the constraints and opportunities surrounding human goals. Time allocation helps in illuminating activities or features that are not obvious from other conventional methods of data collection. Most small-scale farmers in developing countries operate at the household level as a unit of production and consumption and as a result, the activities of all members are tied to the farm enterprise (Wollenberg, 1988).

Time Allocation Studies (TAS) have been used to describe gender and age based labour patterns (Wollenberg, 1988). Labour patterns have been analysed to support a wide range of findings including the determination of peak labour periods (Price and Barker, 1978: Maxwell, 1984), income opportunities for female farmers (Burfisher and Horenstein, 1985), the contribution of children to farm production (Navera,

1978), crop labour investments (Barlett, 1980), seasonal fluctuations in agricultural and non-agricultural activities (Norman *et al.*, 1981) and interhousehold differences in the family cycle (Cadelina, 1985).

One advantage of time allocation is that while it gives a breakdown of the quantity of labour by different members of the household, it also shows how labour is allocated between activities, between crops and even between productive and reproductive activities.

2.10 Theories of the household and their application

Several theories of household decision-making have been posited over the decades (Haddad *et al.*, 1997). One theory holds that households act as single or "unitary" decision making bodies. This theory assumes that either all household members have the same preferences or that the head of household acts completely dictatorially, neither of which is likely. Another theory looks at the household as a "collective" entity where the sometimes, conflicting interests of individuals within the household are combined in various ways to reach a collective choice These two theories have different outcomes for welfare and development policies. The unitary approach predicts that the success rate will be the same regardless of whom in the household a policy targets while the collective approach suggests that the identity of the recipient will affect how transfer is used and who benefits. The consequences of these two types of models have been explored in literature and methodologies have been developed which permit empirical testing of the different predictions of the models

(Manser and Brown, 1980; McElroy and Horney, 1981; Chiappori, 1988; McElroy, 1990; Chiappori, 1992; Bourguignon and Chiappori, 1992; Browning *et al.*, 1994).

In many regions, the extended family makes a definition of a household difficult. In one area of Africa for instance, the definition became those people who eat from the same pot or use the same cooking fire (FAO, 1989). There is dispute on the validity of a household as a valid universal term and the idea of an African household being a single unit of decision-making has been challenged. African households normally have strong ties of an economic nature, which can take the form of money remittance, labour exchanges and other mutual obligations. These often-complex structures are due to the strength of the kinship systems and the prevalence of rural-urban migration.

Freedman and Mueller (1978) cited by Casley and Lury (1987) point out that in developing a definition for a household, the social structures and living arrangements found in the study area should be considered. The authors have identified three features that researchers may rely on in deciding household composition; a common source of the major part of the income, sleeping under one roof or within one compound and a common source of food. This study adapted the definition by Casley and Lury (1987) that defines a household as a person or a group of persons generally bound by ties of kinship, who live together under a single roof or within a single compound and who share a community of life in that they are answerable to the same head and share a common source of food.

It is important to distinguish what this exactly means among the Gikuyu and Embu. What is referred to as a household is called *mucii*. This is the largest, residential, socio-economic unit. It includes the dwellings of the residents, often their separate granaries and enclosures attached to the dwellings in rural areas. Within one *mucii* there may be several *nyumba* (literally "house"), which provides a focus for major functions in the procreation and socialization of children and in preparation and consumption of food (Black-Michaud, 1981). When there are several *nyumba* within one *mucii*, these are often multiple production units. The head of household may give an unmarried son or daughter a piece of land to cultivate In households where the male head has more than one wife, each wife has her own *nyumba*. When assessing who exercises control over decision-making and the allocation of resources, it becomes critical to evaluate the parameters of each production unit within each household independently. For the purpose of this research, when such cases were encountered, each of the *nyumba* was taken as a separate unit of analysis. A conceptual model of household resource allocation is shown in Fig. 2.2

The conceptual model implies that production decisions are affected by the resources that households command, the household structure as well as the external environment, which includes markets and other institutions. Consumption decisions on the other hand are determined by the household structure and the external environment. Both the production and consumption decisions have a bearing on the household outputs and inputs requirements.

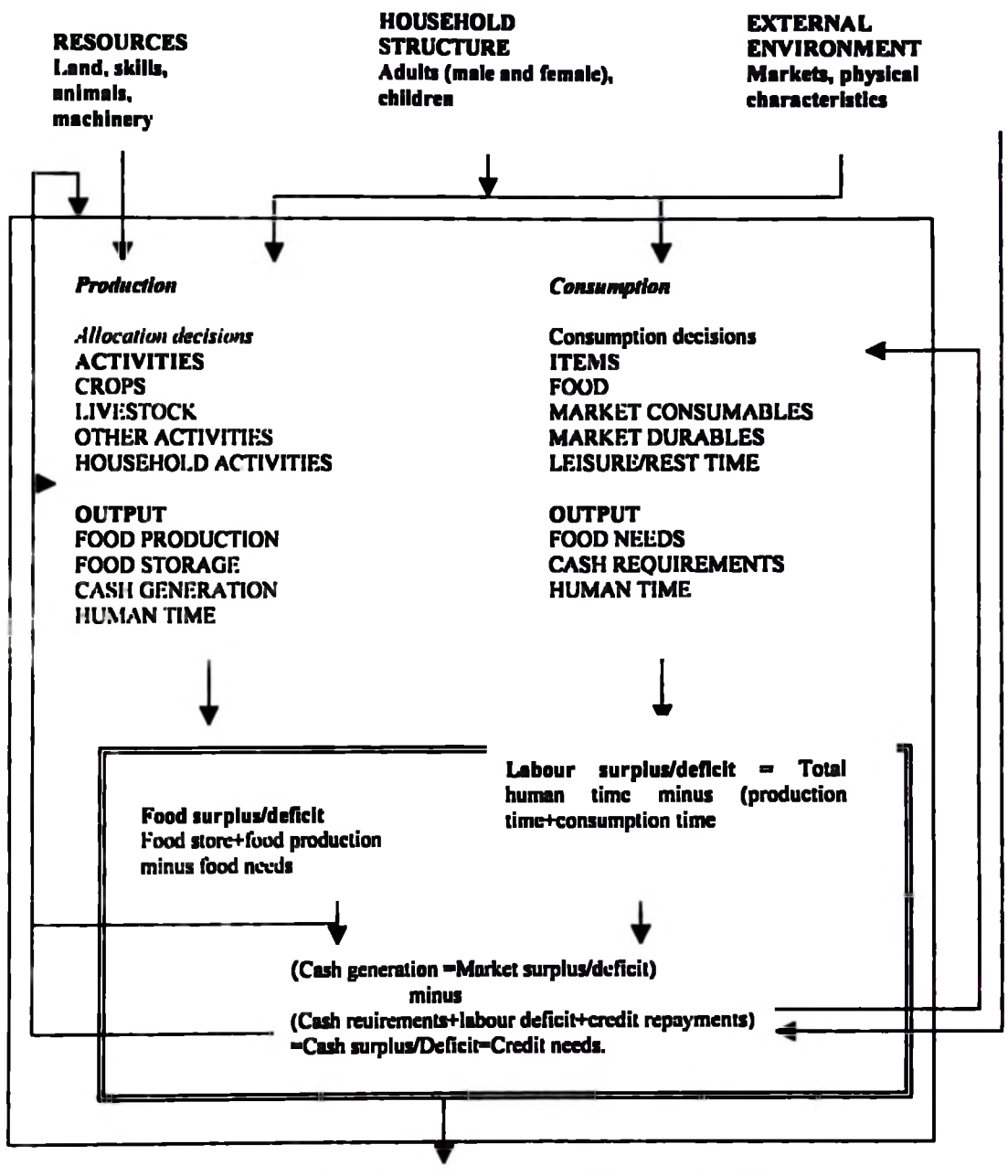

Figure 2.2. A conceptual model of household resource allocation
Source: Rushton (1996)

2.11 Gender and collective action

2.11.1 The concept of collective action

According to Banki (1981) collective action is a dynamic group process in which all members of a group contribute to the attainment of group objectives, share the benefits from group activities, exchange information and experience of common interest, and follow the rules, regulations, and other decisions made by the group.

Collective action can take many forms; attending meetings to discuss matters of common interest, contributing money, labour or both to activities of common interest to the group or the community, seeking knowledge, information and sharing it with other members, adoption of technologies and practices recommended by projects, governments or NGOs and many others. There is a growing body of research, which outlines the conditions for creating and effectively sustaining collective action (Nugent, 1993; Rasmussen and Meinzen-Dick, 1995; Runge, 1986; White and Runge, 1994).

To development agents and governments, there are several major rationale for collective action. These include (a) the reduction in development cost when groups are used as opposed to individuals (b) there is an increase in the actual and perceived benefits to the people (c) increase in the level of political awareness of the people (d) governments and development agents can deliver the benefits of development to all legitimate claimants (e) people gain access and control of resources (f) gradual empowerment of the socially and economically marginalized people and (g) there is easier mobilization of local resources for the benefit of the people.

To individuals. collective action builds social capital and fosters empowerment by strengthening the bargaining power of disadvantaged and marginalized groups. Through collective action, individuals build common objectives, which identify the group. and give them a voice (Knox-McCulloch *et al.*, 1998).

2.11.2 Theoretical orientation to collective action

If a relatively high number of individuals make high demands on a single resource. do not communicate with one another, and act independently, taking only their own independent return into account, the "tragedy of the commons" is likely to occur as described by Hardin (1968). The tragedy may take the simple form of overexploitation or the more complex form of destruction (Ostrom, 1990). The emergence of coordinated action with regards to the management of these resources is what constitutes collective action.

There is no universal theory of collective action but there are conditions under which people do or do not participate in collective action. Olson (1968) has challenged a generally held view that groups of individuals having common interests usually work together to achieve them. The author argues that "...unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational self-interested individuals will not act to achieve their common or group interests" (Olson, 1968. p 2). The same author goes further to say that in some cases, certain small groups can provide themselves with collective goods without relying on coercion or any positive

inducements apart from the collective good itself. This is because in such groups each of the members will find that the personal gain from having the collective good exceeds the total cost of providing the collective good. The author concludes that the success of a group in providing itself with a collective good depends on the logical structure of the group.

Hardin (1971) has summarized the mathematical demonstration of collective action given by Olson (1968). The advantage (A_i) which accrues to an individual member (*i*) in a group because of his contribution to the purpose of the group collective good is given by;

$$A_i = V_i\text{-}C$$

Where V*i* is the value to *i* of his share of total collective good provided to the group at cost C by *i*. This implies that *i* will contribute to the purchase of group collective good on his own rational incentive only if his share of that part of the good purchased at his cost is worth more to him than it costs him (Olson, 1968).

Buchanan and Tullock (1965) hold the same view that individuals would choose collective action when each of the individual members finds it profitable to act collectively rather than individually, i.e. when the perceived costs are less than the perceived benefits from the collective action.

The theory of margin developed by McClusky (1970) states that the majority of rural people in most of the third world have heavy load and little power to cope and are too pre occupied with mere survival to participate meaningfully in development activities that involve collective action which means that for such people to participate, there must be efforts to reduce their load or raise their power or both. Load in this case is defined as the self and social demands by a person to maintain a minimum level of autonomy while power is described as the resources such as abilities, possessions, position which a person can command in coping with this load.

However, the costs of transforming a situation from one in which individuals act independently to one in which they co-ordinate activities can be quite high. Some appropriators of collective action succeed while others fail Theoretically, there is no coherent explanation for why some succeed and others fail Ostrom (*op. cit*) suggests that both the theory of the firm and the theory of the state can each provide an explanation for one way in which collective action can be achieved.

2.11.3 Women and collective action in Kenya

Women groups are a common phenomenon in many African countries (Ardener and Burman, 1995; Nelson, 1995). Membership offers many women the best hope for improving their lives. The groups have come to play a significant role in the social and economic life of their communities.

Women groups provide a forum through which valuable information is transmitted, new ideas are exchanged and various issues discussed informally (Mazingira Institute, 1992). They also empower women in that they become to some extent economically independent from their men and achieve social standing within the community. They are natural vehicles for liberating and strengthening women in patriarchal societies (Ahlberg, 1988; Ardener and Burman, 1995). Working collectively, women are often better able to gain rights where they can most benefit and by means that they construe to retain the complimentary nature of their own, and their families' livelihoods.

In many cases, collective action by women has been instrumental in securing rights for women either as a group or individually. Where women are blocked from holding land individually, they may be able to obtain a parcel for a women's group to use for a collective garden or nursery. It may also lead to a change in rules, permitting individual women to obtain stronger rights over a resource. Members are usually relatively homogenous socially, having links of friendship, which help in building trust and accountability (Nelson, 1995). Apart from registered groups, many women carry on their traditions of co-operation and mutual assistance through informal support networks, which may be just as important to them as formal or commercial activities. Revolving loan associations (often called "merry-go-rounds") are common; each member contributes a pre-determined amount of money at regular intervals and the money is distributed to members in rotation (Mazingira Institute, 1992).

Only a very small percentage of Kenyan rural women are engaged in wage employment and although the majority of them work as subsistence farmers, customary laws that insist on male ownership and inheritance of land bar them from owning land. Group formation enables these women to engage in economic activities and capital formation that are otherwise denied to them as individuals either by custom or by law. These groups offer a source of credit to women without the need for collateral as required in the formal credit organizations such as banks and co-operatives.

Although it is difficult to pinpoint at what point women started organizing into groups, Kenyan women have a long tradition of helping each other through mutual aid and solidarity groups. In pre-colonial times, they helped each other by organizing agricultural work groups and childbirth support networks to cope with their socially assigned work and family responsibilities. These groups were based on the traditional division of labour that assigned most of the day-to-day responsibility for food production to women. Women would gather in small groups to cultivate and harvest each other's crops, moving from one farm to the other until all was done (Mazingira Institute, 1992). This system relieved some of the burden of working and provided extra labour during peak agricultural seasons such as harvest time.

Working together, women were able to make their labour more efficient and productive (Nelson, 1995). Stamp (1989) interprets the activities of women's groups as a way of channelling cash from crops into self-help organizations to prevent

appropriation of their product by their husbands and secondly to accumulate capital as a means of protecting and enhancing their fragile incomes and compensating for lost domestic production.

CHAPTER THREE: METHODS

3.0 Overview

This chapter gives in detail the methods used in data collection and analysis aimed at answering the objectives laid out in Chapter 1. The first section describes the study area in terms of climate, altitude, soils and population. The second section gives the theoretical and conceptual framework on which this research was based. The remaining sections are arranged by objectives and under each, the methods used to collect data, the sampling design and the data analysis. The last section gives the limitations of the study.

3.1 The study area

3.1.1 Kenya: Population and administrative divisions

Kenya is situated along the East African Coast and lies between 4° S and 4° N, and 34° E and 42° E with a total land area of 580 000 km². About 90% of the total land is considered to be agricultural land. Of the total land surface in Kenya, about 80% is classified as Arid and Semi Arid Lands (ASALs) while the remaining 20% comprise the high-medium potential areas (GoK, 1997). Kenya is bordered by Tanzania on the south, Uganda on the west, Sudan on the northwest, Ethiopia on the north, Somalia on the east and the Indian Ocean on the southeast. During the 1989 census, Kenya had a population of 25 million people (GoK, 1994). This has increased to 28 million with females comprising 49.9% of the total population (GoK, 2000)

Administratively, Kenya is divided into eight provinces; Central Province, Rift Valley province, Nyanza province, Western province, Eastern province, North

Eastern province, Coast province and Nairobi province. The provinces are further subdivided into districts and the districts into divisions. Each division is divided into locations and each location comprises of several sub locations. The smallest and lowest level of administration is called a unit and each unit is made up of between 30 and 200 households depending on its size. Each unit is under a unit elder who answers to the Assistant chief who heads a sub-location. These units also form the extension units used by the Ministry of Agriculture's extension department.

3.1.2 Agro-ecological zones of Kenya

Jaetzold and Schmidt (1983) have provided a detailed classification of the agro-ecological zones (AEZ) of Kenya. This classification consists of zone groups classified according to temperature belts, which are defined according to the maximum temperature within which main crops can grow. According to this classification there are 7 main belts; Tropical Alpine (TA), Upper Highlands (UH), Lower Highlands (LH), Upper Midlands (UM), Lower Midlands (LM), Lowlands (L) and Coastal Lowlands (CL). These belts are further categorized into zones. This study was carried out in the Upper Midlands one (UM1) and Upper Midlands two (UM2).

The agro-ecological zone UM1, also called the Tea-Coffee zone, is temperate and humid with an annual average precipitation of at least 80% of the potential evapotranspiration. It rises from 1590m to 1830m above seal level (a.s.l.). The zone has two rainy seasons with the first rains starting in mid March and the second rains

starting in mid October. Annual rainfall in the zone ranges between 1400mm and 1830mm. The climatic conditions are favourable for coffee. tea and maize.

The agro-ecological zone UM2, that is also called the Main Coffee Zone, is temperate and sub-humid with an annual average precipitation of 65-80% of the potential average evapotranspiration. The rainfall in this zone ranges between 1400 and 1590mm and comes in two rainy seasons with the first rainy season starting in mid March and the second rainy season starting in mid October (Jaetzold and Schimdt, 1983). This study was carried out in Embu and Kirinyaga Districts in the agro ecological zones UM1 and UM2. Fig. 3.1 is a map of Kenya showing Embu and Kirinyaga Districts and the agro-ecological zones UM1 and UM2.

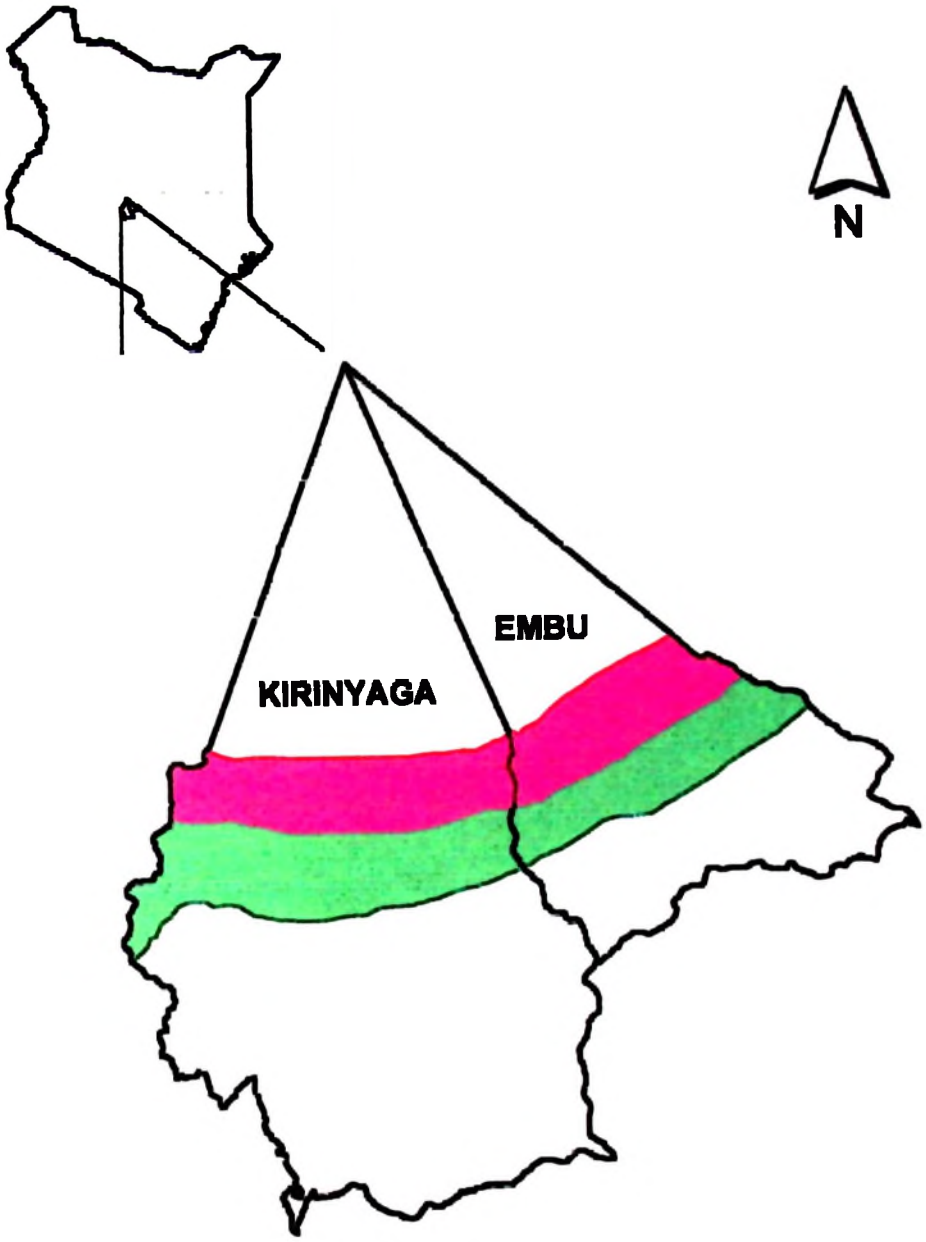

Figure 3.1. Map of Kenya showing Embu and Kirinyaga Districts and the agro-ecological zones UM1 and UM2.

3.1.3 Climate and soils of Embu and Kirinyaga Districts

The central highlands lie on the slopes of Mt Kenya with an altitude ranging from 1300m to 1800m a.s.l. Rainfall is bimodal and averages from 1200mm to 1500mm per year (Minae and Nyamai, 1988). There are two cropping seasons with the long rain season starting from mid-March through to July and the short rain season from mid-October through to December. The central highlands have a high population density, which ranges from 230 to 730 persons per km^2 with an average of 450 persons per km^2.

Embu district occupies an area of 2714 km^2 and rises from about 515m to over 4570m a.s.l. Most of the district is covered by clay soils of different types except for a small area that is covered by loam soils (GoK, 1989b). Embu District has two rainy seasons in a year. The long rains come from March to May and the short rains from October to December. The district has a dry spell between January and February and June through September. The lower parts of the district have less than 550mm per year while the upper parts receive over 1000mm per year.

Kirinyaga District covers an area of 1437 km^2. The northern part of the district is covered by Mt Kenya forest occupying 308 km^2. The higher parts of the district are conducive for cash crops because of high rainfall and an altitude over 1800m a.s.l. These parts receive rainfall of between 1015mm and 1200mm per year while the lower zone receives 700mm to 1000mm per annum. A small portion of the district on

the low plains receives less than 700mm of rainfall per annum. The long rains are from March to May and the short rains from October to December (GoK, 1989c). Soils in the upper parts of Kirinyaga District are rich, fertile, red clay soils in the tea zone while the coffee zone has mainly nitosols and the lower zone has black cotton soils mainly vertisols, ferralsols and acrisols. The major land use in this lower zone is rice, cotton, horticultural crops and zebu cattle (GoK, 1989c).

Fig. 3.2 and 3.3 show the rainfall and temperature patterns for Kirinyaga and Embu Districts during the study period. The rainfall during the study period was lower than the average for the two districts and this led to lower yields being recorded during the study period.

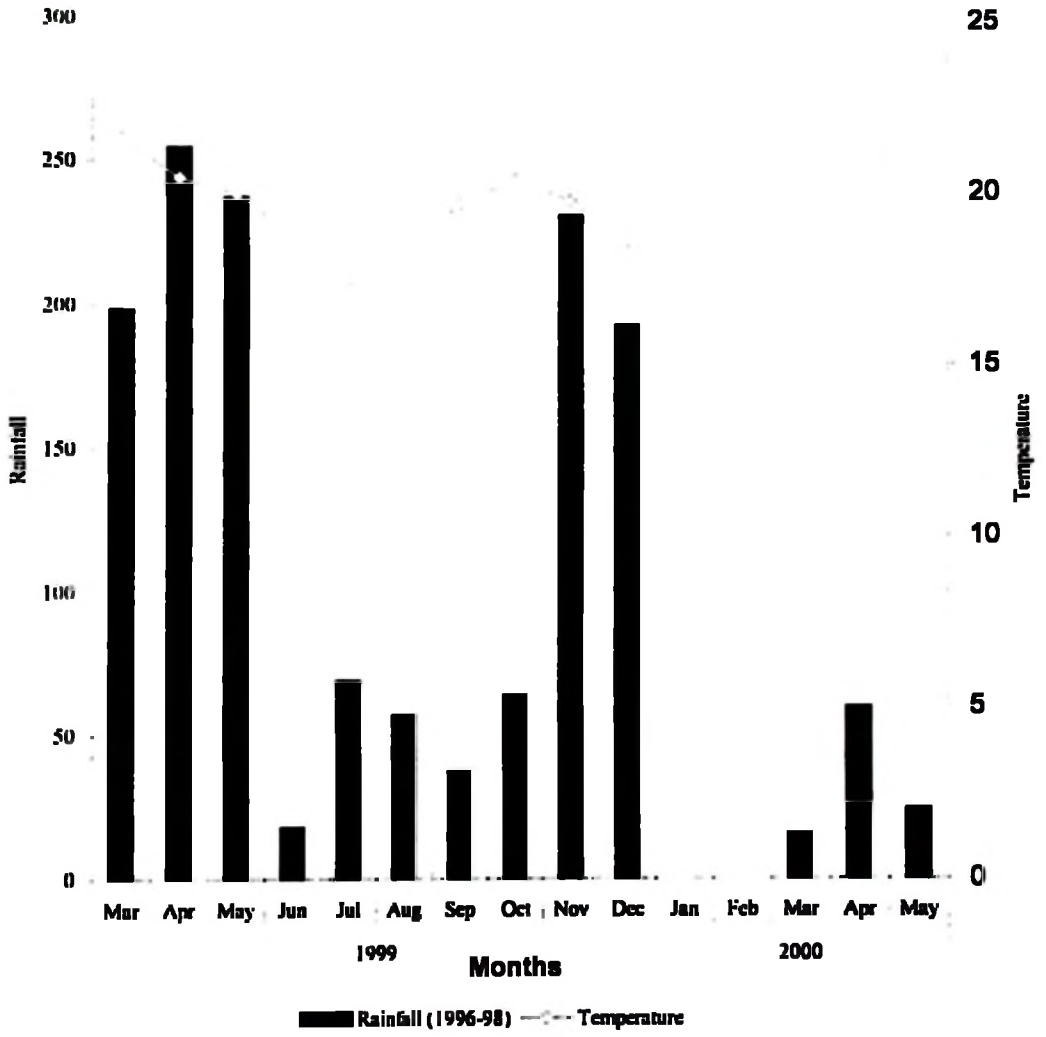

Figure 3.2. Distribution of rainfall and temperature in Kirinyaga District, Kenya

Source: Kerugoya meteorological station, 2000.

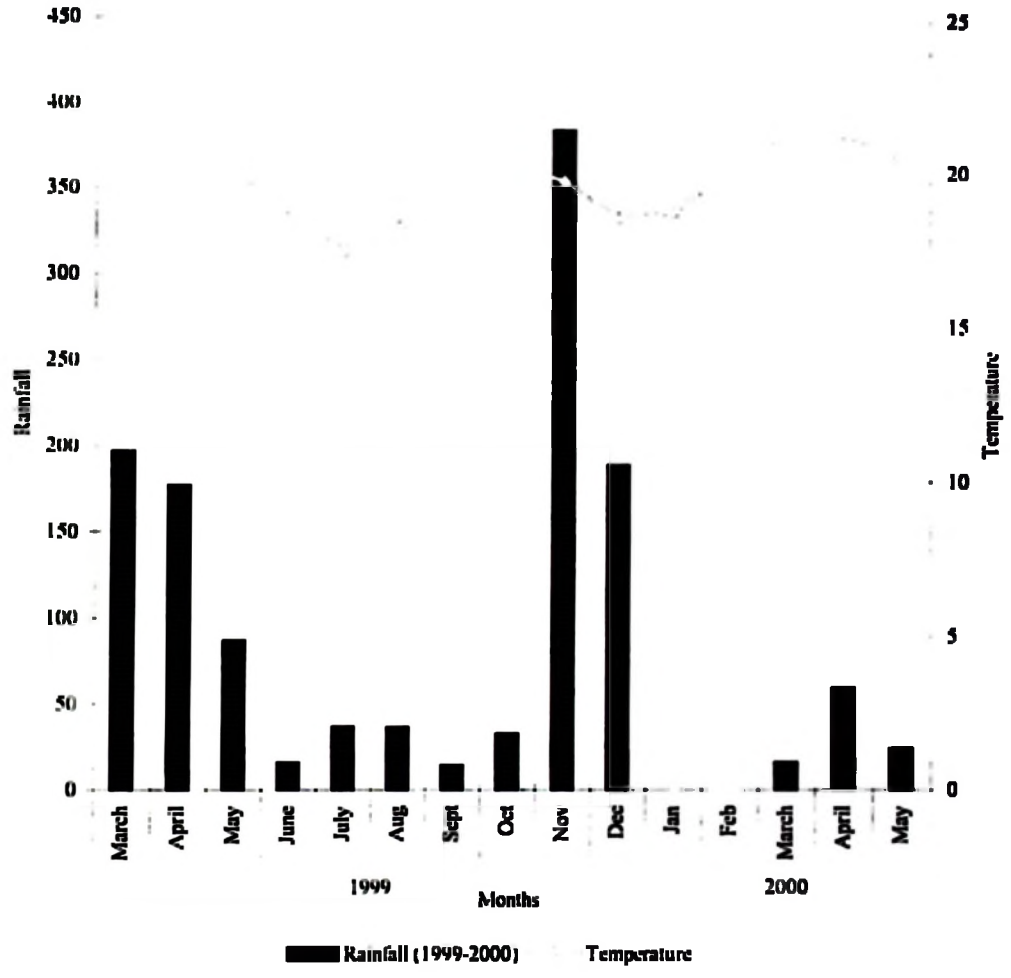

Figure 3.3. Distribution of rainfall and temperature in Embu District, Kenya.

Source: KARI-RRC Embu Meteorological station, 2000.

3.2 The theoretical framework

This study was based on the rural areas of Kirinyaga and Embu, which are among the districts in Kenya that form the mandate area of ICRAF's Agroforestry Research Network for Africa in the bimodal highlands of Central and Eastern Africa. The two districts were selected because of the high level of intensification of agroforestry activities as opposed to the other districts under this project.

The study is concerned with the concept of gender, its application and role in agroforestry. In particular, the study looks at the gender division of labour in agroforestry and the differential access of men and women to resources and how these affect the productivity of agroforestry as well as farm technical efficiency. The study also sets out to establish the relationship between productive, reproductive and community roles of men and women, how these interact and the institutional linkages in these roles.

In Kenya as in the rest of the world, gender research has always gone up to a certain level except in some few instances, i.e. establishing the gender division of labour and the associated differential access to resources between men and women. This study goes beyond this by trying to critically analyse how this division of labour and access to resources affects the productivity of farming systems and specifically agroforestry.

The main rationale for this study arises from the fact that a lot of generalizations have run rampant on the roles of men and women who have always been taken for granted despite the changing structure and functions of the household all over the

world. A one season time allocation study was done on some of the sampled households and several methods were utilized to capture exactly what the men and the women in these households do and how much time they take to do it.

Apart from the differences arising due to sex, men's and women's roles and effect on productivity are also affected by other factors such as education, age, extension services, credit services among others. The context of the extension services, contact person in the household and sex of the extension workers was of particular interest in gauging whether extension services are suited to meeting the needs of both men and women in agroforestry. Both men and women are involved in different elements of subsistence and income generating agricultural activities and although their tasks may be complimentary, they are also distinct.

The other rationale is that there has been a failure by most research to study the local distribution of time and labour and this has resulted in the targeting of training and resources to the wrong or the secondary person in the household thus decreasing the efficiency and effectiveness of the effort. Therefore, apart from providing information necessary in government planning and policy formulation, the results of this study will be useful to rural focused projects that wish to incorporate gender considerations in their design, implementation and monitoring.

One pertinent limitation of this study is the difficulty of separating agroforestry from the rest of the farming system and this study looks at the whole farming system due

to the interactions that exist between all the components of the system. There is however a special emphasis on gender and tree planting.

This study used the principle of the three multiples described by Fisher *et al.* (1991). First, multiple data sources were used to obtain information on the same variables. Thus there was a triangulation of methods both qualitative and quantitative. Each source provided a reliability check on the other sources while at the same time providing additional insights into particular issues and relationships. Qualitative methods provided an insight into reasons for some of the issues brought about by the quantitative methods. They answered the question of why and how.

Second, multiple measurements of the same variables were taken especially during the time allocation studies. Third, multiple replications in this case in Embu and Kirinyaga in order to provide information on whether trends observed are only particular to a certain area or can be generalized to other areas. This generalization is however limited as is indicated in the limitations of the study. The data collection instruments are given in Appendix 2, 3, 4 and 5 while the conceptual framework is given in Fig 3.4.

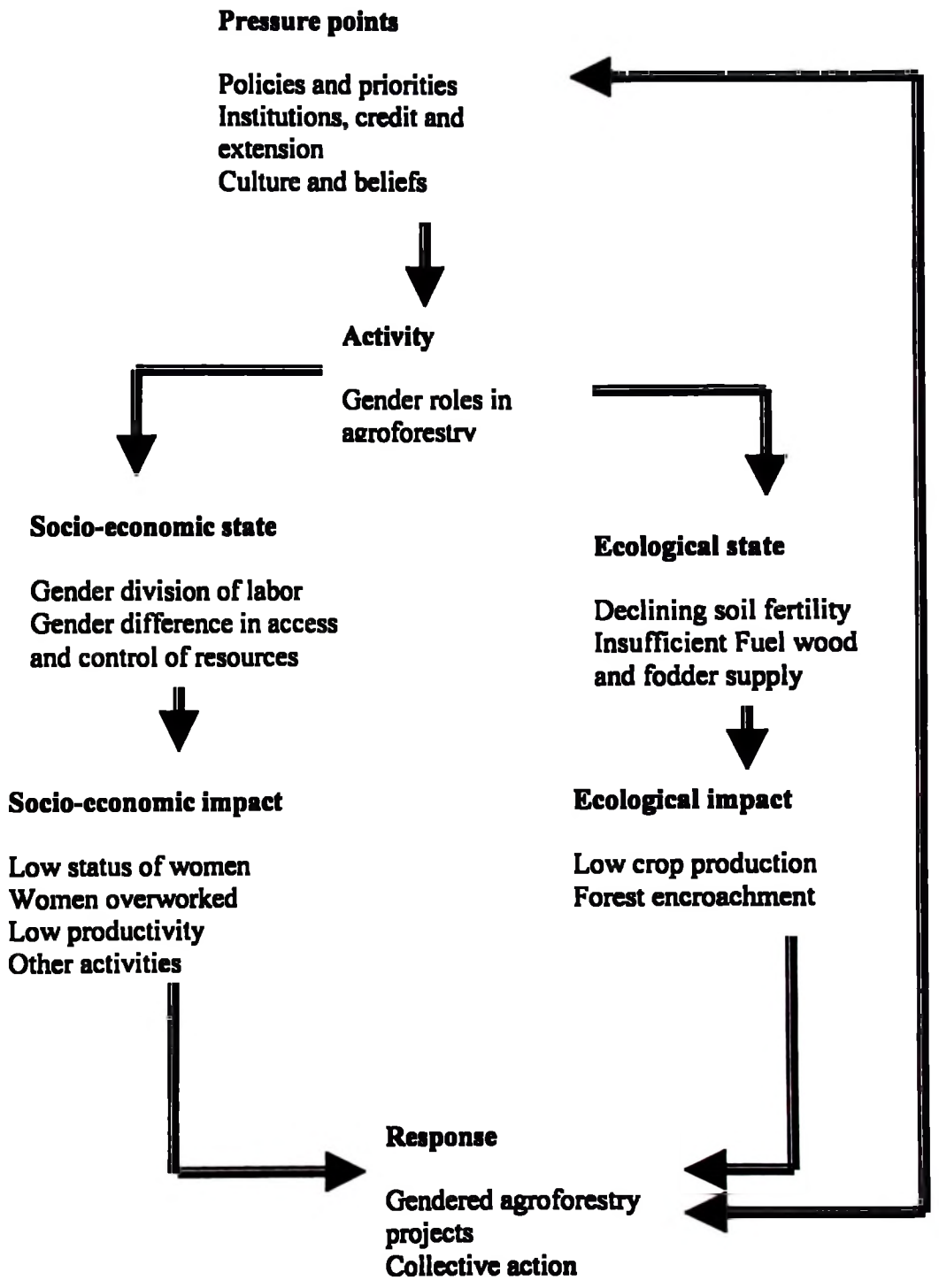

Figure 3.4. The conceptual framework

From the conceptual framework, there are policies, institutional arrangements, culture and beliefs that shape gender roles in agroforestry. These give rise to a gendered division of labour and gender differences in access to and control of resources. Some of the effects of these divisions are low status of women, low productivity of agricultural and agroforestry systems, insufficient fuelwood and fodder supply. Other effects include low soil fertility and a decline in the productive capactity of soil. One response to the gender differences in the division of labour and access to resources is the coming together by women in form of collective action to try and reduce their workloads and increase their access to resources. Some institutional responses include the design of projects that are sensitive to gender issues and change in institutional arrangements especially those that deal with issues of property rights.

3.3 Methods as per objective of the study

The data collection and analytical methods are given for each specific objective. This is because each objective used different data collection methods. Data for objective one was collected using Participatory Rural Appraisals (PRAs) and Focus Group Discussions (FGDs), while that for objective three was obtained using a questionnaire survey. The results of the PRAs, FGDs and the questionnaire survey were then used to classify farmers and obtain a sub sample from which data for answering objective two and four was obtained. It is for this reason that the methods for data collection for objective three are given before those for objective two and four. Due to the intensity of data collection for objectives two and four, data was only collected from 40 households in Kirinyaga District. The selection of Kirinyaga

District was based on the similarities observed between Embu and Kirinyaga Districts and the fact that a lot of research had already been done in Embu. Data for objective five was collected from a questionnaire survey and FGDs.

3.3.1 Objective One: Identification of agroforestry systems, their strengths and constraints.

3.3.1.1 Sampling design

A disadvantage of most probability sampling methods is that they do not take into account geographically dispersed populations. A multi stage cluster sampling allowing geographically dispersed populations to be covered adequately was used. This utilized a combination of probability and non-probability sampling methods used in sequence. Purposive sampling was used to obtain the districts and divisions, random sampling to obtain locations and extension units and finally, systematic sampling to obtain the respondents.

Two districts were purposively selected from the districts comprising the AFRENA sites in Central and Eastern Kenya. From each district, one division was selected and then two locations picked randomly from each of these divisions. Each location is divided administratively into extension units and two extension units were selected randomly from each location. A total of 8 extension units were therefore selected as shown in Fig. 3.5.

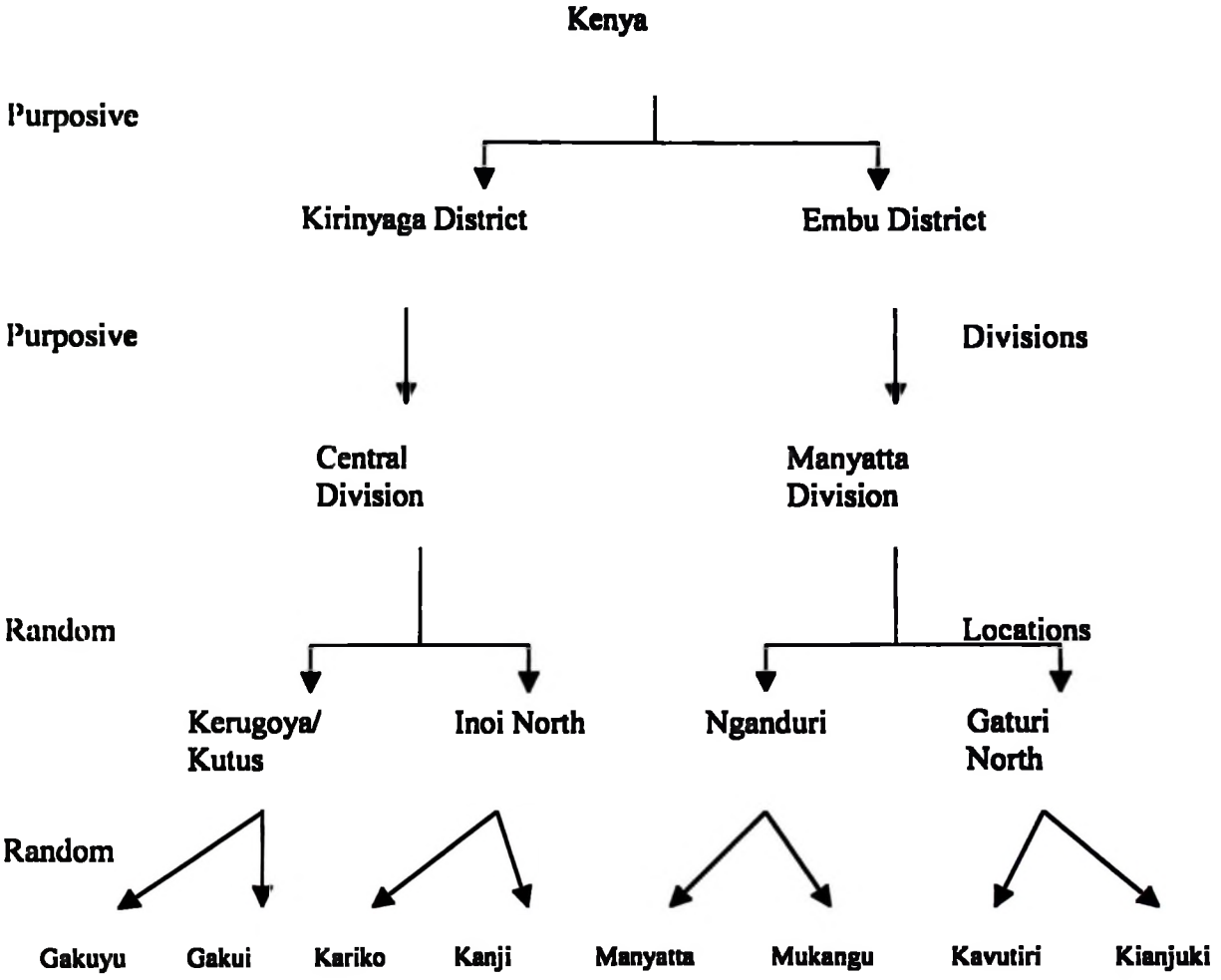

Figure 3.5. The sampling scheme

3.3.1.2 Data collection methods

a) Participatory rural appraisal

PRA was used in the initial stages of this research. The fundamental step in PRA is the basis for dialogue through which information is shared and through which there is an explicit recognition that outsiders need to learn much if not more, from the local people. This method therefore makes use of local knowledge and experience with local people identifying their problems and their needs with only a facilitatory role by the researcher.

Using PRA local people (men and women) were able to describe how they do things, what resources they access, the constraints and strengths in their local environment and their preferences for trees and crops. The gender analysis framework was also incorporated in the PRA as described by Wilde and Mattila (1995a, b and c). The context profile was used to identify agroforestry systems, their constraints and strong points from the farmer point of view. The activity profile was used to analyse the gender-based division of labour by identifying activities done by women, men and by both men and women. The resources profile was used to identify the resources available to men and women and what benefits are derived from these resources. A triangulation of methods was utilized in the PRA as shown in Fig. 3.6.

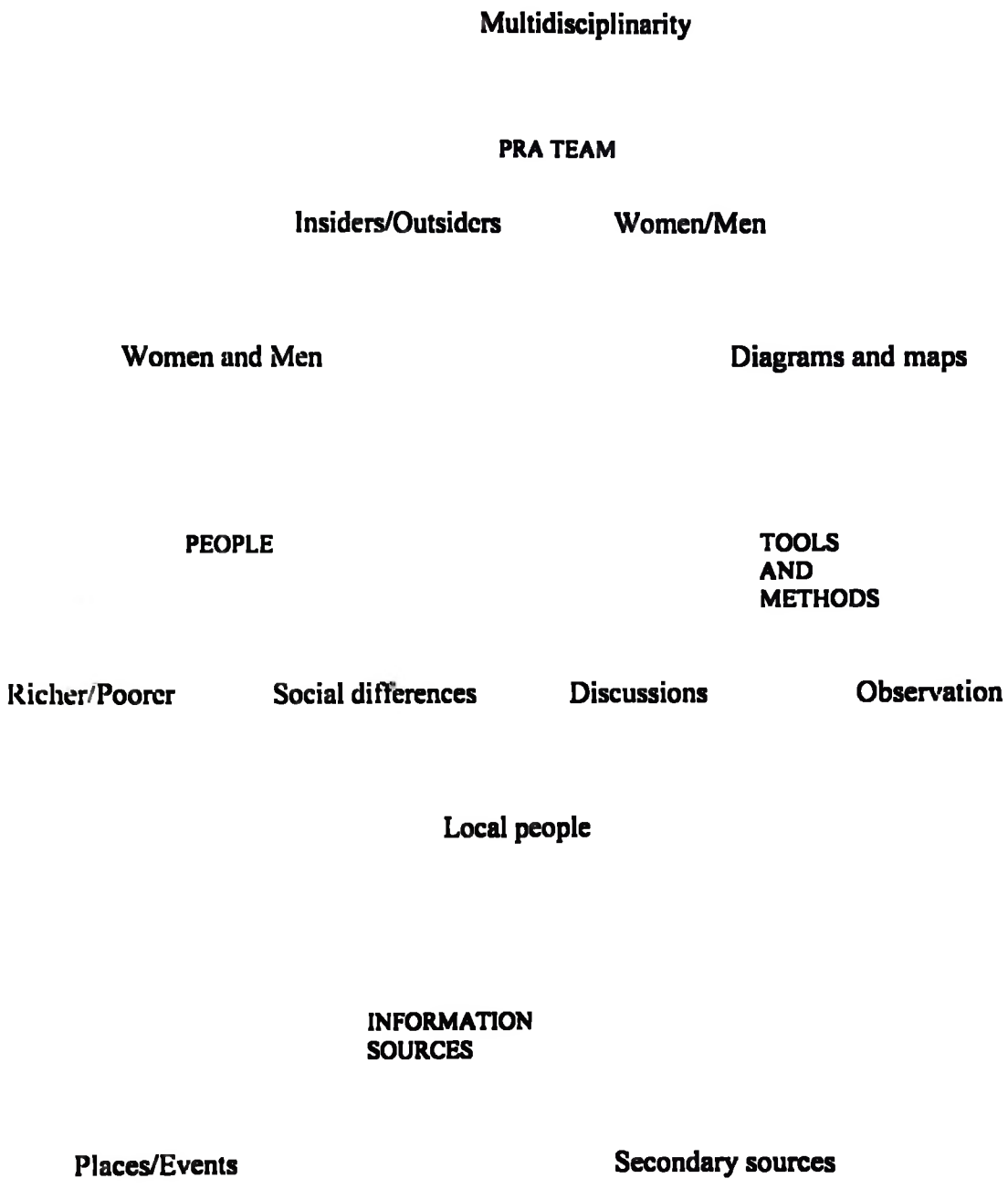

Figure 3.6. Triangulation in PRAs

Source: Adapted from Theis and Grady (1991) in Wilde (1998)

b) Focus group discussions

To get detailed qualitative information from a large group of people, FGDs were carried out before and after the questionnaire survey. A question guide for the FGDs is shown in Appendix 2. Participants for the focus groups were selected purposively based on the criteria required by this study. The criteria used were basically sex, age and socio-economic category. Separate group discussions for men and women were organized as well as mixed groups. Group discussions with young women and men as well as old women and men were also carried out. A total of 24 FGDs were carried out.

These groups provided a forum for detailed discussions of issues, as well as clarifications of perceptions and options found in the community. They were also useful in gender-based priorities for agroforestry through matrix ranking and Strengths, Weaknesses, Opportunities and Limitations (SWOL) analysis of agroforestry practices and tree species and products. FGDs were also carried out for the purpose of wealth ranking of individuals in order to group them into some economic categories during the time allocation household survey. The wealth ranking was aimed at obtaining a sample of households, which is representative of the community's socio-economic groups. It was then assumed that the households selected for the time allocation study represented the range of socio-economic circumstances found in the study area.

3.3.2 Objective Three: Identification of socio-economic and cultural factors affecting gender roles in agroforestry

3.3.2.1 Sampling design

From the extension units selected under objective one, 224 households were selected to gather information aimed at answering this objective. Lists of all households in the extension units selected were obtained from the extension officers working in these areas and these were counter checked with those in the sub location offices. Any missing households were added to the list. This ensured that no households were left out in the sampling frame. Discussions on these lists were held with the extension officers to ascertain that the lists were not in any grouped order. During sampling, the first household was picked using random numbers. The sampling interval was obtained by dividing the number of people in the unit by the number required in that unit. A household was picked every other time after the sampling interval. For example, if N was the number of households in the unit and n was the number of required sample from that unit, the selected household was picked after every N/n households.

A sample size of 224 households was found sufficient to allow for reliable analysis, provide for desired levels of accuracy in estimates of proportions, to test for significance of differences between proportions as recommended by Fisher, *et al.* (1991) and to provide a sampling frame for the time allocation study.

3.3.2.2. Data collection

A questionnaire was administered to the 224 respondents, 113 from Embu and 111 from Kirinyaga. The questionnaire is given as Appendix 3. The questionnaire was pre-tested and modified before being administered. Extension officers from the particular areas were trained in order to understand the objectives of the study and its importance. These extension officers together with the principle researcher and one research assistant administered the questionnaire.

Involvement of the extension officers was important in order to locate the selected households within each extension unit as well as identify the boundaries of the extension units. Either men or women in these households were interviewed depending on their availability. This meant that female household heads, male household heads and wives in male-headed households were interviewed.

3.3.2.3 Data analysis

The questionnaires were processed and analysed using a computer soft ware, Statistical Package for Social Scientists (SPSS, 1988). Data was cleaned and frequencies were run to check its validity. Comparisons were made using chi-squares, correlation coefficients and t-values and tested for significance. A one way Analysis of Variance (ANOVA) was carried out to compare more than two means. If this was found significant, a Turkey's Honestly Significant Difference (HSD) test was done to identify the particular means that were significant. A Turkey's HSD test has been recommended for large samples, as it is more sensitive in detecting differences between pairs of means (SPSS,

1988). A probit analysis was also carried out to assess factors affecting women's ability to plant trees and make decisions on tree planting. The probit analysis was of the form;

$$P(Y=1/X) = \Sigma(b_i X_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textit{Formula 1}$$

Where Y is the dependent variable, in this case women's decision making in planting trees, actual planting and disposal. Y is a binary variable and takes on two values. 0 and 1 where 1 means women plant trees or make decisions on tree planting while 0 means women do not plant trees or do not make decisions on tree planting. The outcomes on Y are mutually exclusive and exhaustive. X represents the independent variables while b represents the coefficients for these variables. The variables entered for the probit analysis and their definitions are given in Table 3.1.

Table 3.1. Variable definition for probit analysis

Variable	Definition
Married	This was a dummy variable for whether the woman was married or not. It took two values, 1 for married and 0 for other. It was expected that women who were unmarried, divorced or separated were more likely to plant trees than women who were married.
Agehh	This was the age of the head of the household in years. It was expected that younger heads of household would not have any prohibitions about women either making decisions on trees or planting trees.
Agewom	The age of the women was the age in number of years of the senior female member of the household. Older women were expected to have more decision-making authority than younger women.
Eduhh	Education was a dummy variable of whether the household head had education or not. Heads of households who were educated were expected not to have prohibitions about women planting and making decisions on trees due to enlightenment on gender issues through education.
Femmag	Female manager was a dummy variable for farms managed by women. Women who were farm managers were expected to have more decision-making authority and to be more actively involved in tree planting than women who were not farm managers.
Insufire	This was a dummy variable for whether the household had sufficient firewood or not. Since women are responsible for the collection of firewood, insufficient supply of firewood in the household was expected to increase women's participation in tree planting. Insufficiency of firewood was obtained by asking a direct question of whether the household had enough firewood or not.
Extenno	This was a dummy for whether the household had been visited by an extension officer in the three months prior to the study. Women who had been visited by extension officers were expected to make decisions and to participate in tree planting than those who were not.
Landacc	This was a dummy variable for whether women had access to land. Women with access to land were expected to make decisions on tree planting and disposal as well as participate in actual tree planting than those who did not.

3.3.3 Objective Two (An assessment of the gender based division of labour, resource and benefit allocation) and Four (effects on the productivity of agroforestry systems)

To answer these objectives, data from the questionnaire survey and TAS was utilized.

3.3.3.1 Classification of households for TAS

Farm households were classified to identify homogeneous categories of households or target groups. The process of classification varies depending on the reasons for classifying farmers, the method of classification used and the number of categories required. Household classification makes it easier to model, conceptually or quantitatively, the household systems (Williams, 1994). This makes it easier to work, diagnose problems and potentials, prioritise research and provide services to the households. Methods used for classifying households include; a) Informal data collection methods (PRA and RRA); b) Formal data collection with classification using cluster analysis and standard descriptive statistical analysis; c) a combination of formal and informal data collection methods (Muriithi, 1998).

The purpose of the classification of the households was to obtain homogeneous groups from which to study the differences in gender roles. It was assumed that, the intra variation of a household category was less than inter-category variation or the total household population variation. PRA and FGD results of wealth ranking of the households were used together with the preliminary analysis of the results of the

cross sectional survey. The criteria used included household headship, education, and the other characteristics identified in the wealth categories. Ensuring the respondents were from the two ecological zones under study controlled for ecological differences.

The categorization of households involved several stages;

1. The definition of wealth categories
2. Selection of wealth indicators important for meeting the objectives of the categorization.
3. Combination of wealth indicators with other relevant indicators.
4. Calculation of index and farmer selection.

During the PRAs and FGDs, the respondents perceived wealth as to be related to the type of housing, number of livestock units, farm size, number of plots owned, presence of off farm income generating activities, use of hired labour and household assets. They grouped the farmers into three categories.

a). Rich (Index number 3)-Anyone who owned any of the following;

- a brick house with tiled or iron sheet roofing
- one or more cars
- three to five cows
- over 5 hectares of land
- has permanent hired labour
- has one or more off farm income generating activities.

b) Medium wealth (Index number 2)-Anyone who owned any of the following;

- 1-5 hectares of land
- wooden house with an iron sheet roofing
- hires land
- one to three cows
- no car but has a bicycle or motorcycle or ox cart
- no off farm income generating activity

c) Poor (Index number 1)-Anyone who owned any of the following;

- less than one hectare of land or squatting
- wooden or mud walled house with thatched roof
- no cows but probably some chicken
- no bicycle, motorcycle or ox cart
- no off farm income generating activities.

The wealth categories were combined with other characteristics to calculate a farmer categorization index. Three categories were established 1=low status farmers. 2=medium status farmers and 3=high status farmers. Table 3.2 is an example of categorization for a farmer.

Table 3.2. Example of farmer selection for TAS in Kirinyaga District, Kenya

Status indicator	Farmer response from questionnaire	Status category number
Formal Education	Yes	2.5 (falls in both 2 and 3)
Off farm activities	No	1.5 (falls in both 1 and 2)
Type of housing	Wooden with iron sheet roof	2
Number of cows	2	2
Hired labour	None	2
Amount of cultivable land	2.5 hectares	2
Household assets	One ox cart, wheel barrow	1.5 (falls in both 1 and 2)
Other plots	4	3

$$\text{Farmer status category} = \frac{\text{Total points}}{\text{Total number of evaluated indicators}}$$

$$= 16.5/9 = 1.833.$$

The farmer in the example on Table 3.2 was placed in category number 2.

3.3.3.2 Data collection

a) Time Allocation Studies

For the purpose of this study, time allocation allowed for the comparison of both men and women's labour and the productivity of the agroforestry systems. Data on the household distribution of time was analysed by crop, task, age and gender. Monitoring sheets used for the TAS are shown in Appendix 4. Methodologies used were respondent recall, direct observation and records kept by the farm households.

b) Type of data collected.

Detailed monthly data were collected on the major crops and livestock. These included maize, beans, coffee, tea, trees and cattle. These crops were then

disaggregated by activity and the time taken by each member of the household to carry out each activity was recorded. In order to obtain the total labour utilized, assumptions were needed about the equivalency of work units by sex and broad age groups. In East Africa, the Collinson (Collinson *et al.*, 1977) and Ruthernberg (Ruthenberg, 1976) equivalencies are most commonly used. Due (1982) modified the Ruthernberg equivalencies in a study in Morogoro, Tanzania.

The Due equivalencies assume equivalency of work of males and females. Although it is acknowledged that in some operations, men achieve more, in others women achieve more and there is therefore no basis for estimating that a female worker is worth less than a male worker is in the same age group. The Due equivalencies were adapted for this study with some modifications. The 18 and over category was split into two categories, 18 to 49 and 50 and above. The 50 and above category was given an equivalency of 0.50. The split of the last category was based on the assumption that older people are less productive in manual work. The equivalencies used in this study are given as the Njuki equivalencies in Table 3.3.

Total production, revenue and sales of the five major crops i.e. coffee, tea, maize, beans and potatoes were recorded in detail. Data on other crops such as tomatoes, cabbages, french beans, bananas and macadamia were also recorded. Inputs on the crops were recorded and any other production costs such as cost of hired labour. Detailed data was recorded on trees including tree types, tree numbers and their locations on the farm.

Tree product supply in the household was obtained as well as labour on tree related activities.

Table 3.3. Labour conversion equivalencies

Age (years)			7-16	Above 16		
Collinson	Sex	M	0.50	1.00		
		F	0.50	0.75		
Age (years)			0-14	15-19	20-50	51 and above
Ruthenberg	Sex	M	0.25	0.67	1.00	0.67
		F	0.25	0.50	0.67	0.50
Age (years)			8-11	12-17	18 and above	
Due	Sex	M	0.30	0.50	1.00	
		F	0.30	0.50	1.00	
Age (years)			8-11	12-17	18-49	50 and above
Njuki	Sex	M	0.30	0.50	1.00	0.50
		F	0.30	0.50	1.00	0.50

Cattle were the main livestock on which data was collected. However, limited data was collected on sheep, goats and chicken. Data collected on cattle included production data, sales and revenue and labour utilized on cattle activities. Lastly, data was collected on household and other domestic activities in order to establish the relationship between the times used for productive and these activities.

3.3.3.3 Data analysis

a) Comparison of means

The analysis was done using SPSS computer software. T-tests were used to compare differences between any two means while a one-way ANOVA was used for the comparison of more than two means. If the F value was found significant, a further

test was required to identify the particular means that were significant. In this case. due to the small sample size in this analysis, a Bonferroni method was used since it is more sensitive when comparing means from small samples (SPSS, 1988).

b) Gross margin analysis

Gross margin analysis of a farm activity is the difference between the gross income earned and the variable costs incurred (Makeham and Malcolm, 1986). It is the most commonly used measure in farm analysis and planning. Before a cost can be considered a variable cost, it must be specific to a single enterprise and must vary approximately in proportion to the size of the enterprise (Sankhayan, 1983). In this context, the variable costs are those costs that vary according to which enterprise is under consideration and the size of these enterprises. For crop enterprises, the variable costs consist mainly of seed, fertilizer, insecticides, pesticides and causal labour hired specifically for that crop. For an enterprise, the gross margin (GM) is defined as;

GM = Total value product of the enterprise – variable cost attributed to it.

Gross margin was calculated for the five major crops; coffee, tea, maize, beans and potatoes and also for cattle. There can be problems measuring gross margins especially where payment for crops is not received immediately and on subsistence farms where the family consumes some of the product. The value of the production therefore included all that was produced irrespective of whether it was consumed, sold or kept for other purposes. For livestock, the variable costs include concentrate

feed, artificial insemination and other veterinary costs. The gross margin was calculated for cattle only due to unavailability of production data on other livestock and was done according to the procedure given by Makeham and Malcolm (1986) as follows;

(i) Sale of animals and animal products plus the value of animals and products consumed.

(ii) Sale of by-products

(iii) Increase or decrease in value of stock

(iv) Gross income=(i+ii+iii)

(v) Cost of feed, hired labour, husbandry, veterinary services

(vi) Cost of replacement of animals

(vii) Total variable costs=(v+vi)

(viii) Gross margin=(iv-vii)

One caution in the use of gross margins is that they can vary widely from one year to the next (Barnard and Nix, 1979). This is due to differences in market prices, weather conditions and efficiency. They can also differ considerably from farm to farm due to differences in performance levels or differences in the overall system of production, the method of recording and the fixed costs. Although the comparison of average gross margins can be useful, they should only be done over a number of years. The gross margins calculated in this analysis are therefore not used for the comparison of farms due to differences between farms and should also not be taken as profit figures since they do not take into account the fixed costs.

c) The Cobb-Douglas Production Function.

A production function is defined in terms of the maximum output that can be produced from a specified set of inputs given the existing technology available to firms (Battese, 1992 cited by Quisumbing, 1996). The most commonly used production function is the Cobb-Douglas production function. The function is easy and convenient to estimate since it is linear in parameters. The dependent variable in the function is Total Value Product (TVP). The TVP is obtained by calculating the value of the gross output using prevailing market prices.

i) Selection of the model for analysis

The Cobb-Douglas production function was selected for several reasons. The data was explored using scatter plots in order to determine whether there was a relationship between the TVP and different independent variables. A scatter plot can be used to see whether there is indeed a linear relationship between the variables in which case a linear regression would be a meaningful and appropriate model to use (SPSS, 1988). An elliptical scatter plot indicates the existence of a linear relationship. When the data was subjected to a scatter plot, the relationship was not linear. The variables were log transformed and subjected to a scatter plot again. Elliptical scatter plots were obtained indicating that there was an almost linear relationship between the natural logarithms of the variables. The use of scatter plots also helped in the identification of outliers.

The Cobb-Douglas production function model has been popularly used because of the ease of its estimation and manipulation. The model provides a compromise

between an adequate fit of data, computational feasibility and sufficient degrees of freedom for statistical testing (Heady and Dillon, 1961; Quisumbing, 1996). The model facilitates the estimation of the marginal resource productivity at the mean level, efficiency measures and the computations of returns to scale. In addition to its use in studying male and female differences in productivity, the Cobb-Douglas production function has also been used to study impact of credit on factor productivity at farm level (Coyler and Jimenez, 1971; Gyekye and White, 1977; Salami, 1988).

A pooled regression of all the farms was done. This approach has been most commonly used to estimate differences in the technical efficiency between male and female farm managers and is recommended if all the farms are producing the same crops or if similar crops are under consideration as was the case in this study (Quisumbing, 1996). Several studies have used pooled regression method (Moock, 1976; Jamison and Lau, 1982; Bindlish and Evenson, 1993; Bindlish *et al.*, 1993). It allows for sex differences by using a sex dummy while also interacting the sex dummy with other variables to see its effect on input utilization. To allow for gender differences rather than merely sex differences, the access to resources and personal characteristics such as age are included in the model. Quisumbing (1996) argues that some of the methodological problems in measuring male–female differences in productivity include the omission of individual characteristics and the lack of clarity regarding the measurement of sex and gender differences.

ii) Model specification

The general form of the Cobb-Douglas production function is specified as:

$$Q = AX_i^{bi} \ldots\ldots\ldots e^{u} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textit{Formula 2}$$

Where Q = total output

A is Constant term of the regression

b_i is Elasticity of production with respect to the i^{th} input

X_i is the i^{th} input used in the production process

u is the error term

e is the base of the natural logarithm.

The function is estimated in its log linear form, which is specified as follows;

$$\ln Q = \ln A + bi \ln Xi + u \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textit{Formula 3}$$

Where ln is the natural logarithm and other variables are as specified in formula 2.

iii) Variable definition

Several factors are known to affect the TVP. The acreage of the farm determines the amount of each crop that will be grown on the farm, the livestock numbers as well as any other activities that will be carried out on the farm. With decreasing land sizes due to population pressure and sub-division, there is need to increase the value of total products from farms. An understanding of other variables that affect TVP and at what level they affect it is therefore required.

Variables included in the function were defined as follow:

- Output was the value of gross output for the farm enterprises studied for the 1999/2000 short rains cropping season
- Land size is the total land under cultivation by the farmer during the same season
- Family labour is the number of person hours from family members utilized in the farm enterprises.
- Inputs are the value in Kenya shillings of fertilizers, planting seeds, pesticides, animal feeds and animal drugs.
- Hired labour is the number of person hours hired for the enterprises
- Extension was a dummy variable indicating whether the farm manager had received extension advice in the three months prior to the study.
- The female dummy was a dummy for the female manager.
- Age was the age in number of years of the farm manager.
- Education was a dummy for whether the farm manager had education or not.

The log linear form of the estimated functional relationships is specified as follows;

$ln\ Y = b_i ln X_i + b_i X_i + \ldots$ ....*Formula 4*

iv) Model evaluation

The model was evaluated using several procedures. Correlation coefficients between the independent variables were run to check for multicollinearity. This does not

however allow for the detection of a case in which three or more variables are collinear. Another measure, Variance Inflation Factors (VIF), which is the inverse of the correlation matrix, was used to adequately detect multicollinearity. VIF is given by $(1-R_i^2)$ where R_i^2 is the R^2 from regressing the i^{th} independent variable on all the other independent variables. A high VIF indicates an R^2 of near unity and hence suggests collinearity (Kennedy, 1985). As a rule of thumb, for standardized data. VIF>10 indicate harmful collinearity.

One commonplace observation concerning the difficulty of directly estimating production functions is the possibility that the error term in the model is correlated with the exogenous variables. For example, farmers may opt to apply more inputs in the higher priced or higher yielding crops or those crops that have a ready market. This means that the error term will be correlated with the variable inputs. As a general practice, therefore, it is prudent to be sceptical of estimates of direct production functions. An appropriate strategy would be to use instruments, typically prices, which influence factor allocation decisions and yet are uncorrelated with the error term as recommended by Jacoby (1993). In this study, factor prices were multiplied with the farm yields and input quantities to try and reduce the correlation of exogenous variables and the error term.

This production function approach focuses on the technical rather than allocative efficiency. Resource allocations within the household are considered Pareto efficient if no reallocation of resources to different household members or to different uses

could increase total output. Quisumbing (1996) argues that the asymmetric distribution of rights, resources and responsibilities by gender may have more serious implications for allocative efficiency than sex differences do for technical efficiency. Attempts to study the effects on allocative inefficiencies in this study have been made by interacting the female dummy with other exogenous variables including extension, education, labour and inputs. Although this does not sufficiently address the issues of allocative efficiency within households, it gives an indication of the relative efficiency in use of resources by male and female farm managers.

The data set used in this model comprised of 37 cases. Three cases were dropped from the analysis due to the presence of outliers. Although the results give a good indication of the productivity differences in male managed and female managed farms, they may not be applicable over a wide area due to the small sample size. Similar studies of the farming system using a large data set may be required. Due to this limitation, separate regressions were not run for the male managed and female managed farms.

d) Resource use efficiency

In order to examine the efficiency with which farmers are using their resources, the Marginal Value Product (MVP) for the respective factors was calculated. From the Cobb-Douglas production function, the marginal factor productivities and the average productivity measures were computed from the estimated production elasticities as follows.

$MVP = b_i AVP = QX_i$ ..... *Formula 5*

Where MVP is marginal value product for the given factor of production

b_i is the estimated elasticity of production for the i^{th} input

AVP is the average value product

Q is the total value product

X_i is the value of the i^{th} input

The MVP gives the absolute response per unit of factor input and allows for a comparison of relative efficiencies of resource use within the given farms.

e) Technical efficiency

The level of technical efficiency, which is the ratio of actual to potential output, was calculated for each of the farmers surveyed for each crop and for all the crops combined. The aim of this analysis was to make a comparison of technical efficiency of male and female managed farms as well as farms managed by both male and female.

Two methods were used in this analysis for the determination of technical efficiency of the sampled farms. The first, a simple calculation of technical efficiency using the potential crop output for specific crops as given by Acland (1971) and the second, an estimation of the frontier production function from the Cobb-Douglas production function. Several studies have recommended the use of the second method in the

determination of technical efficiency (Bravo-Ureta and Rieger, 1990, 1991; Karilajan, 1991; Parikh and Shah, 1994; Tran *et al.*, 1993; Amara *et al.*, 1999).

f) Regression analysis

A linear regression was run to determine factors affecting labour utilization. The regression model was of the form;

$Y = a + b_i X_i + e$ ..... ***Formula 6***

Where Y = the dependent variable

a = constant

b_i = coefficients

x_i = independent variables

e = error term

The model was evaluated as described under the evaluation of the Cobb-Douglas production function.

3.3.4. Objective Five: An assessment of the role of collective action as a strategy by women to improve the gender division of labour, access, decision making and control of resources

3.3.4.1 Data collection

Data was collected through FGDs and key informant interviews of village leaders, officers of NGOs and officers of the Department of Social Services in Kirinyaga District. A questionnaire survey was also administered on the group members. The questionnaire is shown in Appendix 5

3.3.4.2 Data analysis

Data was analysed using descriptive statistics such as means and frequencies and summarized in tables.

3.4 Collection of market data

Market data was collected from the local major open-air markets in the two districts on prices of the food crops. Input prices were collected from outlets owned by co-operatives and private outlets. Prices were also obtained from the district marketing offices in Kirinyaga and Embu as well as from farmers themselves.

3.5 Collection of secondary data

Secondary data was collected from various sources. These included the Ministry of Agriculture and Livestock Development (MALD), Kenya Agricultural Research Institute – Regional Research Centre (KARI-RRC) Embu, and ICRAF.

3.6 Preparation and implementation of data collection

This study was partly coordinated at the KARI-RRC Embu and at the MALD, Kirinyaga District. Before the commencement of the exercise, two days were taken with the team to discuss the objectives and rationale of the study and also the methodologies to be used in the study.

For the questionnaire survey, different teams were used in the two districts for several reasons. One was the slight difference in the dialects used in the two districts and two, was for the purpose of co-ordination. In Embu, all the enumerators spoke the local dialect. The total number of enumerators was six, four from the extension department in the MALD and one research assistant provided by the KARI-RRC centre. All the enumerators had previously done similar surveys and they all lived and worked in the study area. Although the questionnaire was in English, it was administered in the local language. The two-day discussion ensured that there was consensus on the interpretation of the questions. In Kirinyaga, all the enumerators were from MALD.

The questionnaire was pre-tested on 10 farmers who were not part of the sample. This exercise was also used to test the understanding of the questionnaires by the enumerators. Changes were made on the questionnaires depending on the results of the pre-testing. During the interviews, discussions were held every morning between the enumerators and the principal researcher on any problems encountered during the interviews.

For the focus group discussions, one enumerator and the principal researcher were involved. In most of the cases. the enumerator used was the extension officer responsible for the particular extension unit where the group was. At later stages of the group discussions, staff from an international NGO working in the study area. The Association for Better Land Husbandry (ABLH) as well as the dissemination officer at the ICRAF project promoting fodder trees were involved.

3.7 Limitations of the study

Gender, as social construct changes with changing social conditions including culture, race, religion, age, education and many others. What is true of gender roles in Embu and Kirinyaga may not be true of gender roles in the rest of Kenya or the world. Although these results shed light on the differences in gender roles in the study area, they may not be applicable to other areas that have different social and cultural situations.

Some of the limitations and risks faced during the TAS were inability of the respondents to recall everything, influence of the researcher in direct observation and inability to follow all the household members to wherever they were carrying out their activities. The time allocation methodologies also assume that the time taken to do certain activities is related to the importance of these activities. The methodologies do not take into account joint activities and treat an individual's daily routine as a series of single tasks (Johnson, 1975). These limitations were solved in part by using respondent recall, direct observation and farmers' records simulteneously. The researcher also paid several visits to these farmers so as to

establish rapport. This had also been partly established during the PRA, the questionnaire survey and the focus group discussions.

For efficient recall by farmers, the time allocation was carried out over a period of six months and during this period, each household was visited approximately every three weeks. This interval was considered a compromise between too short and too long between visits. Weekly visits were considered too frequent and inappropriate since they could have caused fatigue of the respondents. Visits of duration of over one month were considered too long and since farmers sometimes relied on recall, this would reduce the reliability of the data. Muriithi (1998) in evaluating the role of livestock in mixed smallholder farms used duration of one month for similar reasons.

Forty farmers were selected for the time allocation study due to the intensity required in data collection. This limited the kind of analysis that could be carried out on the data collected from these farmers. Specifically, the production function analysis could not be performed separately for the male managed and female managed farms. The sex differences in farm management were however captured by using a female dummy variable in a pooled regression of all farm data. The implication of this is that the results may not be applicable over a wide area but all the same they provide a good indication of the gender differences in productivity in the agroforestry farming system in the central highlands of Kenya and specifically in Kirinyaga and Embu Districts. Another limitation was that although productivity is affected by

other physical. natural and institutional factors, not all of them have been looked at in this study.

There are several assumptions made for this study. One was the assumption of additivity. It was assumed that when several productive activities are used together, their total product must be the sum of their individual products. Similarly, the combined inputs requirements for several activities combined together were equal to the sum of input requirements if these activities were performed separately.

Another assumption made was the divisibility of units. It was assumed that activities can be produced and inputs can be used as fractional units. This however causes difficulties in such activities and enterprises as livestock production in which only answers expressed as whole numbers are desirable.

Palmer-Jones and Jackson (1997) point out that most empirical studies on the burden of work are based on time allocation studies and neglect other characteristics of work, in particular the effort involved in the work or work intensity. This study suffers from the same weakness partly due to the difficulties involved in measuring the intensity of work. The Due equivalencies partly solve the problem but only for the labour of children and the elderly by assuming that since children are on the lower part of the learning scale and since they only do selective activities biased towards lighter work. then their work equivalence is half of the adult equivalent. The major shortcoming of the equivalencies however is that they do not hold for all

operations. Men may cultivate faster than women but women may pick coffee faster. Similar labour equivalents are used for men and women in this study.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Overview

This chapter presents results form PRAs, FGDs, cross sectional questionnaire survey and the TAS. The first section of the results is a characterisation of the farmers and the farming system. In this section, household characteristics are analysed for both districts and a link is created between the farmers and the farming system. Tree planting patterns, their strengths and constraints and the factors that affect women's tree planting and ability to make decisions on trees are analysed in the last part of this section. The second section looks in detail at the access by women to productive resources including land, farm inputs, credit and extension. The third section gives an economic analysis of the farming system using data collected from 40 households. It looks at the household division of labour and its effect on the productivity of agroforestry and makes a comparison of farms based on the sex of the farm manager. The fourth and last section of the chapter looks at collective action as a strategy by women to reduce their workloads and gain more access to resources and technologies.

4.1 Characterization of the farmers and the farming system

4.1.1 Demographic and socio-economic characteristics of the respondents.

The demographic and socio-economic characteristics of the respondents are given in Table 4.1.

Table 4.1. Socio-economic characteristics of respondents in Embu and Kirinyaga Districts, Kenya.

Characteristic	Embu (n=113)		Kirinyaga (n=111)		Total (n=224)	
	No	%	No	%	No	%
Family size	7.0		5.5		6.3	
Age of household head	51.2		48.2		49.6	
Education						
No education	23	20.4	37	33.3	60	26.8
Primary	57	50.4	36	32.5	93	41.5
Secondary	24	21.2	31	27.9	55	24.6
College	6	5.3	5	4.5	11	4.9
University	1	0.9	1	0.9	2	0.9
Other	2	1.8	1	0.9	3	1.3
Marital status						
Married	99	87.6	90	81.1	189	84.4
Widowed	11	9.7	17	15.3	28	12.5
Single	2	1.8	3	2.7	5	2.2
Divorced	1	0.9	1	0.9	2	0.9
Sex of household head						
Male	101	89.4	93	83.8	194	86.6
Female	12	10.6	18	16.2	30	13.4
Land registration						
Husband	78	69.0	59	53.2	137	60.9
Wife	4	3.5	13	11.7	17	7.6
Both	1	0.9	0	-	1	0.4
Father	16	14.2	28	25.2	44	19.6
Other	14	12.4	11	9.9	25	11.5
Source of land						
Inheritance	76	67.2	102	91.9	178	79.5
Purchase	10	8.8	4	3.6	14	6.3
Government allocation	1	0.9	0	-	1	0.4
Allocation by the Clan	18	15.9	0	-	18	8.0
Other	8	7.2	5	4.5	13	5.8

Source: Survey data (1999)

4.1.1.1 Age and family size

In smallholder farms, the family is the main source of labour for agricultural activities. The average family size in Kirinyaga was 5.5 persons while it was 7.0 persons in Embu. Some of the family members in both districts were working part time or full time on the farm while others were not working on the farm at all. An average of two household members were working on full time basis on farms in Embu.

The mean age of the heads of households was 51.2 and 48.2 years for Embu and Kirinyaga Districts respectively. A two-sample t-test was done to compare the average ages of heads of households. This gave a t-value of 1.414 and a $p=0.159$ with 223 degrees of freedom which was not significant at $p<0.05$. Almost half of the respondents (48%) were above the age of 50 years while only 9% were below 30 years of age. This reflects the fact that many younger people are either employed in towns or are engaged in off-farm activities. In a study in Embu, Muriithi (1998) found that only 21% of respondents in the study area were below 40 years.

Ages were compared based on the sex of the head of household. The results are given in Fig. 4.1. A large proportion of the female heads of households were in the category of 60-69 years while those of the male heads of households were in the category of 30-39 years. These results should however be interpreted with caution since there were only 30 female headed households out of the total sample of 224

households. In the male headed households, only 35% of the heads of households were below forty years.

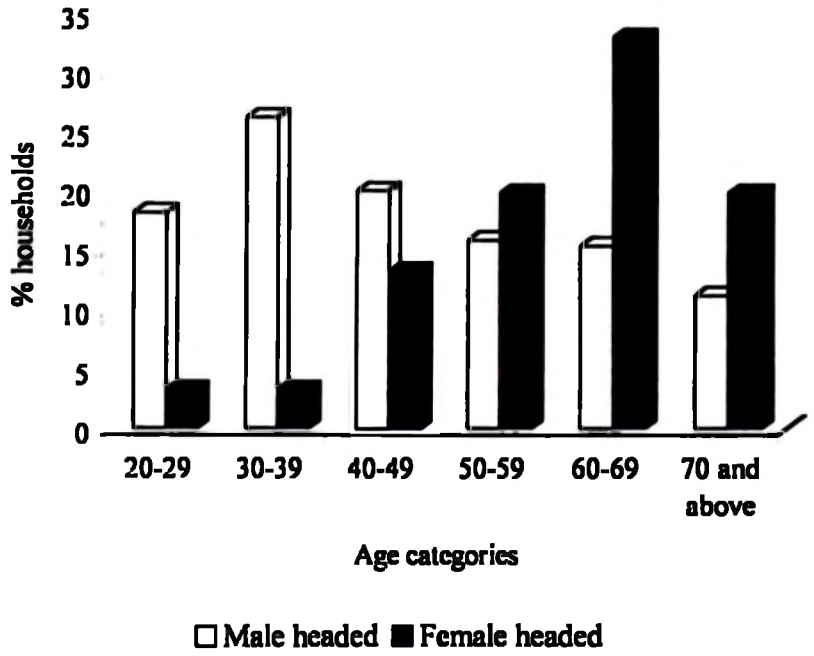

Figure 4.1. Age of household heads in Kirinyaga and Embu Districts, Kenya

4.1.1.2 Education

Data in Table 4.1 indicates that majority of the farm owners (68.3%) had education levels of primary and below. In Kirinyaga District, the government is trying to raise literacy levels through the department of adult education. This department uses already formed women groups and also initiates women groups to use as a media for imparting literacy skills to women. In the two districts, only 2.1% of the farm owners had an education above college level. The cause of differences in education levels of household heads in the two districts is not clear.

4.1.1.3 Marital status

Data on Table 4.1 shows that 84.4% of the respondents were married, 12.5% were widowed while 3.1% were either single or divorced. The percentage of widowed, single and divorced respondents was higher in Kirinyaga than in Embu. A chi square test was run for the marital status and the districts to test for any association. Only two categories were considered, married and widowed since the other categories had very few values and gave cells with expected frequencies of less than 5 in the chi-square table. The Pearson chi-square statistic was found to be 1.817 with 1 degree of freedom and p=0.178. There was therefore no association between the district and the marital status (in this case married and widowed) of the respondents.

4.1.1.4 Sex of heads of households

The number of households headed by women on the fact that they did not have husbands either due to death, divorce or had never been married was 30, which was equivalent to 13.4% of the total households studied. Of the 30 female heads of households, 28 were widowed while 2 were single. Kirinyaga had a higher number of female heads of households than Embu. A chi-square test however showed no association between the district and the sex of the head of household (Pearson chi-square =1.512 with 1 degree of freedom and p=0.219). The two districts had 10.6% and 16.2% of the households headed by women respectively. Ninety six percent of the women heads of households had education levels of primary and below with only 4% having gone to secondary school. The female heads of households however did not

include women whose husbands were living away from home. These were included under female farm managers.

There are several disadvantages of female-headed households as far as agricultural production is concerned. At a minimum, household labour power is reduced since women rely in many cases on a single adult. the woman, while households headed by men usually have available the labour of at least two adults, the husband and the wife. Labour and capital shortages are intimately linked because labour is a commodity in all societies. Often, the availability of capital is associated with an absent husband who sends remittances to the wife. The female-headed households with remittances from the husband are more similar to male-headed households than to the female headed households without remittances.

It is widely accepted that female-headed households are more likely to be poor than male-headed households (Folbre, 1991). A poverty research by the World Bank (Narayan *et al*.. 2000) reports that in 35 villages in Kenya participants were told to mark all the female headed households on a map. Overall, 25% of the study population was categorized as very poor. There was however a higher percentage of female headed (44%) than male headed households (21%) in the group. Eighty per cent of all the female headed households were either categorized as poor or very poor. Almost similar findings were reported for South Africa and Nigeria. Divorced women were found by the World Bank study to be particularly vulnerable to poverty and lack of resources.

4.1.1.5 Farm ownership

Land is the major resource owned by farmers for the purpose of agricultural production. In Kirinyaga and Embu, land tenure is freehold with individual ownership where farmers have titles to their land. Most of the land was registered, 88.5% and 96.4% in Embu and Kirinyaga respectively. Sixty nine per cent of land in Embu was registered in the name of the husband while only 3.5% was registered in the name of the wife and 0.9% was joint registration between husband and wife. The rest was registered in the name of the father of the head of household apart from those registered in the names of the husband, wife or both. This is despite the fact that women managed 39% of the farms. The trend was replicated in Kirinyaga although the number of wives with land registered in their names was higher due to the higher number of female heads of households. Fifty three percent of land in Kirinyaga was registered in the husband's name and 11.7% in the wife's name. Similar findings have been reported by Muriithi (1998) in Embu where 93% of the farms were registered to men and only 7% to women despite the fact that in most households, it is the women who are involved in the day-to-day activities of the farm.

In both districts, 17 households (7.6%) had their land registered in the wife's name. Out of these, 76.5% were widowed while the others were married. Out of the 28 widows in the sample, 39% still had the land registered in the late husbands name, 50% had the land registered in their names while the other 11% had the land registered either in the son's or the father in law's names.

Although some members of the households have seen joint family ownership of land as one way of preventing undesired land sales, only 0.9% of the farms had joint registration. The complexity of household relations with respect to land is manifested in the fact that some of the farms in Kirinyaga and in Embu were registered in the names of people who were not actually using the land, most of it being registered in names of fathers to the household heads. There are several explanations for this. First, individual ownership of land has led to an increase in the land sales especially among the younger people who feel they do not belong in the rural areas and are looking for a better life in the urban areas. In most cases therefore, fathers have not transferred titles to their sons, which means that the sons only have user rights and cannot therefore sell the land. This however may have implications especially on tree planting and other investments that are of long-term nature. In cases where land has been transferred to sons, they may not have updated the titles due to the sometimes long, expensive and bureaucratic process involved.

Women's access to land is subject to their positions in the family. While female heads of households may have exclusive rights to the land they occupy, married women only have user rights on their husbands land. In cases where husbands are present within the farm, the husbands make decisions while in a few cases both husband and wife make them. In female managed farms where husbands are working away from the farm, wives make the day-to-day decisions on the farm while absentee husbands make major decisions such as long-term investments on land. In some

households. unmarried daughters especially those with children are given small parcels of land to cultivate food crops.

4.1.1.6 Source of land

There were four main modes of land transmission in the study area; inheritance, allocation, purchase and lease. Allocation by the clan was used to refer to those farmers who had not sub-divided their land since clan allocation, while inheritance was used to refer to those farmers who had their land given to them after the sub-division of land by their fathers. Inheritance was the most common source of land accounting for 67% and 92% of all land sources in Embu and Kirinyaga respectively. This was followed by allocation in Embu accounting for 16% of all land sources. The absence of transmission of land by allocation in Kirinyaga indicates that all the farms studied had undergone subdivision. Land allocation in Kirinyaga started earlier than in Embu and this is one reason for the higher incidences of land subdivision and inheritance in Kirinyaga as compared to Embu. Purchase was not a common source of land accounting for only 8.8% and 3.6% of land sources in Embu and Kirinyaga respectively.

From the results, majority of the farms (83%) have been sub-divided since allocation or demarcation in the early sixties (some more than once) and sub-division is still continuing. Indeed, Mugo (1999) estimates that in Kirinyaga, land portions will reduce to 0.7 ha in the next decade if the current rate of sub-division continues.

4.1.1.7 Land size

Average land size for the two districts was 2.59 ha per household. Average land size was higher in Embu (3.10 ha) than in Kirinyaga (2.09 ha). Land size was smaller in Kirinyaga District due to the fact that land had been allocated earlier and therefore subdivided more than in Embu District. The differences in land size may also have been due to the difference in area of the two districts and population pressure. An independent two-sample t-test gave a t value of 3.316 at 223 degrees of freedom and a significance level of p=0.001. Muriithi (1998) found a lower mean acreage for Embu (1.5 ha) while Mugo (1999) found a higher average for Kirinyaga (3.5 ha). The coffee-tea transitional zone had mean land size of 2.54 ha while the mean land size in the coffee zone was 2.74 ha. A two-sample t-test showed no significant difference in land size between the two zones (t=0.902; p=0.368; df=223).

4.1.2 Farm enterprises

The sampled households were involved in a variety of enterprises including food crops, cash crops and livestock rearing. This was done for several purposes including; meeting household food needs, cash generation, food surplus and long-term investment to meet future food and cash needs.

4.1.2.1 Cash crops

a) Cash crop production

Cash crops grown in the study area include coffee, tea, macadamia, fruit trees and sugarcane. The production levels for the major cash crops (coffee and tea) are shown

in Table 4.2. Coffee was grown by 208 of the total 224 farmers while only 92 farmers grew tea. Coffee was considered by majority of the farmers as the major cash crop in the main coffee zone while it ranked second after tea in the tea-coffee transition zone.

The recommended spacing for coffee in this area is 2.7 m by 2.7 m (9 by 9 ft), which gives a population of 1329 trees per hectare or 537 trees per acre (Coffee Research Foundation, 1983). The mean area under coffee was 0.2854 ha. In Embu farmers had an average of 421 coffee stems with the highest number being 3400 stems. In Kirinyaga District, the mean number of coffee trees per farm was 334 with a maximum of 1300 stems. The number of coffee stems was lower in Kirinyaga than in Embu due to the smaller land size.

Table 4.2. Mean production levels for coffee and tea in Kirinyaga and Embu Districts, Kenya

	Coffee(n=208)		Tea(n=92)	
	Mean	Standard Deviation(sd)	Mean	sd
Number of trees/bushes	379	383	3 221	4 105
Area (ha)	0.2854	0.2884	0.4481	0.5963
Yield per farm (kg)	1 562	1 732	2 969	2 859
Yield per ha (kg)	5 473	4 150	6 625	5 413
Value per farm (Ksh)	18 744	20 787	56 411	54 334
Value per ha (Ksh)	65 676	49 862	125 889	102 860
Operational costs per farm	16 638	22 439	10 193	8 952
Operational costs per ha	58 297	44 821	22 747	23 577

Source: Survey data (1999)

The mean coffee output for both districts was 1562 kg per farm equivalent to 5473 kg/ha. The total value of coffee per farm was Ksh 18 744 equivalent to Ksh 65 676 per ha of coffee. This was computed using the prices used by the co-operative societies to pay for the coffee, which averaged Ksh 12 per kg of cherry. Payment for coffee was in one major payment per year given to farmers in three instalments.

Most operations on coffee used family labour. However, 67% of the households also used hired labour to carry out some activities. Most of the hired labour was used on harvesting. pruning and weeding. Manure was used on coffee by 77% of the farmers.

Tea was named as the top cash crop in the tea-coffee zone although it ranked second overall. Hired labour on tea was used by 71% of the farm households. Although weeding and pruning used hired labour. these are occasional activities with pruning done after every three to five years. Most of the hired labour was utilized on harvesting tea. This is an activity mainly dominated by female labour through labour contracts comprising of underemployed and in most cases landless women. Pruning was however a male activity mainly done by male hired labour.

Manure is not commonly used on tea and only 12 households applied manure to their tea during the duration of this study. Majority of these, (92%) used manure from their own sources. One of the important roles of cattle in the farm was therefore provision of manure and farmers saved on the cost that they would otherwise have incurred purchasing manure. In the transitional zone where tea is grown, 36% of the

households said they did not have enough manure compared to 30% in the coffee zone. Eight per cent of the farmers purchased manure from other farmers at a mean cost of Ksh 547 per farmer. Unlike coffee where fertilizers were purchased directly by the farmers. tea farmers obtained fertilizers and other inputs from the Kenya Tea Development Authority (KTDA) as a loan against the anticipated crop. Fertilizer on tea was mainly used for top dressing and was applied approximately twice a year. The mean operating costs for tea was Ksh 10 193 per farm equivalent to an average of Ksh 22 747 per ha.

Payments for tea are normally in monthly instalments and one major yearly payment. Although the monthly payment goes to women in order to meet their household needs, men control the major tea payment given at the end of the year. The average monthly payment was at Ksh 4 per kg for tea harvested during that month while the yearly pay out is at an average of Ksh 15 per kg for tea harvested throughout the whole year. The value of tea was therefore calculated with an average of Ksh 19 per kg of green leaf. The value of tea harvested, using these prices was Ksh 56 411 per farm, which was equivalent to Ksh 125 889 per ha of tea.

b) Gender issues in cash crop production

Forty three percent of the households indicated that the dominant labour for coffee was male as opposed to female in 31% of the households. Labour for coffee was gender neutral in 27% of the households. In 52% of the households, men were in charge of tea production while women were in charge in 32% of the households. In

the remaining households, both men and women were in charge of tea. Men formed the dominant labour on tea in 32% of the households while women provided the dominant labour in 46% of the households. This indicates an imbalance between women's labour and their control of cash crops. Labour on tea was gender neutral on 28% of the households.

Decision-making on coffee was made by males in 60% of the households, by females in 21% and by both male and female in 19% of the households. Even in women managed farms, it was only in 48% of the households where women made decisions on coffee. On the remaining farms, absentee male husbands and/or sons made decisions. In farms managed by both male and female managers, men made decisions on coffee in 54% of the households and by both men and women in 39% of the households. This means that even in joint management of the farm, there are still decisions that are solely made by the men such as decisions on the major cash crops. Compared to coffee, more women were making decisions in tea especially in female managed farms where in 72% of the households, decisions on tea were made by women and by absentee husbands and sons in 28% of the households. This is mainly because the women handle monthly payments from tea. In case of the husband being away, women in female managed farms can make decisions on how to use this money in tea production and other household expenditures. However, in male managed farms, no women made decisions on tea although joint decision-making was done in 19% of the households.

Production levels were calculated on the basis of the sex of the farm manager as shown in Table 4.3. Although there were five categories of farm management; female manager, male manager, both male and female managers, hired manager, and joint family management, only the first three categories were considered for this analysis as the majority of the farms were in these.

Out of the 224 farms, 71 were managed by males, 88 by females, 62 by both male and female, 1 by a hired manager and 2 were managed jointly by both male and female managers and their sons.

An ANOVA was done to establish whether there was significant difference in the area under coffee, the yields and the operational costs between the farms based on their managers. For the area under coffee an F value of 3.698 was obtained which was significant at $p=0.028$ and 204 degrees of freedom. To establish the source of the significance, A Turkey's HSD test was run to show the variation between each of the management categories. The acreage under coffee was found to significantly vary between the farms managed by females and those managed by both male and female. The analysis had a $p=0.021$. The ANOVA did not give significant variation in the coffee yields per ha and the operational costs per ha at $p<0.05$. The analysis of coffee yields gave an F value of 1.475 and $p=0.234$ at 204 degrees of freedom while that for operational costs gave an F value of 0.380 and $p=0.234$ at 204 degrees of freedom.

Table 4.3. Mean coffee and tea production levels based on plot management in Kirinyaga and Embu Districts, Kenya

	Coffee(n=208)			Tea (n=92)		
	Male	Female	Both	Male	Female	Both
Number of trees/bushes	389	289	528	2 520	3 607	4 112
	(284)	(220)	(617)	(1760)	(6249)	(2745)
Area	0.2933	0.2175	0.3979	0.3237	0.4968	0.5712
	(0.21)	(0.16)	(0.46)	(0.22)	(0.90)	(0.38)
Yield per farm	1 523	1 284	2 043	2 424	2054	5444
	(1656)	(1112)	(2447)	(1364)	(1090)	(4950)
Yield per hectare	5 193	5 903	5 134	7 488	4 134	9 530
	(4785)	(4126)	(3131)	(3433)	(4906)	(8072)
Value per farm	18 276	15 408	24 516	46 056	39 026	103 436
	(19 873)	(13 354)	(29 369)	(25 933)	(20 725)	(94 050)
Value per ha	62 312	70 836	61 613	142 279	78 554	181 085
	(57 424)	(49 514)	(37 572)	(62 245)	(93 217)	(153 381)
Operational costs per farm	18 141	14 191	18 148	8 358	10 199	14 230
	(31 192)	(9269)	(21 592)	(7041)	(8401)	(12 509)
Operational costs per ha	61 851	65 245	45 609	25 820	20 529	24 912
	(52 711)	(43 506)	(28 446)	(19 876)	(28 509)	(19 697)

*Figures in brackets are standard deviations
Source: Survey data (1999)

The ANOVA for tea gave no significant difference between the number of tea bushes owned by the male managed, female managed and both male and female managed farms at $p<0.05$. The F value for this analysis was 0.066 and with a $p=0.936$ at 88 degrees of freedom. The analysis for the amount of tea harvested however gave an F value of 5.781 with a $p=0.007$ at 88 degrees of freedom. The significant difference in the amount of tea harvested was between the male managed farms and the farms managed by both male and female farm managers in which a Turkey's HSD test gave a p value of 0.022 and also between the female managed farms and farms managed by both male and female farm managers which had a $p=0.006$. Both were significant at $p<0.05$.

4.1.2.2 Food crops

a) Food crop production

Maize, beans, irish potatoes, tomatoes and bananas were ranked as the most important food crops by the farmers. Maize ranked first both among the women and the men followed by beans. These are the staple foods in the study area. Some farmers grew them as mono crops while others intercropped them. The maize/beans intercrop is very common especially among farmers with small land sizes. All the 224 farmers were growing maize while 144 were growing beans. The maximum acreage under maize was 4 hectares while the mean acreage per household under maize was 0.77 hectares.

A majority of the farmers (98%) purchased hybrid seeds for planting while 2% used their own seeds from previous seasons. About 89% of the farmers used fertilizer on maize while the others used a combination of manure and crop residues to boost maize production. Hired labour was used on maize by 52% of the farmers with the major activities using labour being land preparation and weeding. Weeding was done by hired labour in 24% of the households and land preparation in 41% of the households. Hired labour was either on casual or seasonal basis. These results are shown in Table 4.4.

Table 4.4. Percentage of farmers using various inputs in food crops in Kirinyaga and Embu Districts, Kenya

Inputs	Maize (n=224)	Beans (n=144)
Purchased seeds	98	92
Fertilizer	89	29
Hired labour	52	28

Source: Survey data (1999)

Both men and women indicated beans as the second most important food crop. Majority of farmers grew beans as an intercrop with either maize or coffee. The mean area under beans was 0.56 hectares. Majority of the households (92%) purchased beans for planting while the rest obtained the beans from their farms from the last season as shown in Table 4.4. About 29% of the households used fertilizer on beans while the rest did not. The fertilizer was used during planting. Beans, being nitrogen fixing did not require top dressing with fertilizer. Hired labour was used on beans by 28% of the households mainly on weeding, planting and harvesting.

Mean maize output was 330.36 kg per farm, which was approximately 4 bags and equivalent to 428.20 kg/ha. This is lower than yields for the same area observed by Muriithi (1998) due to shortage of rainfall during the season when the present study was carried out. Sixty three per cent of the farmers indicated that the maize they produced during the season was not enough for home consumption and purchased additional maize at an average of 230 kg per household. Maize was sold in 13% of the households at an average of 52 kg per household. The production levels are shown in Table 4.5.

Table 4.5. Food crop production levels in Kirinyaga and Embu Districts, Kenya

	Maize (n=224)		Beans (n=144)	
	Mean	sd	Mean	sd
Area (Ha)	0.7715	0.7650	0.5600	0.7056
Cost of planting material (Ksh)	495.74	464.89	554.08	620.29
Cost of fertilizer (Ksh)	1 046.85	1 036.13	155.44	373.28
Cost of labour (Ksh)	1 678.70	2 11.03	1848.24	2644.88
Yield per farm (kg) [1]	330.36	384.94	107.96	162.38
Yield per hectare (kg)	428.20	522.36	192.79	102.76
Amount sold (kg)	51.68	160.16	10.63	43.05
Amount consumed (kg)	366.79	922.97	97.33	135.85
Additional amount bought (kg)	230.36	271.76	101.44	118.39

[1] The yield per farm + the amount bought is higher that the amount consumed + the amount sold. The reason for this is that farmers retained some of the crop for planting material and also gave to neighbours and relatives while some exchanged the crop with other commodities such as salt. They could not however recall the specific amounts of maize or beans used for these purposes and in this case, it was assumed that this comprised the difference.

Mean bean production per farm was 107.96 kg, which is approximately one bag. and yield per hectare was 192.79 kg (2 bags). About 64% of the respondents indicated that the beans produced was not enough for home consumption. Households purchased a mean of 101 kg for home consumption to supplement the farm production. However, some households (7%) sold surplus beans at an average of 10 kg per household. Compared to maize, beans were not as good a source of income due to the low production although market price for beans was higher than that of maize.

b) Gender issues in food crop production

Although activities in maize production are gender sequential, some of the activities are actually gender neutral and are carried out by both men and women. Women formed the dominant labour in maize production in 47% of the households while

labour was neutral in 37% of the households. Land preparation was done by men in 62% of the households, weeding in 17% of the households and harvesting in 48% of the households. Harvesting was considered a gender sequential activity in itself whereby cutting the maize stovers was mainly done by men while women removed the maize from the stovers and from the cobs. Men later carried away the maize stovers from the farm area to be fed to livestock. Decision making on whether to sell maize was done by women in 42% of the households and by both men and women in 20% of the households. In 38% of the households, men made the decision.

Dominant labour in the production of beans was female in most of the households while the decision on whether to sell or not to sell beans was made by women in 53% of the households and by both men and women in 29% of the households. Men made decision-making on the sale of beans only in 18% of the households. This indicates the higher level of control of some of the food crops by women as opposed to the cash crops.

The differences in maize and bean production in male, female and both male and female managed farms are shown in Table 4.6. Although the mean area under maize was higher for the farms managed by both male and female managers, there was no significant difference at $p<0.05$ between average area under maize for the three management levels and neither were the yields. An ANOVA for the area under maize gave an F value of 1.729 at a probability level of $p=0.182$ and 220 degrees of

freedom. Non-significant differences were also found for the yields of maize for all the three farm management categories (F=0.516 and p=0.599).

Table 4.6. Production differences in food crops based on farm manager in Kirinyaga and Embu Districts, Kenya

		Mean maize production	Mean bean production
Male	Area	0.7371(0.75)*	0.5481 (0.64)
	Yield per farm (kg)	382.94 (479.09)	152.56 (234.56)
	Yield per ha (kg)	519.52 (427.78)	278.34 (254.85)
Female	Area	0.6779 (0.61)	0.5389 (0.50)
	Yield per farm (kg)	303.47 (320.53)	88.27 (102.77)
	Yield per ha (kg)	447.66 (712.76)	163.79 (159.29)
Both	Area	0.9961 (0.96)	0.6296 (0.96)
	Yield per farm (kg)	297.64 (335.38)	67.07 (56.65)
	Yield per ha (kg)	298.81 (321.08)	106.53 (187.92)

*Figures in brackets are standard deviations
Source: Survey data (1999)

Mean yields were also compared for beans based on plot management as shown in Table 4.6. Although the mean acreage in female managed farms (0.5389) was lower than the mean for male managed farms (0.5481), this difference was not significant at $p<0.05$. ANOVA results gave an F value of 0.189 and p=0.828 at 141 degrees of freedom. The same test found the bean yields not to be significantly different based on the manager of the farm (F=1.751, p=0.181).

4.1.2.3 Trees

a) Tree populations

The farmers grouped trees into four categories, trees for timber, poles and firewood; trees for fruits; trees for fodder and indigenous trees. All the households studied had

trees. Table 4.7 shows the number of trees on farms. Trees for timber included *Grevillea robusta*, *Eucalyptus spp.* *Juniperus procera*, and *Cordia africana*. The dominant tree was *Grevillea robusta* and this was present in 94% of the farms. The age of *Grevillea robusta* trees ranged from one to thirty years with a mean age of 11.57 years.

Table 4.7. Number of trees on farms in Kirinyaga and Embu Districts, Kenya

Category	Maximum	Mean (n-=224)	sd
Timber, poles and firewood	900	89.41	121.57
Fruit trees	130	7.61	15.83
Fodder trees[1]	100	1.25	9.69
Indigenous trees	30	1.04	4.21

[1] Only four farmers had planted fodder trees.

Source: Survey data (1999)

Mugo (1999) found that households in Kirinyaga had a household fuel demand of 7.8 tonnes in the tea and 5.3 tonnes in the coffee zone. This is an average of 6.6 tonnes per year. With a ten year tree producing approximately 40 kg per year of wood and taking the fact that in Kirinyaga farmers use only three quarters of the wood harvested for firewood and the rest for other purposes such as tomato staking, fencing and construction (Tyndall, 1995), farmers would need an average of 220 trees to meet their fuelwood needs. The average of 89 trees for fuelwood, timber and poles does not therefore meet household needs. Fruits were present in 64% of the farms and these included mango, avocado, macadamia, citrus, loquat, guava, passion fruits and tree tomato among others. Only four farmers had planted fodder shrubs.

b) Tree planting patterns and agroforestry practices

Tree planting patterns adopted by the farmers depended on the type of trees, purpose for which the tree was grown and the frequency of pruning. The most common patterns were outer boundary planting, inner boundary planting, on homestead, intercropped with crops and as a woodlot. Trees used for timber and fuelwood were more common on the outer and inner boundaries. Due to the declining land size, woodlots are not common in the study area. They compete with other more profitable land use options such as food crops and horticultural crops as well as cash crops such as macadamia.

Although boundaries are a very important niche for planting useful trees and shrubs, farmers have used them for shrubs that have no other major purpose apart from acting as a live fence. These include *Euphorbia tirucalli* and *Caesalpinia decapalata.* both on the external and internal boundaries. There is a lot of opportunity to plant fodder trees such as *Calliandra carothyrsus* and *Leucena trichandria* on these boundaries. The farmers however cited lack of information on the appropriate trees and shrubs to plant on these boundaries and even when they have such information, they lack seeds and seedlings.

Fruit trees were mainly planted interspersed within crops (77%) and around the homestead by 7% of the households. Due to the fact that fruit trees are not pruned regularly, they are more suitable interspersed within other crops as this causes minimal damage to crops.

c) Disputes associated with tree planting patterns

Planting trees along boundaries was reported to cause disputes with neighbours over associated crop loss and destruction of crops during pollarding of the trees. In many cases both the farmers neighbouring each other had planted trees on the common boundaries creating disputes on tree ownership. This was cited by extension agents in Kirinyaga district as a major problem between the farmers. In a study by Mugo (1999) in Vihiga and Kirinyaga Districts of Kenya, the author found that 20% and 31% of the households in Vihiga and Kirinyaga respectively did not plant trees on boundaries to avoid disputes with neighbours. From the same study, 16% and 30% of the households in Vihiga and Kirinyaga respectively had had tree related boundary disputes.

Planting along boundaries is also used to mark boundaries after land sub-division. Majority of the fathers are not willing to officially sub-divide their land and issue title deeds to their sons because of the growing land market in the area. Sub-division is therefore always wrought with controversy and so is the associated planting of trees on the newly sub-divided boundaries.

d) Farmers perceptions on uses, advantages and disadvantages of trees

Farmers gave their views on what they thought were the most important uses of some specific trees and what they perceived as their advantages and disadvantages. The results are shown in Appendix 6.Farmers used a variety of trees for timber and firewood. These included *Persia Americana, Cordia africana, Croton megalorcapus,*

Markhamia lutea, Acacia mearnsii and *Ficus thoningii*. Fruit trees included *Psium guajave, Persia Americana, Mangifera indica* and *Cyphomdra butacea*. The major disadvantages of some of these trees were competition with crops, dense canopies, harbouring of insects and birds and difficulty in controlling them.

e) The role of indigenous trees

Indigenous trees were predominant in most of the farms. They were mostly interspersed with crops, on outer boundaries and around the homestead. Majority of the farmers however indicated that these trees are not purposively planted but have grown on their own. They are used for a variety of purposes ranging from medicinal to forage either for the larger animals or for sheep and goats. *Commiphora eminii* is a popular tree for marking boundaries due to its method of propagation (vegetative) and fast growth. It is a very common fodder for goats. Women in the study area use *Croton macrostachyus* to provide warmth for ripening bananas and other fruits such as mangoes and avocados. *Markhamia lutea* provides props for bananas and is also useful for firewood, posts and tomato staking. *Ficus thonningii* is mostly a ceremonial tree. *Cordia africana* provides high quality timber and good mulch for crops growing underneath it.

Majority of the farmers expressed willingness to plant indigenous trees to serve these purposes while women felt that they would have more access to indigenous trees as sources of fuel wood. This has been confirmed by various studies (Mugo, 1997; Warner 1995; Kerkhof, 1990). The problems associated with indigenous trees

included lack of seeds and seedlings. One farmer with a nursery for indigenous trees could not meet the farmers' demands and encountered problems collecting seeds from the forest. A once common source of seeds for his nurseries (the *kamuruana* hill) was cleared by the government, replanted with one species, and gazzetted as a forest reserve.

f) Tree crop interactions.

The total number of trees, numbers of trees per ha and trees per capita differed in the two zones as shown in Table 4.8.

Table 4.8. Differences in tree populations in the two zones in Kirinyaga and Embu Districts, Kenya

Zone	Trees per ha	Trees per capita	Total trees
Main coffee zone	30.82 (29.45)[1]	15.17 (15.89)	91.16 (89.97)
Transitional tea coffee zone	54.32 (72.26)	18.63 (33.41)	127.56 (184.68)
P-values	0.021*	0.466	0.240

*Significant at $p<0.05$

[1] Figures in brackets are standard deviations

Source: Survey data (1999)

The transitional tea-coffee zone has a higher number of trees per capita, trees per ha and total number of trees. However, only the number of trees per ha was significantly different between the two zones. Farmers in the coffee zone had problems with some trees such as *Grevillea robusta* and *Eucalyptus spp* trees amongst the coffee and on the boundaries next to the coffee crop as they destroyed the coffee stems during pruning and pollarding. Farmers however still had these trees as they were not sure which trees would be more profitable or beneficial given the uncertainty of future

markets. Extension workers have for a long time been discouraging the planting of any other crops or trees in coffee in a bid to increase coffee productivity.

In the light of decreasing coffee prices however, farmers have planted other crops and trees in coffee which they see as having better cash returns ranging from macadamia, to beans and fruit trees. Majority of tea farmers on the other hand did not have trees interspersed with the tea crop. This is explained by the fact that the most common tree, *Grevillea robusta*, has harmful effects on the tea. The leaves when shed form a blanket cover over the leaves of tea thus lowering photosynthetic capacity of the leaves while it also acts as a secondary host to the *amelaria* fungi which attacks tea (Mugo, 1999).

g) Role of land size and land tenure in tree planting

There was a positive correlation between land size and number of trees planted per farm. The Pearson's correlation coefficient was 0.391 and was significant with a p value of 0.0005. Similar results have been reported elsewhere (Van Gelder and Kerkhof, 1984; Luciene *et al.*, 1988; ICRAF, 1994, 1995, 1996). The Pearson's correlation coefficient for the correlation between land size and number of trees per ha was however not significant (R= 0.145 p=0.125). For households with small land size, meeting their fuel needs becomes a challenge. The near absence of woodlots in the study area is partly a response to the decreasing land size as is the big number of farmers using their boundaries for tree planting.

There have been contradicting results and arguments on the effect of land tenure on tree planting. Studies conducted in Indonesia (Luciene *et al.*, 1988), Cameroon (Tonye *et al.*, 1993), Benin (Neef and Heidhues, 1994), Nigeria and Togo (Lawry and Steinbarger, 1991; Lawry *et al.*, 1994) and Kenya (Mugo, 1997, 1999) show that insecure land tenure contributes significantly to limited adoption of tree planting. A land tenure study by ICRAF (1995) shows household land tenure security as not being a major constraint to tree planting within the communally owned land tenure system. The effect of security of tenure on tree planting may however be different depending on the land tenure system in question.

There was a significant correlation between land registration and the total number of trees. The number of trees was rank ordered into categories and Spearman's correlation was run. This gave a correlation coefficient of 0.277, which had a p-value of 0.005. This means that with land registration, households are likely to plant more trees. These findings are similar to those by Fortmann (1985) and Mugo (1997). Mugo (1999) however found no significant difference in trees per capita and trees per ha between households whose land was registered and those whose land was not registered. Land security is important in tree planting. This is because the benefits of trees are long term in nature and unless farmers are assured of long-term occupancy in their farms, they will not invest in trees. Sons who are given land to cultivate do not plant trees because they are not sure whether these will be their permanent plots or not. There have been instances where sons have had to uproot trees and other cash crops after sub division of land.

h) Role of social and cultural factors in tree planting

In both Kirinyaga and Embu, there were no taboos identified that have an effect on tree planting by both men and women. Although women felt that tree planting was a man's job, they said that they had no limitations in planting trees if they wanted to. In some households, women were already planting trees and especially those who were members of women groups involved in tree nurseries. What emerged as more important in the planting of trees was who made decisions on which trees would be planted and where they would be planted. Even in cases where women planted trees, the decisions especially on where to plant the trees were made by men.

i) Relationship between tree populations and source of fuelwood

Households that used their own farm trees for firewood had higher numbers of trees per farm and per capita than those who obtained from other sources as shown in Table 4.9. The mean number of trees per ha for those who purchased firewood was higher than for those who used their own trees as a source of firewood. The explanation for this could be that there are households that have planted trees on their farms but are not using them for firewood either because women do not have access to them or men do not allow the pruning of trees for firewood so as to obtain good quality timber from their trees. Some of the households could also have recently planted the trees such that they are not ready for harvesting to use as firewood.

Table 4.9. Source of firewood and tree population in Kirinyaga and Embu Districts, Kenya

Source	Trees per ha	Trees per farm	Trees per capita
Forest	13.7(7.48)*	44.83 (37.38)	5.12 (3.70)
Farm trees	38.9 (47.77)	103.9 (105.07)	15.68 (15.69)
Purchase	41.21 (72.49)	37.31 (75.19)	7.49 (12.11)

*Figures in brackets are standard deviations
Source: Survey data (1999)

There is also a lot of competition in the use of tree pruning especially from grevillea. eucalyptus and coffee, which are also used for tomato staking and a variety of other functions. The temporary closure of forests to saw millers has seen a majority of them buying trees from farmers. In most cases they buy trees in whole denying women much needed firewood that they would have got if the tree were sold separately as timber and prunings left for use as firewood.

j) Gender differences in trees preference.

Ranking of trees was done using groups of both men and women. Results of the preference ranking are shown in Table 4.10. *Grevillea robusta* was the highest ranked tree by both men and women overall followed by *Persia americana* and *Cordia africana*. Women ranked *Persia americana* as the most important tree, while *Grevillea robusta* came second followed by *Cordia africana*. Men's most important tree was *Grevillia robusta* followed by *Eucalyptus spp*. Although eucalyptus was high on men's priorities list, it was not common on the farms. *Persia americana* scored well with women both as a source of fruits for home consumption and a source of cash. Most women indicated that this is a fruit tree predominantly controlled by women and women are responsible for sale of the fruits. The

introduction of faster growing and high yielding varieties has increased its attractiveness to farmers as a source of cash.

Table 4.10. Men and women's tree preferences in Kirinyaga and Embu Districts, Kenya

	Men	Women	Total	Rank
Grevillea robusta	53	22	75	1
Persia Americana	34	34	68	2
Cordia africana	40	20	60	3
Eucalyptus	42	14	56	4
Mangifera indica	32	12	44	5
Calliandra carothyrsus	20	18	38	6
Markhamia lutea	11	7	18	7
Albizia gummifera	8	9	17	8
Brideliu micrantha	8	7	15	9

Source: Survey data (1999)

Grevillea robusta scored highest as a source of firewood with both sexes. This was followed by eucalyptus by the men and *Cordia africana* by the women. *Eucalyptus spp* has a negative effect on the growth of food crops and it is not therefore attractive to women as opposed to *Cordia africana* whose mulch boosts crop growth. Even from observation, crops under *Cordia africana* were doing better than on the other parts of the farms. The most important source of timber was Eucalyptus for both the men and the women while *Grevillea robusta* was second for the men and *Cordia africana* was second for the women. *Calliandra carothyrsus* ranked highest as a source of fodder for both men and women. Although many of the farmers did not have *Calliandra carothyrsus* on their farms, they had seen its potential as a feed from farmers who had adopted it.

Other results have also shown dissimilarities in tree and tree product preference (Fortmann and Rocheleau, 1985; FAO, 1993). In Senegal, women expressed a preference for fodder and shade trees whereas men favoured income-producing species (Kumar, 1988). The same author however gives examples of cases where women have been engaged in fruit, fuelwood and pole markets. Similar results have also been reported in Rajasthan (Kaur, 1991).

k) Differences in tree population based on farm manager

There were differences in tree numbers based on the manager of the farm as shown in Table 4.11. Farms managed by both male and female managers had the lowest mean number of trees per ha (24.8) while male managed farms had the highest at a mean of 57.15 trees. Widows had a mean number of 43 trees per farm, which is higher than the mean for all female headed households and the farms headed by both men and women. An ANOVA was run to test for significance in the variation in the number of trees per farm, number of trees per ha and number of trees per capita for the three farm management categories.

Table 4.11. Differences in tree population per hectare based on sex of farm manager in Kirinyaga and Embu Districts, Kenya

	Minimum	Maximum	Mean	SD
Male manager	2	311	57.15	70.47
Female manager	0	144	27.50	30.28
Both male and female	0	102	24.80	28.90

Source: Survey data (1999)

The numbers of trees per ha were found to vary significantly between the management categories with the ANOVA giving an F value of 5.367 with a probability level of p=0.006. To find out the source of the significance, a Turkey's HSD test was carried out. There was found to be a significant variation in the number of trees per ha in male managed and female managed farms at p=0.013 and between male managed farms and farms managed by both male and female managers at p=0.020. These results are in contrast to those by Bonnard and Scherr (1994) that gender is not a very useful explanation of farmers' willingness to plant trees.

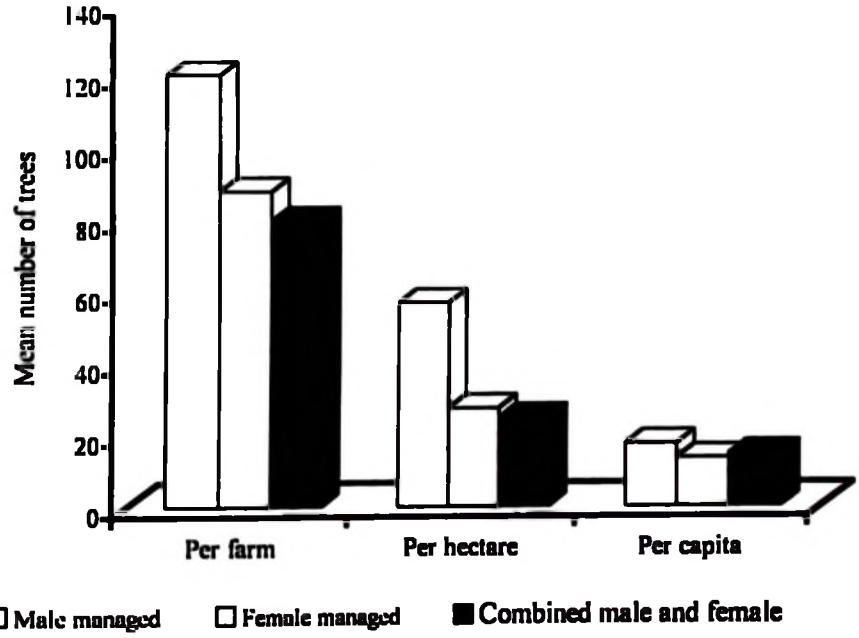

Figure 4.2. Tree population based on the manager of the farm

In Cameroon and Kenya, as in other parts of the world (Tonye *et al.*, 1993; Mugo, 1997), it has been observed that while women were willing to adopt tree planting since they are the ones who suffer from fuelwood shortage they are handicapped in

this since they do not have direct access to land. In most instances, male members of the households make decisions on the use of land. Tree planting especially poses a major challenge because traditionally, trees were planted as visible evidence of a claim to land. Men therefore did not allow their wives or their children to plant trees (Brokensha and Glazier, 1973).

l) Decision making on tree issues

Although there are no restrictions against planting trees by women, some of the women still had to seek consent from their husbands on whether to plant or to cut down trees. This however depends on whether the husband lives within or away from the farm. Households that had trees for timber and fuelwood in their farms were 209 while those with fruit trees were 124. Male members of the households made decisions on whether to plant *Grevillea robusta* in 67% of the households while female members in only 14% of the households made the decisions.

The percentage of women making decisions on tree planting however increased with fruit trees where in 29% of the households women made the decision to plant trees. Of these, 17% had to consult their husbands before planting fruit trees. These results are shown in Table 4.12. Disposal of the trees took the same patterns as planting of trees whereby in about 50% of the households, decision on whether to dispose the fruit trees or tree products was made by men, by women in 34% of the households and by both men and women in the remaining 15% of the households.

Table 4.12. Decision-making and planting of trees by women in Kirinyaga and Embu Districts, Kenya

	Trees for timber and fuelwood (n=209)			Fruit trees (n=124)		
	Male	Female	Both	Male	Female	Both
Decision making on planting	66.7	14.3	19.0	57.5	34.2	8.3
Actual planting	68.6	17.1	14.3	53.4	28.8	17.8
Decision making on disposal	66.7	15.2	18.1	50.7	34.2	15.1

Source: Survey data (1999)

In the four households that were growing fodder trees both the decision to plant and to dispose the trees was made by women in two of the households, by men in one and by men in consultation with the women in the remaining household. Women also did actual planting in two of the households. It would be expected that most women would be involved in the decision making and planting of fodder and soil fertility enhancing.trees. These trees are generally not considered as trees but as shrubs and there is no objection to women planting them. On the other hand, women are also involved in cattle rearing in the two districts and would be responsible for growing fodder for the livestock. The other reason for this would be the economic value of shrubs, which is lower as opposed to trees.

Fodder trees being regarded as shrubs and not trees have a lower economic value than other trees. Mugo (1997) reported that in Bungoma District, Kenya some trees had become "men's trees" simply because of their increased demand for charcoal making hence increased economic value. The issue therefore may not necessarily be the tree species but the economic value of the species. This however cannot be confirmed in this study due to the small number of households that had fodder trees.

m) Decision making and planting trees based on farm management.

The proportion of men and women who made decisions on planting and disposal of trees and also did actual planting was compared for male managed, female managed and both male and female managed farms. Only in 2.6% of the male managed farms did women make decisions on tree planting as compared to 31.7% in the female managed farms and 4% in farms managed by both male and female. A chi square test showed a significant difference at $p<0.05$ between male and female managed farms in the number of women making decisions on tree planting (chi square statistic=29.126, p=0.0005), number of women doing the actual planting of trees (chi square statistic=39.06, p=0.000) and number of women making decisions on disposal of trees (chi square statistic=24.17, p=0.0005). These results are shown in Table 4.13.

Table 4.13. Proportions of men and women making decisions on trees based on sex of farm manager in Kirinyaga and Embu Districts, Kenya

Farm manager	Decision making on planting			Actual planting			Decision making on disposal		
	Male	Female	Both	Male	Female	Both	Male	Female	Both
Male	84.2	2.6	13.2	89.5	2.6	7.9	78.9	5.3	15.8
Female	46.3	31.7	22.0	43.9	39.0	17.1	48.8	31.7	19.5
Both male and female	72.0	4.0	24.0	76.0	4.0	20.0	76.0	4.0	20.0

Source: Survey data (1999)

n) Factors influencing decision making and tree planting by women

A probit model was run to determine the factors that affect women's ability to make decisions on tree planting and tree use .The variables considered included a dummy for extension services, age of the household head, age of the woman, a dummy for

married women, a dummy for women's access to land and a dummy for insufficient household fuelwood supply among others. The results are shown in Table 4.14.

The results on Table 4.14 show that being a farm manager increases the likelihood of women making decisions on tree planting. However, in absolute terms, the female managed farms still did not have as many trees as the other categories of farms. This implies that even when women can make decisions about planting trees, they still plant fewer trees than men.

Table 4.14. Predictors of women's decision making and tree planting in Kirinyaga and Embu Districts, Kenya

Variable	Actual planting		Decision making on planting		Decision making on use and disposal	
	Coeff	t-values	Coeffi	t-values	Coefficients	t-values
Married	-3 191	-0 0465	-1.984	-1.833	-0.505	-0.6296
Age of husband	0.037	0 1659	0.008	-0.2003	-0.491	-1.1834
Education of husband	0.065	0.2390	0.042	-0.0398	0.982	0.9432
Female manager	5.175	1.3264	2.239	2.35328*	1.330	1.9993
Insufficient firewood	4.235	0.2880	0.261	0.3091	0.823	1.7467
Woman's age	0.052	1.3453	0.035	1.1426	-0.011	-0.3223
Extension services	0.169	0.2061	0.412	1.1690	-0.128	-0.8307
Access to land	-3.7466	-0.8179	-1.323	-0.8902	-1.056	-0.8529
Chi square statistic	0.192		18.575		21.631	

* Significant at $p<0.05$

A number of studies have identified the lack of decision-making authority by women as a constraint to tree planting and harvesting (ICRAF, 1995; Mugo, 1997). In most of the households where both the husband and the wife are present, control and decision-making remain the sole responsibility of the husband. Mugo (1999, 1997) has argued that it is women's decision making on planting and cutting trees that is more important than their actual planting of the trees. This is because they could hire men to plant the trees if cultural restrictions prohibit them from actual planting.

4.1.2.4 Livestock

Majority of the farmers (83%) had cattle with the mean number of cattle being 1.63 with a standard deviation of 1.23. Sixty six percent of the farmers had either one or two cows while 17% had over two cows. The maximum number of cattle kept by any of the households was six. Other farm animals reared by the farmers included sheep, goats, chicken and pigs.

Cattle were mainly reared in zero grazing units (86.5%). About eight percent of the farmers tethered their cattle while three farmers were free grazing their cattle. This was mainly done along the roadsides and on their farms after harvest while awaiting land preparation. In Central and some parts of Eastern Kenya where mean land acreage is less than 3 hectares, there are no opportunities for free range or extensive cattle rearing. These results are shown in Table 4.15.

Table 4.15. Number of cattle and the system under which they are kept in Kirinyaga and Embu Districts, Kenya

	Number of households (n=224)	% of households
No. of cows		
None	38	17
1 –2	148	66
Over 3	38	17
Grazing system		
Zero grazing	161	86.5
Tethering	15	8.1
Extensive grazing	3	1.6
Zero grazing and tethering	7	3.8

Source: Survey data (1999)

Farmers kept cattle for a variety of reasons. The majority of the farmers kept cattle for the major purpose of milk production while others kept for the purpose of obtaining both milk and manure. The manure was mostly used on coffee. There were however other uses for cattle. Those with beef cattle used them for pulling ox drawn carts and ox drawn ploughs. Although ox ploughing is not very common due to the small land holding, several farmers were using cattle for ploughing especially those with land in other areas. Farmers also hired out their oxen to neighbours for cash.

4.2 Access and control of productive resources by women

4.2.1 Land

In 21% of the households studied, women had access to land although women in only 15% of the households controlled land. Out of the women who controlled land, 47% were widowed while the others were either single or married. Although the statutory law in Kenya does not discriminate against women, legal pluralism (co-

existence of customary and statutory laws) sometimes acts against women especially in cases where customary law prevails against statutory law. Kenya is among the countries where this legal pluralism has created havoc with four overlapping legal systems, customary law, Islamic law, Hindu law and statutory and civil law.

Women's rights in access to and control over land and other productive resources is essential to women's everyday survival and economic security and is the most critical factor in women's empowerment and their struggle for equality in gender relations (HABITAT, 1999). Women's relative economic power from ownership of resources increases their relative status in the household and the community. This is in line with Blumberg's general theory of gender stratification (Blumberg, 1984).
With increased migration by male members of household to urban areas leading to increase in the number of female-headed households, women have been left to undertake agricultural activities and yet their relationship to land and resources is that of lack of security of tenure. Another difficulty faced by women in the study area is the inefficiency of the judicial system in the country, which continues to allow male members of households to sell land without the consent of other family members. During focus group discussions, women felt that even the establishment of joint ownership titles have had no impact in terms of their security of land as men still continue to sell land without their consent.

4.2.2 Farm inputs

There are two dimensions to access to farm inputs; ability to purchase farm inputs and membership in crop and marketing co-operatives. Farm inputs for cash crops were mostly obtained from marketing co-operatives on credit against the future crop. However, this was only applicable to members of the co-operatives. Membership to the co-operatives is based on the registered owner of the land and the crop. In majority of cases, household heads are the registered members of these co-operatives and therefore have the exclusive rights to benefits and services of these co-operatives. This has implications for women's access to inputs. Women had access to credit from co-operatives in 19% of the households. Out of these, 56% were widowed and 4% were single. Widows had higher access mainly because after the death of their husbands they change the membership names with the co-operatives.

Women's ability to purchase inputs for crops is in part determined by the intra household negotiations and how much of the household capital they control and can mobilize for improvements in farm production. Inefficiencies in resource and input allocations within households have been blamed for low agricultural productivity in Africa. In Burkina Faso, evidence from an efficiency point of view suggests that too little labour and fertilizer are used on plots controlled by female farmers (Udry, 1996) and that productivity could be increased by as much as 20% by reallocating factors of production from men's plots to women's plots. Although the study area had no separate men's and women's plots, the total amount of money used for

fertilizers in the three different farm management categories was compared. An ANOVA yielded an F value of 0.822 (p= 0.442, 221df).

4.2.3 Credit

In the 10 years before the study (1988-1999), only women in 14% of the households had obtained credit from the credit institutions. Except from the traditional banks. lending institutions available in the two districts are the District Cooperative Union that draws its membership from coffee farmers and the District Tea Savings and Credit Cooperative that draws its membership from tea farmers. Membership in these co-operatives is based on land and crop ownership. In male-headed households, only the male members of households are registered members and wives cannot get credit independently. Women in female-headed households are however eligible for loans but only if they are the registered members. These co-operatives have therefore also locked out the majority of women from getting credit whereas they would be ideal sources of credit since they do not require collateral as the loans are obtained against the future crop.

Evidence has shown that the impact of female borrowing is different from that of male borrowing. The impact of female borrowing on per capita household expenditure is twice as large as the impact of male borrowing. Female borrowing also has a greater impact on child welfare and children's nutritional well being (Khandker, 1998). Women's independent access to credit empowers them by

increasing female control of non-land resources as well as increasing their role in household decision-making.

4.2.4 Agricultural extension

Evidence suggests that female farmers tend to have relatively poor access to production information, training and technologies through national agricultural extension services (World Bank, 1990).

Within the three months prior to the study, women in 17% of the households had been approached directly by extension agents for the purpose of training while men had been approached directly in 35% of the studied households. In 48% of the households, both the husband and the wife were approached for extension training. Of the women targeted for extension services, 78% were female farm managers while the rest were women in male managed farms. This implies that the targeting of women for extension is because their husbands are not living within the farms and not necessarily because of efforts in the extension services to target women, who are the majority food producers.

Evidence from Kenya, Malawi, Nigeria and Tanzania has shown that if extension agents are predominantly male, then they target male members of households (Bindlish and Evenson, 1993; Bindlish *et al.*, 1993). This has been on the assumption that males are the decision makers and any information given to them will trickle down to other members of the family. However, these assumptions do not always

hold. Women farm managers are increasing in SSA and other parts of the world as males migrate to the cities. Even in cases where men are present, information may often not be pooled within households and the anticipated trickle down effect of information is the exception rather than the rule. In addition, men may be responsible for different crops than women and consequently their extension needs may differ. Contact with male farmers for purposes in which women are responsible makes the situation of women worse as it unconsciously reinforces the right of men to give information and make decisions regarding all the aspects of the household.

Traditionally, extension services have been devoted to farmers who own land and who are willing and able to obtain credit and invest it in inputs and technological innovations. Since women often lack access to land, or to other collateral with which to obtain credit, extension services, unintentionally, bypass women.

Attitudes of extension staff have also been found to be an important barrier to women's access to extension services. Beliefs about women not really being significant contributors to agricultural production, their pre-occupation with household chores and children, and their shyness have denied women important extension information. Men predominantly staff extension divisions. The male to female staff ratio in the study area was 1.7:1 while the extension staff to farmer ratio was approximately 1:700. The delivery of extension services faces many problems including inadequate staffing that leads to the high farmer to extension staff ratio, inadequate transport facilities and lack of frequent and relevant training opportunities. For example, during the period of this

study. in Kirinyaga. there was a total of 41 extension staff. 15 of who use bicycles. one with a motorcycle and the rest do their work on foot. They cover an area of 213 km² with a total of 24 084 farm families. Getting extension information to these farm families is a big challenge. The ratio of female to male extension staff has been cited as a contributing factor to women's non-participation in a lot of activities including tree planting. Although there is no empirical evidence against male extension agents working with women farmers, female extension agents are believed to interact better with women farmers. Limited extension services and content of extension information have been blamed for poor productivity (Bastone, 1988). A comparison of extension messages given to farmers gave results as shown in Table 4.16.

Table 4.16. Content of extension messages by district in Kirinyaga and Embu Districts, Kenya

Subject	% Households in Embu[1]	% Households in Kirinyaga[1]
Crop production	94.0	70.1
Livestock production	11.1	39.8
Home economics	2.0	3.5
Soil conservation	6.0	3.5
Tree planting	1.3	1.8

[1] The percentages add up to more than 100% due to multiple responses

Source: Survey data (1999)

Most of the respondents indicated receiving messages on crop production followed by livestock production. Only 1.3% and 1.8% of the respondents from Embu and Kirinyaga respectively received extension advice on tree planting.

4.3 An economic analysis of the farming system for the case study farmers

4.3.1 Farm characteristics and production.

4.3.1.1 Land size and cropping patterns.

The average land size owned by the farmers was 2.455 ha. The farmer with the largest farm area had 9 ha while that with the lowest had 0.25 ha. A mean area of 0.2724 ha, 0.2628 ha, 0.4974 ha, 0.5974 ha and 0.2548 ha were under coffee, tea, maize, beans and potatoes respectively. Other crops grown included cabbages, tomatoes, kale, macadamia and bananas. Farmers practice mixed cropping and intercropping. Common crops that were intercropped included maize and beans, maize and potatoes, beans and coffee, coffee and macadamia, maize and tomatoes. Bananas were mainly planted around the homestead and on internal boundaries. Out of the 40 farmers, 37 were growing coffee, 17 were growing tea, and 38 were growing both maize and beans while 29 were growing potatoes.

4.3.1.2 Production

Crop production statistics for the period under study are shown in Table 4.17. Average coffee production in the 40 farms was 1611.92 kg per farm, which was equivalent to 5917.47 kg per ha. The coffee production for previous years was 2968kg/ha, 3047 kg/ha and 3200 kg/ha for 1996, 1997 and 1998 respectively (MALD, 1997, 1998, 1999).

Muriithi (1998) found an average coffee yield of 2824 kg/ha in Embu District. Average number of coffee stems and tea bushes was 338 and 804 respectively. Of

the food crops. beans production was the lowest both per farm and per ha with an average yield of 62.47kg per farm equivalent to 104.57 kg per ha. The reason for the low yields was the low rainfall recorded during this period.

Table 4.17. Crop production levels for Kirinyaga District, Kenya

Crop	Yield per farm		Yield per hectare	
	Mean (kg)	Value (Ksh)	Mean (kg)	Value (Ksh)
Coffee	1 611.92 (1444)*	19 343.04 (17 511)	5 917.47 (3864)	71 009.69 (46 377)
Tea	1 073.71(1356)	20 400.49 (25 775)	4 085.65 2971)	77 627.44 (56 465)
Maize	138.29 (213)	2 420.07 (3743)	278.03 (309)	4 865.44 (5410)
Beans	62.47 (84)	2 342.63 (3183)	104.57 (126)	3 921.38 (4743)
Potatoes	194.48 (310)	2 625.48 (1346)	763.27 (241)	10 304.08 (5353)

*Figures in brackets are standard deviations
Source: Survey data (1999)

Households had an average of 64.7 (± 83.2) trees on their farms, the majority of which were *Grevillea robusta* trees. Tree densities were high ranging from 1 to 400 trees per farm. About 82% of the farms had less than 100 trees while 10% of the farms had between 200 and 400 trees. The tree numbers and tree products are shown in Table 4.18.

Table 4.18. Tree numbers and tree product yields in Kirinyaga District, Kenya

	Min	Max	Mean	SD
Number of trees	1	400	64.72	83.21
Age of trees	1	30	11.57	7.50
Timber yield (m^3)	0	570	29.27	105.58
Firewood yield (m^3)	0	48	13.40	14.19

Source: Survey data (1999)

Age of the trees varied from one year to 30 years with a mean age of 11.5 years. Twenty five per cent of the farms had trees of ages one to five years while 44% of the farms had trees with ages over 10 years. Trees of between 6-10 years were in 31% of the farms. Trees were planted in different niches including outer boundaries, inner boundaries, interspersed with crops and around homesteads. None of the farmers had a woodlot probably due to the small farm size. This study did not consider the interactions between trees and crops from the production point of view. These are well documented in Tyndall (1995).

4.3.2 Labour

4.3.2.1 Labour utilization by major crops

In traditional farming systems, labour or the cash to hire it is frequently the limiting resource in the farming system more so during the peak periods (Collinson *et al.*, 1977). A measure of its availability and requirements are therefore critical. The availability of labour governs not only the size of farms but also the improvements and technologies that can be introduced and successfully implemented.

Labour availability may be very high on average but actual supply may be limited because of the prevalence of such factors as rain and social events including weddings, funerals and festivals that greatly reduce the labour supply. Hence during the dry season, there is frequently an abundant labour supply relative to labour requirement for different crop activities whereas in the rainy season, available family

labour is normally short of that required. Labour utilization for the different crops is shown in Table 4.19 while the activities calendar is shown in Appendix 7.

Coffee was the most labour-intensive crop using about the same amount of labour as the sum for all other crops. Among the food crops, beans used the highest number of person hours per hectare compared to maize and potatoes making it the most labour intensive of the food crops. Maize was the least labour-intensive food crop.

Table 4.19. Total labour utilization on crops for the short rain season in person hours per ha (based on Njuki equivalencies) in Kirinyaga District, Kenya

Major crop	Male	Female	Total	% Female	p-values
Coffee	626.49	979.61	1606.10	60.99	0.130
Tea	230.17	807.86	1038.03	77.83	0.018
Maize	73.55	161.85	235.40	68.75	0.013
Beans	53.86	188.16	242.02	77.74	0.001
Potatoes	89.97	162.55	252.52	64.37	0.027
Total	1074.04	2300.03	3374.07	68.17	0.005

Source: Survey data (1999)

What is interesting in the labour utilization is the distribution of labour between the sexes. Contrary to belief and results of other studies (Due, 1988; Henn, 1988; Rassam and Tully, 1988), women accounted for a higher percentage of the labour per hectare in both the food crops and the cash crops. T-tests showed that female labour was significantly higher than male labour at $p<0.05$ for all crops apart from coffee. Females contributed 60.9%, 77.8%, 68.8%, 77.7% and 64.3% of the total labour in coffee, tea, maize, beans and potatoes respectively.

Women put in three times as much labour as men in maize and bean and two times as much in potatoes. Female labour comprised of 68% of the total labour used in crop production. The p values in the table are the significance levels for the differences in male and female labour contribution for the various crops. There was a significant difference between male and female labour contribution in all the crops apart from coffee. Gleason (1988) found women to contribute 54% of the total labour in Taiwan while Bastone (1988) found a labour contribution by female labour of 53% in the Gambia.

In contrast, Ghosh and Mukhopadhyay (1988) found females to contribute only 10% of the fieldwork in crop production in West Bengal a fact attributed to restrictions of religion and caste. The reasons for the higher labour contribution by females in all the crops are partly male migration to urban areas for wage employment and men's higher involvement in off-farm activities relative to women. In cases where households had other off farm income generating activities, these were handled and managed by male members of the households.

4.3.2.2 Labour utilization for major farm operations

Labour was disaggregated for different crops and activities as shown in Table 4.20

a) Food crops

Weeding was the most labour intensive activity accounting for 36.7% of all the labour used on food crops. Planting and harvesting each took almost half as much labour as weeding while land preparation took up 24% of the total labour on food

crops. It was only in land preparation and spraying where men used a higher percentage of labour than women.

Table 4.20. Total labour utilization on major farm operations for the short rain season in person hours per ha for Kirinyaga District, Kenya

Activity	Male	Female	Total	%Female	p-values
Food crops					
Land preparation	92.33	83.21	175.54	47.40	0.838
Planting	39.53	95.69	135.22	70.77	0.001
Spraying	3.82	-	3.82	0	-
Weeding	54.06	214.10	268.16	79.84	0.000
Harvesting	27.66	119.56	147.22	81.21	0.000
Total	217.40	512.68	730.08	70.22	0.001
Cash crops					
Weeding	53.09	167.96	221.05	75.98	0.005
Pruning	61.27	19.98	81.25	24.59	0.212
Manuring	43.27	20.62	63.89	32.27	0.148
Spraying	13.99	0.48	14.47	3.32	0.110
Harvesting	685.03	1578.43	2263.46	69.73	0.002
Total	856.65	1787.47	2644.12	67.60	0.020
Livestock[1]					
Feeding cattle	109.57	180.17	289.74	62.18	0.183
Milking cattle	27.54	33.56	61.10	54.93	0.419
Feeding goats	157.71	54.21	211.92	25.58	0.459
Total	294.82	267.94	562.76	47.61	0.352
Trees[2]					
Tree pruning	7.32	0.00	7.32	0.00	0.000
Domestic[3]					
Cooking	92.4	892.5	984.9	90.62	0.000
Child care	0	178.5	178.5	100.0	0.000
Water collection	0	52.5	52.5	100.0	0.000
Firewood collection	0	142.8	142.5	100.0	0.000
Total	92.4	1266.3	1358.4	93.22	0.000

[1]Labour is in person hours per livestock enterprise
[2] Labour is in person hours per tree enterprise
[3] Labour is in person hours per domestic activity
Source: Survey data (1999)

Female labour in land preparation was 47.4% while they did not contribute any labour to spraying. Of the food crops studied, spraying was only done on potatoes and was mainly done by hired male labour. The highest percentage labour contribution by women was on harvesting where they contributed 81.2% of the labour followed by weeding (79.8%)

The female labour contribution in land preparation was lower than the males due to the nature of equipment and implements used. In some households, land preparation was done using ox-drawn ploughs, which are mainly handled by men. The highest labour on food crops by males was spent on land preparation, which accounted for 42.6% of the total male labour. This was more than four times the labour they used on harvesting and almost three times the labour they used on planting. Weeding, which was the most labour intensive activity accounted for only 24% of total male labour on food crops. In planting, females put in almost three times as much labour as the males, and almost five times as much in harvesting. There was a significant difference at $P<0.01$ in the labour input by men and women in planting, weeding and harvesting. The difference in labour input in land preparation between men and women was not significant.

b) Cash crops

Harvesting was the most labour-intensive activity with the cash crops taking up a mean of 2263.4 person hours per ha during the season that this study was carried Although tea is harvested all year round, coffee is only harvested twice a year.

between April and June and between October and December. The main coffee crop is harvested in November and December and this coincided with the longitudinal study, which could explain the high number of hours spent in harvesting.

Female labour comprised of 69.7% of the labour utilized in harvesting and 75.9% of labour in weeding for cash crops. Only in these two activities did women contribute more labour than men. Women provided 3.2%, 24.6% and 32.2% of the labour used in spraying, pruning and manuring of cash crops. However, this comprised of only 2% of the total female labour in cash crops. Total female labour contribution in cash crops was higher than male labour contribution (67.6% of the total labour in cash crops).

These results contrast those of Henn (1988) in Cameroon where men were found to put in more hours per week on cocoa production than women and those of Rassam and Tully (1988) who found men to contribute 71% of the labour in cash crops in Australia. In Tanzania, Due (1988) found women to contribute 39% of the labour days required for sunflower and cotton, which are both cash crops with the rest of the labour coming from men. In some situations where labour is allocated by crop, it has been common for men to take up primary responsibility for the export and non-consumable products such as coffee, tea and cotton while women take primary responsibility for food crops. This is however changing as more and more men migrate to urban centres for non-farm work. Women are finding themselves taking up tasks that were sorely male tasks such as land preparation and cash crop activities.

Knowledge of the labour patterns and how they are changing is important in planning innovations and improved technologies.

c) Livestock

Labour data on livestock was collected for two species only, cattle and goats. Out of the 40 households, 33 were keeping cattle and 14 were keeping goats. Although a higher number of households were keeping chicken (32) than those keeping goats. labour input on chicken both for feeding and watering was negligible. Only one farmer was keeping a large number of chickens for commercial purposes. The other 31 households kept chicken for household consumption and used free-range system to rear the chicken, a system that utilizes minimal or no labour.

Feeding cattle took an average of 289.74 person hours per household equivalent to 1.38 person hours per day per household as shown in Table 4.20. Total labour on livestock was 562.76 person hours per household. Of this labour, female members of the households provided 47.6%. There was no significant difference in the male and female labour utilized in all livestock activities at $P<0.05$. Muriithi (1998) in his study of Embu District found cattle production to take the largest amount of family labour compared to other activities. In the current study, cash crops were found to be the most labour intensive.

Labour for goats was only collected for the feeding activities. Milking activities were negligible. Feeding goats took up to 37% of the total labour on livestock. Male

members of households provided more labour for goats than female members contributing 74.5% of the total labour on goats. These results are contrary to findings by Paris (1988) in the Philippines that women are responsible for the small livestock such as sheep, goats, swine and chicken. One reason for this contrast in the results could be the fact that in the study area, most of the labour on livestock activities including labour on goats was male hired labour. The difference in the average time used by males and females to feed goats was however not significant at $p<0.05$.

d) Trees

Management activities on trees were almost absent compared to management activities of other farm components. Pruning of *Grevillea robusta* appeared to be the only routine management activity on trees. Other trees especially fruit trees were pruned when and if they became a nuisance either to crops by creating too much shade or on people by falling off branches. Some farmers however reported spraying the improved mango varieties although this did not occur during the course of the study. Family males spent an average of 2.65 person hours pruning trees while the mean labour for pruning trees by all labour was 7.32 person hours. No female labour was reported on any tree activities.

e) Domestic activities

Female members of households used an average of six hours per day on domestic activities, half of which was used in cooking. Childcare used a mean of 0.85 hours per day while firewood collection took a mean of 0.68 hours per day. Male members

of households were only involved in cooking where they used an average 0.44 hours per day. Despite women taking up more responsibilities on farm work and other off farm activities, they remain solely responsible for maintaining their households' domestic needs. This adds on to their labour burden making them overloaded.

4.3.2.3 Differences in labour utilization in male managed and female managed farms

Labour utilization in food crops and cash crops was compared for male managed and female managed farms using a one-way ANOVA. The means, F- values and the p-values are as shown in Tables 4.21 a and b. There were no significant differences between total male and female labour on cash crops based on farm management.

Table 4.21(a). Female labour utilization for the short rain season in person hours per farm for cash crops in Kirinyaga District, Kenya

Activity	Female labour				
	Male managed	Female managed	Both	F-value	p-value
Weeding	44.09	218.41	80.65	4.905	0.013
Pruning	0.00	41.06	0.00	1.026	0.369
Manuring	5.44	29.60	1.30	1.874	0.168
Spraying	0.00	0.98	0.00	0.514	0.603
Harvesting	582.07	1213.70	1293.79	1.705	0.196
Total	631.60	1503.75	1375.74	2.388	0.106

Source: Survey data (1999)

The F-value was significant for female labour for weeding activities. A Bonferroni test was carried out to determine which set of means was significant. The female

labour input in female managed farms was found to be significantly higher than that in male managed farms at p<0.05). The test had a p=0.024 at 39 degrees of freedom.

Table 4.21(b). Male labour utilization for the short rain season in person hours per farm for cash crops in Kirinyaga District, Kenya

Activity	Male labour				
	Male managed	Female managed	Both	F-value	p-value
Weeding	39.00	15.90	71.81	1.451	0.247
Pruning	150.94	18.87	56.88	1.760	0.187
Manuring	71.92	10.74	51.11	2.675	0.082
Spraying	6.42	2.53	41.44	2.236	0.122
Harvesting	555.75	428.6	694.44	1.035	0.365
Total	824.03	476.64	915.68	1.767	0.185

Source: Survey data (1999)

The substitutability of male labour by female labour in female managed farms is clear in Table 4.21a in spraying and pruning whereby female labour in these activities was 0 and 0.98 and 0 and 41.06 in male managed farms and female managed farms respectively. Further, in manuring, a predominantly male activity, male labour in female managed farms was significantly lower than in male managed farms.

4.3.2.4 A comparison of male and female labour on food and cash crops

To test the hypotheses that women put in more of their labour on food crops than cash crops while men put in more labour to cash crops than food crops, the mean person hours spent by men and women in both food and cash crops were compared using a paired sample t-test as shown in Table 4.22.

Table 4.22. A comparison of male and female labour on food and cash crops (per ha) in Kirinyaga District, Kenya

Labour	Mean person hours (n=40)	t-values
Male labour /cash crops	856.65	5.410*
Male labour /food crops	217.40	
Female labour /cash crops	1787.47	4.706*
Female labour /food crops	512.68	
Male labour /cash crops	856.65	-2.425*
Female labour /cash crops	1787.47	
Male labour /food crops	217.40	3.576*
Female labour /food crops	512.68	

* Significant at $p<0.05$
Source: Survey data (1999)

The hypothesis holds true for male labour in that males contributed significantly more labour on cash crops than on food crops. However, the male labour on cash crops was still significantly less than the female labour on cash crops. Women on the other hand put in significantly more labour on cash crops than on food crops. For this particular study therefore, the hypothesis that women put in most of their labour to food crops as opposed to cash crops is rejected. Compared to the male labour input, women put in significantly more labour hours in both food and cash crops.

4.3.2.5 Determinants of labour utilization

Factors determining the availability of labour were investigated. A multiple linear regression was utilized. Labour was differentiated into hired labour, family labour, male labour and female labour and regressed against the above variables. Data

included in the model was checked by correlation coefficients and VIF and found not to suffer from multicollinearity.

The results in Table 4.23 indicate that there was no correlation between any of the variables entered in the regression. The VIF were all less than 10 for all variables while none of the variables had a correlation greater than 0.80 with any other variable. According to Kennedy (1985) a VIF of greater than 10 or a correlation coefficient greater than 0.80 indicates the presence of multicollinearity.

Table 4.23. Correlation matrix for regression on the determinants of labour

Variable	Total labour	Transit	Male manager	Education	Family size	Land size	Off farm income	VIF
Total labour	1.000 (.)*							
Transit	-0.236 (0.219)	1.000 (.)						2.409
Male manager	-0.365 (0.110)	0.433 (0.070)	1.000 (.)					1.592
Education	-0.054 (0.431)	0.675 (0.006)	0.433 (0.070)	1.000 (.)				2.857
Family size	-0.121 (0.347)	-0.316 (0.146)	-0.477 (0.063)	-0.623 (0.011)	1.000 (.)			3.314
Land size	-0.696 (0.004)	0.164 (0.296)	-0.189 (0.268)	-0.191 (0.266)	0.644 (0.009)	1.000 (.)		2.383
Off farm income	0.167 (0.293)	0.048 (0.438)	0.395 (0.091)	0.111 (0.359)	-0.360 (0.114)	-0.371 (0.106)	1.000 (.)	1.366

* Figures in brackets are one tailed significance levels

The regression results are given in Table 4.24.

Table 4.24. Determinants of farm labour utilization

Variable	Total labour/ha		Family labour/ha		Female labour/ha	
	Coefficients	p-values	Coefficients	p-values	Coefficients	p-values
Constant	2.443*	0.050	1.450	0.197	2.211	0.069
Transit	1.355	0.224	0.884	0.411	0.682	0.521
Male manager	-3.160*	0.020	-2.965*	0.025	-5.627*	0.001
Education	0.531	0.614	1.281	0.247	2.411*	0.050
Off farm income	0.884	0.411	2.041	0.087	0.592	0.576
Land size	-5.397*	0.002	-7.447*	0.000	-5.973*	0.001
Family size	2.368*	0.051	4.502*	0.004	2.916*	0.027
R^2	0.884*		0.933*		0.931*	

* Significant at $p<0.05$

Data on Table 4.24 shows that the regression on female labour had an R^2 of 0.931, which was significant at $p<0.05$. The coefficients for education of the household head and family size were positive and significant while those for male manager and land size were negative and significant. Households with heads who have education use more female labour than those with heads who have no education at all. With increased education, heads of households have better opportunities for off farm employment. As they migrate to urban areas and transfer their labour to off farm activities, women are forced to put in more labour to farming activities. This is also supported by the negative and significant relationship between male farm managers and female labour. Male managed farms have less female labour as compared to female managed farms. The positive sign on the coefficient for family size is as expected. An increase in the family size leads to an increase in the labour available for farm enterprises. Increasing the land size reduced the amount of female labour available per ha of land for farming enterprises.

The R^2 for family labour was 0.933 and was significant at $p<0.05$. Land size and the male manager affected family labour negatively while family size had a positive and significant impact on family labour. Similar to its effect on female labour, as the land size increases, the family labour available per ha decreases significantly.

Total labour on farms was affected negatively by male manager and land size and positively by the family size. The R^2 for this regression was 0.884 and was significant at $p<0.01$. While the relationships between family size and land size with total labour are expected, it would be expected that male managed farms would have more labour due to the presence of both the husband and wife on the farm. However, as earlier discussed, female managed farms hire significantly more labour than male managed farms in addition to women in these farms working longer hours to compensate for the absence of adult male labour. In addition to this, the male labour contribution to various cropping enterprises was quite low compared to the total labour utilized. None of the regressed variables had a significant effect on hired labour.

4.3.3 Productivity analysis

4.3.3.1 Gross margin analysis

Gross margin analysis was done for coffee, tea, maize, beans, potatoes, livestock and tree enterprises as shown in Appendix 8. Detailed production data were collected on all the enterprises including labour, inputs such as fertilizers and pesticides and output data. Input prices were obtained from the local dealers in the study area.

which included cooperative owned outlets and private dealers. This is because although the farmers could remember the amounts of fertilizer they applied to their crops and the chemicals sprayed, not all of them could remember the prices at which they bought them. For the cash crops, some of the farmers obtained the inputs from the cooperative societies in the case of coffee and from the Kenya Tea Development Authority (KTDA) in case of tea as credit against the future crop. This was then deducted from the dues accruing to the farmer from the crop delivered.

a) Coffee

Coffee output was collected from sales slips given to farmers once they deliver their coffee to the cooperative society. Coffee prices have declined over the years and the coffee industry especially in Central Kenya has been going through a difficult period. Most of the coffee was sold to cooperative societies although a few farmers were selling their coffee directly to the Coffee Board of Kenya with the expectation of earning higher value for their crop. This was not however considered during the analysis since none of such farmers had received payment for their coffee thus making it impossible to obtain an estimate of the value of their crop. The price of Ksh 12 per kg of cherry was used for all the 37 farmers who were growing coffee.

The input costs included costs of fertilizers, pesticides, herbicides and manure. The mean value of coffee output was Ksh 19 343 per farm equivalent to Ksh 71009 per hectare. Farmers spent a mean of Ksh 6106 and Ksh 3442 per ha on coffee inputs and labour respectively. Labour was taken at Ksh 70, which was the prevailing daily

wage for casual labour per an eight-hour working day. The result is that the gross margin for coffee per hectare was Ksh 61 459. This was close to the gross margin for coffee found by Muriithi (1998) in Embu of Ksh 61 592 per ha. On average per farm. farmers were getting a gross margin of Ksh 16 741. There were however very big variations both in the value of output and the variable costs as indicated by the large standard deviations.

Coffee was found to be an important crop for farmers in this region for two reasons. First, coffee acts as security for loans from the cooperative societies and second as a security for school fees in both primary and secondary schools. two areas that are very critical to people in the rural areas. Children are taken to school on credit against future coffee crop. something that is not done with any other crop in the study area.

b) Tea

A price of Ksh 19 was used for calculating the gross margin for tea as shown in Appendix 8. Total value of output from tea was Ksh 77 627 per ha of tea while operational costs were Ksh 13 582 and Ksh 7248 per ha for tea inputs and labour respectively. This gave an average gross margin for tea of Ksh 56 796 per ha.

c) Maize

The total variable costs for maize were Ksh 2068 and Ksh 915 per ha of maize for inputs and labour respectively. Maize costing was done using the market value of

maize. which was Ksh 35 per 2 kg tin. This amounted to Ksh 17.50 per kg of maize. The total value of maize output was Ksh 4865 per ha of maize. This gave an average gross margin from maize of Ksh 1880 per ha.

d) Beans

The market price for beans was higher than that for maize with beans retailing at an average of Ksh 75 per 2 kg tin. Variable costs for beans were Ksh 503 per ha for inputs and Ksh 1605 per ha for labour. Beans gave an average gross margin of Ksh 1812 per ha.

e) Potatoes

Of the food crops, potatoes had the highest gross margin both per farm and per ha. Total variable costs for potatoes comprised of only input costs since no labour was hired specifically for potatoes. The input costs were Ksh 2947 per ha while the total value of potato output was Ksh 10 302 per ha. This gave an average gross margin of Ksh 7354 per ha of potatoes.

f) Livestock

Calculations for gross margins for livestock enterprises were done for cattle. Farmers had an average of 1.93 cattle. Total income from cattle was Ksh 10130. The variable costs for the cattle enterprise were Ksh 3252 This gave an average gross margin of Ksh 6878 per enterprise, which was equivalent to Ksh 3563 per livestock unit.

Apart from providing output in terms of products for subsistence consumption and cash income. cattle also perform other functions including providing inputs, asset and security and social and cultural functions. In the provision of inputs, cattle provide farm work and transport. manure and have an integration function by using otherwise seasonally unemployed labour. and converting low value crop residues to high value animal products. Animals have an asset and security function by acting as a tradable asset and a social and cultural function for example in paying bride price and determining a family's social status in some communities (Makeham and Malcolm, 1986).

g) Trees

Farmers spent an average of Ksh 22 on inputs for trees, which included fertilizer. and manure for application on tree seedlings. Out of the 39 farmers with trees. 28 sold some form or other of tree products including fruits, firewood and timber. The average earnings from the sale of tree products were Ksh 1799 per household.

4.3.3.2 Contribution of various farm enterprises to TVP

Figure 4.3 shows the contributions of various enterprises to TVP. Tea made the highest contribution to TVP contributing 34.5%. followed by coffee, which contributed 32.8%. Livestock, maize and beans contributed 17.2%, 4.1% and 4.0% to the total value product respectively. Tree products contributed 3% to the TVP. When the TVP was compared for different farm management categories, a one-way ANOVA found no significant differences ($F=1.531$; $p=0.230$; 39df).

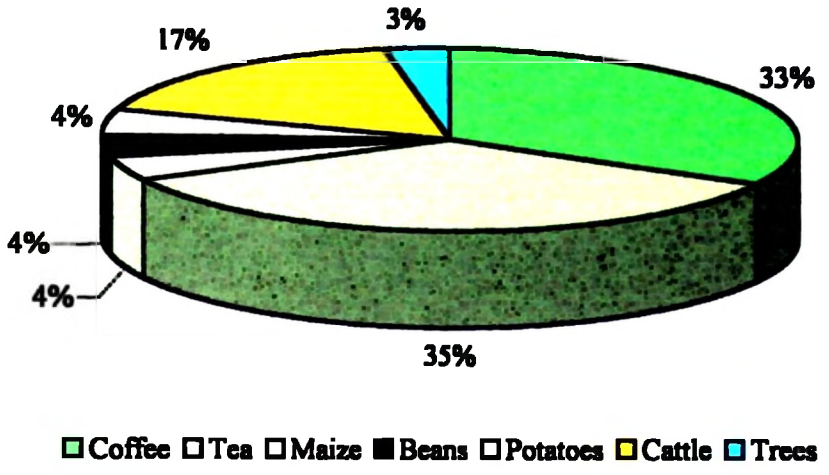

Figure 4.3. The contribution of various enterprises to TVP

4.3.3.3 Factors affecting TVP

The factors affecting the TVP were determined using a Cobb-Douglas production function model. The correlation matrix and the VIF values are shown in Table 4.25 while the regression results are shown in Table 4.26.

Table 4.25. Correlation matrix for the Cobb-Douglas production function

Variable	Output	Land	Female labour	Male labour	Inputs	Age	Exten	Educ	Fem manager	VIF
Output	1.000									
	(.)*									
Land	-0.543	1.000								2.017
	(0.000)	(.)								
Female labour	0.589	-0.446	1.000							1.926
	(0.000)	(0.003)	(.)							
Male labour	0.420	-0.231	0.041	1.000						1.341
	(0.005)	(0.085)	(0.405)	(.)						
Inputs	0.448	0.097	0.349	0.220	1.000					1.548
	(0.003)	(0.283)	(0.017)	(0.096)	(.)					
Age	-0.059	0.256	0.056	0.014	-0.014	1.000				1.305
	(0.365)	(0.063)	(0.370)	(0.467)	(0.467)	(.)				
Exten	-0.108	-0.100	-0.194	-0.091	-0.205	-0.201	1.000			1.222
	(0.262)	(0.279)	(0.125)	(0.297)	(0.112)	(0.117)	(.)			
Educ	0.299	-0.316	-0.089	0.055	0.158	-0.411	0.255	1.000		1.705
	(0.036)	(0.029)	(0.300)	(0.373)	(0.176)	(0.006)	(0.064)	(.)		
Female manager	-0.094	-0.148	0.321	-0.242	-0.030	0.142	0.004	-0.328	1.000	1.510
	(0.289)	(0.191)	(0.027)	(0.074)	(0.431)	(0.201)	(0.491)	(0.024)	(.)	

*Figures in brackets are one-tailed significance levels. All the coefficients were less than 0.80 and VIF were less than 10.

Data on Table 4.25 shows that there was no multicollinearity between any of the variables that were entered for this analysis.

From the results of the estimation, the value of R^2 was 0.667 and was significant as indicated by the significance of the F value (7.306) which had a p=0.005. The variables in the function explained almost 67% of the variability of TVP. From the specified variables, the coefficients for land, inputs, female labour and the age of the farm manager were statistically significant.

Table 4.26. The determinants of TVP in Kirinyaga District, Kenya

Variable	Unstandardized	t-values	P values	MVP	MROCR
Constant	4.858	2.893	0.007	-	
Lnland	-0.483	-2.711	0.011		
ln of female labour	0.281	2.328	0.027	1.47	0.021
ln of male labour	0.153	1.503	0.144		
ln of inputs	0.258	2.363	0.025	9.01	9.01
ln of age	0.731	1.778	0.089	-	
Extension dummy	0.0129	0.050	0.960	-	
Education dummy	0.0681	0.268	0.790	-	
Female dummy	-0.360	-1.595	0.122	-	
R^2		0.667			

Source: Survey data (1999)

The coefficient for the female dummy was not significant. A negative and significant female dummy would indicate that female farm managers are less productive than male farm managers while a positive and significant female dummy would indicate that they are more productive than male managers. The non-significant female dummy shows no evidence of difference in productivity between male and female farm managers. Other studies (Moock, 1976; Bindlish and Evenson, 1993; Saito *et al.*, 1994; Jamison and Lau, 1982) have found women farm managers to be as productive as male farm managers. The study by Jamison and Lau (1982) in Korea however found male household heads to be more productive than female household heads in mechanized farms. Bindlish *et al.* (1993) on the other hand found female heads of households to be less productive than men in a study in Burkina Faso, a fact that the authors attributed to cultural, religious and ethnic factors.

Interactions between the female dummy and other variables were used to test for sex differences in input utilization. The interactions with female labour, male labour and education of the farm manager were significant. The female dummy had a positive interaction with female labour and a negative interaction with both male labour and education of the farm manager.

The interaction of the female dummy with education was negative and significant ($r=-0.328$, $p=0.024$) indicating that female farm managers benefit less from education than male farm managers as far as farm production is concerned. One explanation for this could be that as women get more education, they tend to shift their focus and efforts from farming activities to other off farm and income generating activities. When the same happens to men, it is assumed that women take over the responsibility for farming activities. When it happens to women however, farming activities are left in the hands of hired labour. These results agree with those of a study by World Bank (1990) in Kenya, which found that as women's number of years of schooling increases, the number of hours spent farming decreases at a much faster rate than for men.

The non-significance of the interaction between the female dummy and the extension dummy is important in that it indicates that both male and female managers benefit equally from extension. Moock (1976) found a negative and significant interaction between a female dummy and extension dummy indicating that exposure to

agricultural extension increases the productivity of male farmers relative to female farmers in Kenya.

The coefficient for land was significant and took a negative sign. It would be expected that increasing the land area would have a positive effect on the gross output. However. given the importance of inputs in the farming system and the low access to these inputs and their high cost, increasing the area cultivated implies a wider application of insufficient inputs in terms of fertilizers and pesticides as well as the use of uncertified seeds which could lead to a reduction in the value of gross output. A similar relationship between plot size and yield has been observed in other research in Africa without satisfactory explanation (Bindlish *et al.*, 1993; Carter, 1994; Blarel *et al.*, 1992).

The variation of the TVP with land is shown in Figure 4.4. As land size increases, there is a fluctuating but general increase in the TVP. Beyond a land size of 2.5 ha however, there is a fluctuating but general decrease in the TVP, which reaches a minimum at approximately 3.5 ha. Other reasons for the negative relationship between land size and the value of total products could be the difference in crops grown in the various farms as well as agricultural intensification which is normally associated with small farms or inefficient allocation of the inputs between farm enterprises. An example of such inefficiencies is the study by Udry *et al.* (1995) in Burkina Faso who found that re-allocating the inputs used in male owned plots to female owned plots would increase productivity considerably.

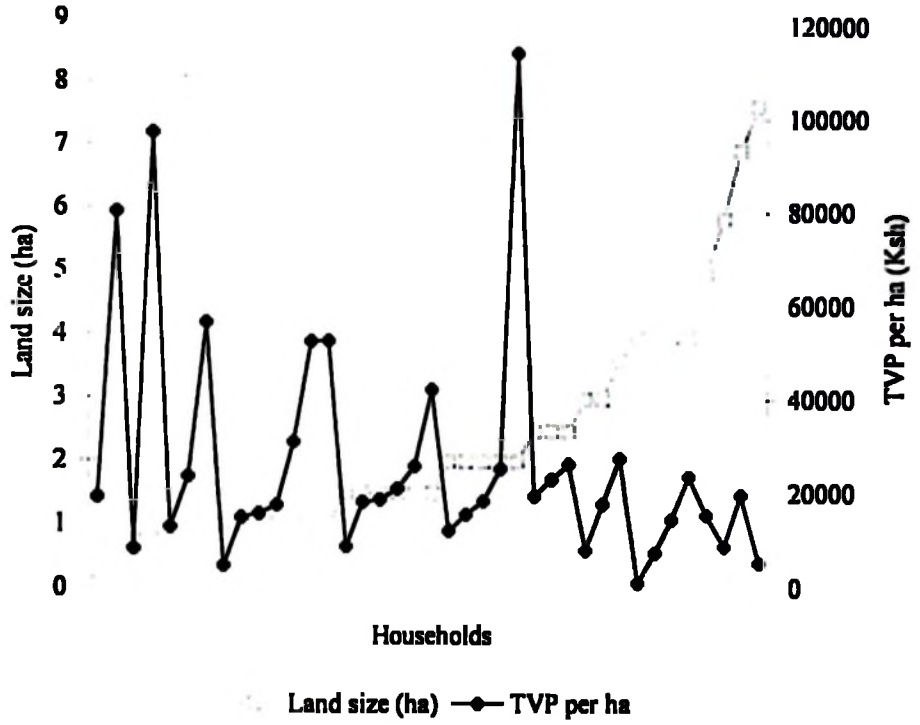

Figure 4.4. Variation of TVP with land size

An increase in inputs led to an increase in the value of total products. This is shown by the positive and highly significant coefficient of inputs in the regression model. Saito *et al.* (1994) found a significant increase in production with increase in insecticide use while Jamison and Lau (1982) found an increase in productivity with fertilizer use.

The age of the farm manager, which was used as a proxy for experience, was found to be positive and significant. It was found that the longer the farming experience, the higher was the TVP. Saito *et al.* (1994) found a similar relationship in a study in

Nigeria when they used plot level data. Age was however not significant when farm level data was used. Bindlish and Evenson (1993) found a significant relationship between age of the farm manager and productivity in Kenya.

4.3.3.4 Resource use efficiency

Using the estimated production elasticity and the Average Value Product (AVP). the Marginal Value Product (MVP) was estimated and was presented earlier in Table 4.26. This was done for both female labour and inputs since they were both positive and significant. An increase in 1 Ksh worth of inputs increases the value of total products by Ksh9.01. The marginal value product for female labour was 1.47, which means that adding one-person hour of female labour increases the value of output by Ksh 1.47.

The Marginal Returns to Opportunity Cost Ratios (MROCRs) was calculated and used as a measure of the efficiency of resource use prevailing on average throughout the sample. It is computed as the ratio of the marginal product to the marginal cost given as the opportunity cost of the respective factor. For profits to be maximized, the ratio of the marginal product to the marginal cost must be one (Heady and Dillon. 1961 cited by Atieno. 1995). This means that the revenue from using one additional unit of an input is equal to the cost of acquiring that unit. A ratio of less than one implies that too much of the resource is being used under the existing price conditions. implying inefficient resource use. If the ratio is greater than one. it

indicates that too little of the resource is being used, and increased use of the resource would result in increased profits.

For the given production resources used. their opportunity costs represent the market prices that prevailed on the average during the production period. The prevailing wage rate of Ksh 70 in Kirinyaga was used as the marginal cost of labour. On the assumption that the employment of additional labour would imply the purchase of hired labour. the market wage rate of labour is taken as the opportunity cost of a unit of both male and female labour in this analysis. This reflects the benefits forgone by the family in order to participate in the activity (Gittinger, 1982). For inputs. the marginal cost was taken as the market price of these. Since the inputs were measured in monetary terms the marginal cost is taken as equivalent to Ksh 1. The computed efficiency measures for each resource were presented in the last column of Table 4.26.

The ratio for inputs was greater than one indicating that too little inputs are being used. If the use of fertilizers, improved seeds and farm chemicals were increased. it would result in increased production. The low level of factor use could be explained by farmers inability to purchase these inputs or inefficient marketing conditions for commodities as well as delayed payments and low prices giving farmers little incentive to invest more resources in production of these commodities. The ratio for female labour on the other hand was less than one. This means that under the existing

price conditions, too much female labour is being used in relation to the level at which farmers use other factors of production.

4.3.4 Technical efficiency

4.3.4.1 Technical efficiency in the production of specific crops

The technical efficiency for different crops was determined. The results are shown in Table 4.27. The mean technical efficiency was 21%, 11%, 13%, 92% and 82% for maize, beans, potatoes, coffee and tea respectively. Compared to the cash crops, the technical efficiency of food crop production was relatively low probably due to the more severe effect of rainfall shortage on these compared to cash crops.

Table 4.27. Technical efficiency in the production of specific crops in Kirinyaga District, Kenya

Crop	All farms	Male managed	Female managed	Both	p-value
Maize	0.21	0.15	0.19	0.29	0.429
Beans	0.11	0.14	0.07	0.20	0.159
Potatoes	0.13	0.20	0.06	0.14	0.135
Coffee	0.92	0.87	0.81	0.98	0.098
Tea	0.82	0.37	0.93	0.91	0.533

Source: Survey data (1999)

Higher levels of technical efficiency for food crops have been reported elsewhere (Amara *et al.*, 1999; Yao and Liu, 1998; Bravo-Ureta and Evanson, 1994). ANOVA results gave a non-significant F-value for a comparison of the technical efficiency based on farm management for all the crops.

4.3.4.2 Overall farm technical efficiency

This analysis used the deterministic frontier production function to test the technical efficiency. The average production was estimated using the coefficients of the Cobb-Douglas production function. Only those observations with positive error terms were retained. These were then regressed against the same explanatory variables and the process repeated until the estimates were stable, that is they did not vary noticeably from one iteration to the other. This was achieved after three iterations. This estimation procedure has been used in empirical research by Amara *et al.* (1999). The coefficients for inputs, land and female labour were still significant and in addition, those for male labour and the female dummy were significant. The ratio of actual to potential output was calculated for each of the farmers. The actual output is the observed output while the potential output is the output from the frontier production function. The levels of technical efficiency and a comparison of the same based on farm management are shown in Table 4.28.

Table 4.28. A comparison of technical efficiency based on farm management in Kirinyaga District, Kenya

	Min	Max	Mean	SD	Level of efficiency (% of farms)		
					<0.50	0.51-0.75	>0.76
Male manager	0.19	0.98	0.62	0.25	30.0	30.0	40.0
Female manager	0.23	0.97	0.56	0.24	50.0	18.8	31.3
Both	0.49	0.94	0.77	0.14	11.1	22.2	66.7
Overall	0.19	0.98	0.64	0.23	34.3	22.9	42.9

Source: Survey data (1999)

This level of technical efficiency was lower than that given by Amara *et al.* (1999) for potato farmers in Quebec (80.27) and by Bravo-Ureta and Rieger (1991) for dairy farms (83%). It was however higher than that given by Bravo-Ureta and Evanson (1994) for cotton and cassava farmers (58-59%) and that given by Yao and Liu (1998) for grain farmers in China (63%). There were no studies available in literature for technical efficiency in Africa for comparison with the current study.

About 43% of the farms had an efficiency level of above 75% while 34.3% were operating at an efficiency level of below 50%. When farms were compared based on farm management, farms managed by both male and female managers had the highest proportion of farms with technical efficiency above 75% while female managed farms had the lowest. Mean technical efficiency was 62%, 56% and 77% for the male managed, female managed and combined male and female managed farms respectively. Half of the female managed farms had an efficiency level below 50% while only 11.1% of the combined management and 30% of the male managed farms were in this category.

When the mean technical efficiency was compared for the different farms based on management using ANOVA, the F-value was found to be 3.135 and was not significant at $p<0.05$ with a $p=0.056$. A Bonferroni test was carried out to determine the significance levels between pairs of the management categories. The test was not significant for any means giving a $p=0.763$ for the mean between male managed and female managed farms, $p=0.371$ for the mean between male managed farms and

farms managed by both male and female and p=0.054 for the means of the female managed and the farms managed by both male and female manager.

4.4 Gender roles beyond the household: collective action

Collective action is one strategy that women are using in order to raise their disadvantaged position both in terms of their access to productive resources and heavy workloads. In addition, a number of organizations. government departments. research institutes and NGOS work with farmer groups to achieve various objectives. in marketing. dissemination of technologies, as a source of indigenous knowledge. provision of inputs among others.

The gender analysis literature abounds in examples of how systematic. socially constructed patterns of differences between men and women affect the distribution and use of resources within households (Haddad *et al*.. 1997; Hart, 1995). Argawal (1997) argues that leaving this analysis at the household level is incomplete, because it does not take into account the effects of the community on gender relations in the household and vice versa. This section details a brief study of eight groups in Kirinyaga District studied at two levels, as a whole group and also the individual members of groups. A quantitative analysis of the characteristics of the group members is given followed by case studies of some of the groups studied and finally a synthesis of the role of collective action, which include the empowerment of women, provision of services among others.

4.4.1 Characteristics of Group Members

A total of 133 group members from the eight groups were studied, in order to establish the socio-economic characteristics of the people who form groups as shown in Table 4.29.

Table 4.29: Socio-economic characteristics of group members in Kirinyaga District, Kenya

	All groups		Mixed groups (n=82)		Women's groups (n=51)	
Age in years	**No**	**%**	**No**	**%**	**No**	**%**
Below 20 years	3	2.3	3	3.6	0	-
20-39 years	48	36.0	44	53.7	4	7.9
40-59 years	57	42.9	30	36.6	27	52.9
60 years and over	23	17.3	5	6.1	18	35.3
Non responses	2	1.5	-	-	2	3.9
Education levels						
No education	20	15	15	18.3	5	9.8
Primary	31	23.3	26	31.7	5	9.8
Secondary	39	29.3	39	47.6	0	-
College	2	1.6	2	2.4	0	-
Adult education	41	30.8	0	-	41	80.4
Marital status						
Single	10	7.5	10	12.2	0	-
Married	80	60.2	58	70.7	22	43.1
Widowed	18	13.5	0	-	18	35.3
No responses	25	18.8	14	17.1	11	21.6
Occupation of spouses						
Farmer	59	44.4	39	47.6	20	39.2
Employed	16	12.0	16	19.5	0	-
Business person	5	3.8	3	3.7	2	3.9
No spouses	28	21.1	10	12.2	18	35.3
No response	25	18.7	14	17.0	11	21.6

Source: Survey data (1999)

Such data as their ages. educational levels. marital status. occupations, occupations of their spouses and others was collected. This formed a basis for determining the heterogeneity of these groups. The data was obtained from a questionnaire survey and from group records.

The survey data indicated that most of the group members were old with only 38.3% being below 40 years of age. The average age was 43.5 years. There was however a significant difference between the average ages in mixed groups, which was 37.5 years and the average age in women groups, which was 53.5 years. In the mixed groups ages ranged from 18 to 70 years while the women groups had a minimum age of 35 and a maximum of 86 years. Only 7.9% of the group members in the women groups were below 40 years. This difference in ages could be due to the fact that most mixed groups were carrying out farming activities and especially of horticultural products. which is labour intensive and requires younger, more energetic people.

Majority of the men in the groups (59%) had secondary education compared to 17% of the women. Most of the women (43.6%) had gone through adult literacy classes under the department of adult education. The department is using groups and especially women groups to impart literacy skills to the rural population. Despite these efforts. 20% of the women had no education at all.

When compared with mixed groups, all those with secondary education were from the mixed groups while none was from the women' groups. This could be attributed to the old age of the group members in the women's groups. The younger people have had better chances for education than the older generation.

In the mixed groups, all the single people are men. Given the fact that the mixed groups are mainly farming groups, single women are disadvantaged as they do not have and do not control land and they may therefore not be able to join the mixed groups. Single women are expected to marry and obtain land from their husbands and although now daughters may inherit land from their fathers, land still continues to be allocated to sons. Unmarried women on the other hand are supposed to cultivate together with their parents until they get married This puts single mothers in very precarious positions as in all purposes, they act as a separate household, but still without the resources they need such as land.

All the women in the women groups had no other occupations apart from farming while only one woman in the mixed groups was working as a teacher. In contrast, 86% of the men in mixed groups were farmers while 14% were employed. This means that more men than women have other sources of income apart from group activities and farming. This becomes a very important aspect especially when it comes to membership contributions and who can and cannot afford to pay to be in the group. Women are clearly at a disadvantage, as many have to rely on their husbands for membership contributions.

In the mixed groups. 19.5% of the member's spouses were employed while none was employed in the women's groups. In the women only groups. 39.2% of the spouses were farmers while 3.9% were involved in business activities. Thirty five per cent of the women in women only groups did not have spouses. All these women were widowed. An explanation for this large percentage of widowed women in women only groups could be that these women join groups in order to consolidate the meagre resources that they have as women heads of households such as labour and capital and thus benefit from labour groups and the social capital generated from within these groups.

4.4.2 The role of collective action

4.4.2.1 Technology adoption and common resources management

While some technologies can be applied individually at plot or household level. others can only be applied over a wide area or landscape such as technologies for natural resource management (Knox-McCulloch. *et al.*, 1998). For such technologies, collective action becomes the key to their implementation and success. In Kirinyaga District. such technologies and the potential for collective action are exemplified in the management, maintenance and use of the traditional fallow irrigation systems. Although these fallows have been in existence since independence. collective management has emerged recently with the realization that individual use and management was not working due to the reduction in water flow and the intensification of agriculture with the rapid growth of the horticultural industry.

According to Swallow *et al.* (1997). such technologies as irrigation technology and Integrated Pest Management (IPM) require substantial space to operate effectively and hence are facilitated by collective action to coordinate their adoption and management. As more and more farmers have turned from traditional agriculture to the more water demanding horticultural crops. conflicts over water have grown necessitating coordination in the use of this resource. Collective action institutions not only facilitate joint resource management but also include inter-community dialogue and conflict resolution (Knox-McCulloch *et al,* 1998).

In organizing collective action however. a stabilizing or an intermediate organization may be required to initiate this coordination and although the ABLH's initial role in these groups was to organize farmers into marketing groups. these groups also formed the basis for the management and coordination in the use of the irrigation canals. Members take turns to divert water to their farms in order to ensure that every group member has water during the growing season. Since all farmers plant the crops at the same turn, a daily calendar is drawn up for water use as well as for other crop related activities such as date of planting, spraying and other activities. Although the monitoring and enforcement costs increase with the space covered by the resource under collective management, the coordination costs and the losses in efficiency of managing such resources privately normally overwhelm other costs making collective action economically superior in terms of social costs and benefits.

In such arrangements, tenure security becomes key because for users to be involved there must be sufficient duration for them to reap the benefits. Due to the fact that horticultural products take a relatively short time to mature, tenure security is not critical for households. However, to be in these marketing groups requires that someone should have land and this is a disadvantage to unmarried women who do not command any rights to land. One of the groups involved in collective management of irrigation furrows requires that members contribute shares from the coffee savings and credit society thus blocking all those who do not own coffee from membership. Most of the people in this category are the resource poor farmers and majority of women. Adoption of technology through collective action may also lead to adoption at individual level. In one of the groups studied, agroforestry trees grown on nurseries in a collective farm are then transferred to the individual farms of the group members.

4.4.2.2 Marketing

Collective action in marketing increases the bargaining power of individuals, as the collective voice is stronger than the individual voice. There is an increase in members potential to negotiate prices for their products in the market and this could lead to increased returns to land and labour from farm products marketed collectively. In the study area, groups of farmers sign a contract with an exporter that is binding requiring the exporter and exporting company to purchase their products at a certain price and for a certain period of time. Farmers are not therefore affected by the seasonal fluctuations in the market prices of agricultural products. The cost of

collective action in terms of coordination becomes less than the cost of private marketing in the sense that there is no cost associated to marketing in terms of transport and "during transport and marketing" losses since marketing is done on the farm.

4.4.2.3 Credit and savings

One of the most notable forms of collective action is the credit and saving groups. These groups act to lower the transaction costs of lending and offer credit in areas where formal financial institutions are rare. Formal financial institutions especially for the purpose of agricultural lending remain a rarity in rural areas where it is most needed. The requirements for this form of lending that is, collateral which is normally in form of land title and assets is beyond the reach of many farmers especially the resource poor and women. Collective action, both at local and higher levels provide farmers with opportunities for credit to invest in improved technologies on their farms. Savings with these groups provides group members a capital base and for women, this is a source of empowerment.

Majority of the farmers groups irrespective of the purpose for which they are formed have one sort or another of a credit and savings scheme be it at the basic level where members contribute for one of them at each group meeting (merry-go-round), or the more advanced form where members have a savings account where any member who needs a loan is given and pays with interest to the more regional and national levels

of the Savings and Credit Societies such as the Tea growers and the Coffee growers savings and credit societies.

While collateral in the smaller groups is the social capital generated within the group, the larger groups have different types of collateral, which caters for the majority of the farmers including the resource poor. For the tea and coffee growers credit societies, collateral is in the form of the future crop. According to Knox-McCulloch *et al* (1998) such groups provide a forum for building assets and self-reliance via savings programs as well as opportunities via credit for purchasing technologies and inputs to develop and maintain technologies. Group credit also makes it possible to acquire large-scale expensive technologies by sharing the costs among members. This is exemplified in coffee processing where farmers have been able to purchase coffee processing machines for collective processing of coffee through credit schemes in their Savings and Credit Co-operatives (SACCOs). Another aspect of credit in and within groups is that group activities get noticed by government departments, donors and NGOs who give grants or funds for the groups' activities.

4.4.2.4 Women's empowerment and ownership of resources

Argawal (1994) defines empowerment as a process which enhances the ability of the disadvantaged (powerless) individuals or groups to challenge and change (in their favour) existing power relations, that place them in subordinate economic, social and political positions. Two sources of empowerment have been identified; property rights for women and the organization and support of women groups to attain rights,

whether ones to which they are already entitled or ones that need to be established (Meinzen-Dick, et al, 1997). Given the competition for resources, which are a defining factor in women's status (Collins, 1971) women work collectively to gain rights and resources, which they otherwise do not and would not have.

Most women groups acquire land for commercial or agricultural development either through purchase or from the state. Under normal circumstances, the state would give land to male members of households on the assumption that they are the heads of households as opposed to individual women. Due to the resource poverty of women, and their lack of collateral for credit, many of them cannot afford to purchase land individually while in some cases, customs and traditions also prevent them from inheriting land. In groups, women are able to achieve collectively what they cannot achieve individually. Thus, group formation and action by women, which is socially sanctioned in the name of development, also enables them to transcend boundaries of custom and specifically to acquire productive resources as well as capital. Control over a productive asset such as land increases women's bargaining power as workers and could lead to changes in local production relations as well as power relations within the family and the community.

Two of the women groups studied had acquired land, one for agricultural purposes and the other for commercial purposes. The Karia Women group purchased a plot from members' contributions on which they have built houses, which they rent out on a commercial basis. Group members have a steady income from these houses.

Ngaru Adult Education group on the other hand has been allocated land by the local council on which they carry out several activities including tree nurseries and rice farming. Although they have not obtained title yet, they have exclusive user rights on this piece of land. These are but two examples of women's empowerment by property ownership through collective action. In this way, women who would otherwise have no access to these resources benefit through group action. A project in India benefited resource poor women when those who had land donated it for collective management by women (FAO, 1989). The rule of the project was that all members would have the same rights to the land, whether they had donated or not and the benefits therefore extended even to the landless and asset less women. Poor rural women are motivated for group action because they regard this as the only protection against their vulnerability as individuals at work, home and the society.

The organization of women in groups enables them have a voice that can be heard both by the local and national governments. It also acts as a step to the incorporation of women in decision-making levels of local organizations. Women groups in India that had been formed to reclaim wasteland were so successful that government departments took this as the most preferred structure for development programs (FAO, 1989). Even in the study area, the government's local machinery tends to support women's groups more readily than individual women through, for example, training and extension. In addition women groups form an important niche from which development agents can make a difference in the lives of women without the benefits of women activities being claimed by the men.

4.4.2.5 Information and extension

Groups serve as conduits for agricultural information and extension both from government departments, NGOs and other organizations. For these organizations, there is a reduction in development cost through use of groups as opposed to individuals. This is because more people are reached per unit cost. Extension agents in MALD in the study area when interviewed stated their preferences for working with groups rather than individual farmers. Although they attribute this to reduction in cost, they do not have the facilities in terms of transport to reach all the individual farmers in their homes.

Extension and development agents have always focused their attention and information on the male members of households with the assumption that these are the heads of the households and landowners and any information channelled to them will trickle down to other members of the households (Argawal, 1994; Fortmann and Rocheleau, 1985; Lastarria-Cornheil, 1997). At the community level, extension services have often favoured those who control the greatest quantity of resources, that is, the wealthy. Groups and especially women groups have to a large extent shifted the attention of extension from the men to the women and from the haves to the have-nots. Groups also provide a forum for sharing information on technology as well as other matters between the members. A summary of 4 of the groups studied is given as Appendix 9.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter gives a summary of the key findings and conclusions drawn from them. The summary is outlined based on the objectives of the study. Recommendations for policy, development and future research are also given.

5.1 Summary of key findings and conclusions

5.1.1 Crop production and agroforestry: Constraints and potential

The study has revealed that the major constraint to agroforestry is the perception by respondents that trees contribute to crop loss if integrated in the farming system. This has led them to believe that the only appropriate niche for planting trees and especially trees for timber and fuelwood is the farm boundaries. The planting of trees on farm boundaries has however been affected by boundary disputes. The number of trees for fuelwood and timber were not adequate to meet the fuel demand of households and there exists great opportunity for agroforestry in form of multipurpose trees and shrubs on the inner and outer farm boundaries of farms, which are currently planted with shrubs whose only purpose is to act as a live hedge without serving any other major function. Such trees and shrubs include *Eurphobia tirucalli* and *Caesalpinia decapulata*. Multipurpose trees and shrubs such as *Calliandra carothyrsus, Leucena trichandria, and Grevillea robusta* are potential species for these niches.

Respondents gave important uses of some indigenous trees but indicated that the major constraints with these are lack of seeds and seedlings and the long growing periods of

these trees. There is opportunity for use of these trees by farmers both as sources of firewood, timber, fruits and for other traditional uses if planting materials are made available and if tree domestication efforts of these trees are intensified with a focus on the trees that meet farmer needs.

Crop yields during the period of this study were lower than the average yields due to a shortage of rain and declining soil fertility. When enterprises were evaluated for their contribution to TVP, tea was found to make the highest contribution to TVP followed by coffee. Cattle made the third largest contribution to TVP while food crops made the lowest contribution. Both tea and coffee had a higher gross margin than the food crops. Among the food crops, potatoes had the highest gross margins.

The factors found to have a significant influence on TVP were female labour, land and inputs. An increase of 1Ksh worth of inputs was found to increase TVP by Ksh 9.01. The marginal rate of opportunity cost ratio for inputs was greater than one indicating that too little of inputs was being used in the farming enterprises. This underlines the importance of fertilizers, pesticides and improved seeds in raising agricultural productivity in this region. Average farm technical efficiency was found to be 64% with the highest technical efficiency being in tea (82%) and the lowest being in beans (11%).

Given the irreversible trend in the decline of agricultural land, one feasible way to raise food output is to increase land productivity. The short-term solution is to use more land augmenting inputs such as fertilizers and irrigation. However, the law of diminishing

returns is in operation as more physical inputs are applied to shrinking land. Growth of agricultural food production must therefore rely on improvements in technical efficiency. Higher levels of production and productivity however cannot be achieved without improving the income level of farm households. Conditions that are conducive to high levels of efficiency and production including economic incentives, education, and improved nutrition are closely related to incomes.

5.1.2 Gender roles, division of labour and their effect on productivity

Women were found to put in more labour than men on all the crops studied (60.9% by women and 31.9% by men in coffee, 77.8% by women and 22.2% by men in tea, 68.8% by women and 31.2% by men in maize, 77.7% by women and 22.3% by men in beans and 64.3% by women and 35.7% by men in potatoes). Labour contribution in all crops by women was 68.2% while the remainder was male labour. Women's total labour contribution in livestock was 47.6% while in domestic activities it was 93.2%. Men only put in 52.4% of the labour in livestock and 6.8% of the labour in domestic activities. By activity, women contributed more than half the labour for weeding, planting and harvesting in both food and cash crops. When compared to male labour, female labour was significantly higher in both food and cash crops.

The marginal rate of opportunity cost ratio for female labour was less than one indicating that too much female labour was used in the farming enterprises relative to other inputs. Women are overloaded in terms of their labour inputs into both cash crops

and food crops and domestic activities in addition to any other time that they spend in off farm activities.

Agroforestry and other agricultural interventions need to take into account the gender division of labour and the labour burden of female members of households to avoid undesirable consequences such as increasing the female burden without necessarily increasing the benefits accrued by women from these interventions. The policy implication of the gender division of labour distribution is that if any technologies that will affect cropping patterns are to be introduced or recommended, knowledge of the distribution of labour by crops is necessary. This is because total output could decrease instead of increase if more stress is put on available labour resources. Before new technologies or crop varieties are introduced, an analysis of the potential effects of these on the existing labour arrangements and on the availability of labour is required. This may involve a consultation of members of households who carry out the activity or activities in the particular crop or enterprise. Such technologies should particularly be aimed at saving labour while at the same time increasing productivity. The division of labour is also crucial for targeting of information and extension services.

The study noted that the ability of women to make decisions on and to have control over crops depended on the particular crops and especially their economic value. In the study area, more women were making decisions on food crops than cash crops. The study found no evidence of productivity and technical efficiency differences

between male and female farm managers. The female dummy was however significant for the potential output in the production function frontier indicating that for farms to achieve the maximum potential output, gender considerations would have to be considered.

Men and women's preferences for trees were different, as was the use of the trees and tree products. This may lead to conflicts on how the trees and tree products should be used in the household and who will use them. Women incurred a loss in terms of insufficient fuelwood supply despite the presence of large numbers of trees on their farms. It can be argued that introduction and promotion of any tree or tree species must take into consideration men's and women's preferences and their reasons for these preferences. Blanket introduction and promotion of trees may have adverse effects on aspects of the farm that are the domain of men or women.

The number of trees in male managed farms was higher than that in female managed farms, a trend that was also observed between male and female headed households. This implies that even though women who are farm managers are more likely to make decisions in tree planting than those who are not, they still plant fewer trees than in the male managed farms. It was noted in the study that land registration had a significant effect on the number of trees planted per ha because the benefits of trees are long term in nature and trees also take time to mature. Farmers therefore require an assurance of long-term occupancy before they can invest in trees.

5.1.3 Factors affecting gender roles in agroforestry

Women were more likely to make decisions in planting and use of fodder and fruit trees as opposed to trees meant for the supply of firewood, timber and poles. Women who were farm managers were also more likely to plant trees than women in households managed by men. In addition, women who were farm managers were more likely to make decisions on tree planting than women in male managed farms. In households where men managed farms, women put in less labour in agricultural activities than in households where women managed farms.

Among the household characteristics, the education of the head of household head had an effect on gender roles. Women in households with educated heads worked longer hours than those in households where heads had no education. As discussed in the previous chapter (see section 4.3.2.5). as male heads of households get more education, they have better opportunities for off farm employment and as they migrate to urban areas. women find themselves putting in more of their labour to agricultural production. An increase in the family size increases the total labour. including female labour available for agricultural production.

Other factors that were considered as possibly affecting women's decision making and tree planting but were not significant were; the age and education of the woman, age of the husband and whether the household had sufficient firewood or not.

There were found to be no strong taboos that have an effect on tree planting by either men or women. However, among the women, there was a belief that planting of trees was a man's job and most of them had to get male consent before planting trees on their farms.

5.1.4 Women's access to productive resources

In 19% of the households, women had access to credit for inputs from cooperatives. 56% of the women being widows. From other credit institutions, women in only 14% of the households had access to credit. Women were approached directly for extension in 17% of the households while men were approached directly in 35% of the households. Women were found to benefit equally with men from extension. This has important implications for extension services. Women as farm managers require extension in all aspects of farm operations and not only in those activities or crops that are considered feminine such as chicken rearing and home gardening among others.

Few women were found to have access to land. Even in cases where women had cultivation rights, they had no control on the land and other resources and consequently could not make decisions on these resources nor use them as collateral to obtain credit. Most of the land was registered in the men's names even in cases where women were the heads of households. Scepticism on joint titling was expressed by majority of women who cited inefficiency and corruption in the local land boards that allowed men to sell land without the consent of their wives and children. The implications of this are that there is a need for the review of the

existing land laws to enable more women to own land. The local land boards should be made more efficient and sensitive to the issues of women particularly in matters of land sale.

5.1.5 Gender and collective action

Collective action by women has been instrumental in securing rights for women, either as a group or as individuals. The study has revealed that where women are blocked from holding land individually, they are able to obtain a parcel either by purchase or from the state for use on a collective basis. The ownership of resources is a source of empowerment for women and a step towards equity. Collective action provides women with easier and less expensive information and extension as well as credit on the basis of collateral that they can afford to accumulate either as individuals or in a group.

Groups form an important niche for development agents whose aim is to improve the lives of women and to ensure the benefits of women's efforts remain in their hands. In some groups however, the difference in men's and women's roles and responsibilities have prevented the integration of women into mixed groups.

Despite the crucial role played by collective action in promoting the interests of women, there is still no sufficient integration of women as decision makers in the traditionally male dominated local institutions. From the groups studied, it is also

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Despite the crucial role played by collective action in promoting the interests of women, there is still no sufficient integration of women as decision makers in the traditionally male dominated local institutions. From the groups studied, it is also

clear that those membership conditions and requirements may be locking out a lot of resource poor women who would otherwise benefit from group action.

One pertinent question as regards women groups is whether women are better off in their own groups or they would similarly achieve their objectives if integrated in male dominated group. Although this research does not sufficiently answer this question, it is clear from the results that there are both advantages and disadvantages of mixed and women only groups. Even in women only groups, there is no homogeneity as women are differentiated in terms of age, social status, whether they are female heads of households or members of male headed households and their economic status. The most important form of homogeneity is one on group members' interests, objectives and expectations from the groups.

5.2 Recommendations

5.2.1 Recommendations for policy and development

- Given the importance of farm inputs in raising the total value product, future policies should be aimed at increasing rural farmers' access to agricultural inputs at an affordable price as a strategy to increase agricultural production. More fertility enhancing tree species such as *Tithonia diversifolia* should be introduced in the study area to improve soil fertility and thereby increase crop yields. Efforts should also be made to promote the use of other useful shrubs such as *Calliandra carothyrsus* and *Leucena trichandria* through provision of information and seeds.

- The gender stereotypes on what the roles of men and women are in the household have been reinforced by norms and customs. These norms create powerful incentives for people's behaviour and any behaviour outside the accepted boundaries can have some serious formal or informal systems of social sanctions. These stereotypes can however change and this offers a challenge to organizations working with local communities to influence these gender stereotypes. The fundamental inequities in gender relations in regards to property rights also need to be addressed not even so much by law as by the social and traditional relations that are governed by custom and practice within family and community.

- Based on evidence of the different impacts of resources and their control by different members of the household, i.e. either men or women, there is a strong case for gender targeting of agricultural and agroforestry interventions. Interventions that aim to increase female access to resources be it credit or extension can be effective not only in improving women's autonomy and status within the household but also productivity. Gender targeting is critical in ensuring that interventions do not have unintended and adverse consequences. Extension services to women need to be strengthened in addition to having extension departments that promote gender equity in their services and training.

- Group members' needs are consistent in the study area; they need land for commercial activities, they need finance to develop their projects, they need

training. they need better infrastructure and support from both the community and the government.

- Women's groups should be supported in terms of training. financing their activities and encouraging their participation in other rural institutions. There should be integration of women into local decision making institutions as they are now mainly in small rural based groups. Researchers, scientists and development agents should also consider the possibilities of using groups not only for development activities but also in research such as tree species selection and breeding programmes.

5.2.2 Recommendations for future research

- There has been a methodological debate on the appropriateness of using cross sectional data in measuring technical efficiency. For a more comprehensive analysis of a comparison of technical efficiency in male and female managed farms. a data set covering more years, larger sample and more information on farm and farmer characteristics as well as the different management strategies employed by farmers would be better to draw more firmer conclusions than have been drawn in this study. The factors that affect farm technical efficiency should also be investigated.

- An investigation of how both male and female farmers can be involved in tree selection and tree domestication whether on farm or on station is necessary so

that farmers have trees with the qualities that are desirable and of use to them. The incentives, either economic or otherwise of what makes trees to be used for different purposes is an area of research that needs to be looked at. This would ensure that both men's and women's needs are taken care of when introducing tree species.

- There is need to investigate the best way to reach women farmers in terms of extension or in other words gender sensitive extension. Further research should be done to investigate the best way of reaching women farmers be it preferential targeting of women farmers, increasing the female to male extension staff ratio, training extension staff on gender issues or other ways.

- Groups and especially women groups in Kenya constitute an important social movement whose activities remain largely undocumented and unanalysed. It is important to document the various parts and functions of this movement in relation to its origins, composition and purposes and its potential role if the social, economic and political life of the country is to be fully realized. A study of hierarchical groups and especially the marketing co-operatives to investigate the effects of membership conditions on women and whether there is adequate and accountable representation of women and disadvantaged groups at the higher hierarchies is necessary.

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APPENDICES

Appendix 1. Major government policies that have had an effect on agroforestry development in Kenya

1. The forest policy for Kenya developed in sessional paper I, economic management for renewed growth in 1986 which directed the Ministry of Environment and Natural Resources to carry out farm forestry activities.
2. The Rural Afforestation Extension Scheme (RAES) (1971) to promote tree planting by farmers.
3. The Chief's Authority Act passed to prevent tree cutting and promote establishment of chief's nurseries.
4. The Establishment of a Permanent Presidential Commission for Soil Conservation and Afforestation (PPCSCA) which recognized agroforestry as a key instrument in protecting the environment.
5. Parts of the Basic Land Usage Act of 1965 that was revised in 1985 to allow land use in steep slopes as long as agroforestry principles were used.
6. The creation of the Ministry of Energy and Regional Development (MOERD). which promoted tree planting as a renewable energy programme, especially using agroforestry to generate biomass energy.
7. The interministerial committee on agroforestry under MOERD to promote and coordinate agroforestry.
8. Presidential tree fund (1985) which improved the financial basis for Kenya African National Union (KANU) youthwingers to be involved in tree planting programmes.
9. The 8-4-4 education system (1985). which required schools to teach tree planting and maintain nurseries.
10. Sessional paper no. I of 1986 recognized agroforestry as a sound land use and planned for 3 million hectares for the planning period 1984-1988.

11. National annual tree planting day.
12. Directorate of Personnel Management (DPM) in mid-1986 instructed the MOERD to develop a common policy and operation for agroforestry under MOERD leadership and increased manpower in agroforestry
13. Kenya Forestry Research Institute (KEFRI) and Kenya Agricultural Research Institute (KARI) became autonomous research institutes thereby taking much of agroforestry research responsibilities.
14. Ministry of Planning and National Development (MOPND) in 1986 instructed the District Development Committees (DDC) to include agroforestry in their plan and budget.
15. In 1987, the national steering committee for agroforestry research was established.

Adapted from Getahun *et al.* (1990)

Appendix 2. Question guide for focus group discussions

1. What major crops and trees do you plant in the area?
2. What major problems do you face in the growing of these crops and trees?
3. What are your priority trees and crops and what are their major uses?
4. Given a choice would you plant other crops and trees apart from the ones that you plant?
5. If yes, which ones and why?
6. Do you have any problems as far as land is concerned?
7. If yes, which ones
8. How do you think these problems can be solved?
9. Who do you think should take the initiative to solve these problems, yourselves, the government or other organizations?
10. What institutions operate in this area and how have they helped you in crop and tree production?
11. Is there a division of labour between men and women?
12. Which activities are predominantly for men and which are for women?
13. How does this division differ with different crops?
14. Have these changed with time or have they always been this way?
15. If they have changed, how have they changed?
16. Are you satisfied with the division of labour or do you think something needs to be done to change this?
17. If something needs to be done, what do you think this should be?
18. Do you think women have adequate access to land capital, credit and labour?
19. How do you think their access to these resources affects agricultural productivity
20. A detailed activity analysis
21. A wealth ranking exercise

Appendix 3:Questionnaire on gender roles in agroforestry: a socio-economic analysis.

FARMER QUESTIONNAIRE

IDENTIFICATION

Questionnaire number..... Household number.....

Name of interviewer ..... Date of interview .....

Name of district..... Name of extension unit.....

A. FARM AND FARMER CHARACTERISTICS

A1 Name of respondent.....

A2 Relationship to household head .....

A3 Name of household head .....

A4. Sex of the household head

1 = Male ..... 2 = Female .....

A5. Age of household head .....

A6. Level of education of household head

1 = None .....2 = Primary school .....3 = Secondary .....

4 = College .....5 = University ..... 6 = Other .....

A7. Marital status of farm owner

1 = Single ..... 2 = Married ..... 3 = Living together.....

4 = Separated ..... 5 = Widowed ..... 6 = Divorced .....

A8. What is your religion?

1 = Moslem ..... 2 = Roman catholic..... 3 = Other christian.....

4 = Traditional..... 5 = No religion .....6 = Other (specify).....

A9 Occupation of farm owner

.....

A10 Total size of the land under use by the household .....

Do you have plots of land away from the main farm? .....

A11 Location of the land and tenure

Location	Size in acres	Owned or rented
Homestead farm		

A12. Is your land adequate?

1 = yes ..... 2 = No .....

A13. How much land did you hire in 1998 .....

A14. What major problems do you experience as far as your land is concerned?

1 = Land is not enough..... 2 = Insecure land rights.....

3 = Lack of inputs..... 4 = Lack of decision making on land use

5 = Low soil fertilty..... 6 = Soil erosion

7 = Other

A15. How did you acquire your land?

1 = Inheritance..... 2 = Buying..... 3 = Government allocation.....

4 = Clan..... 5 = Lease..... 6 = Other.....

A16. What rights do you have over the land?

A16. What rights do you have over the land?

1 = Title deed..... 2 = Customary rights .....

3 = User rights ..... 4 = Other .....

A17. Is your land registered?

1 = Yes..... 2 = No .....

A18. Under whose name is the land registered?

1 = Husband..... 2 = Wife.....

3 = Both..... 4 = Other.....

A19. Who is the manager of the farm ?

1 = Male manager..... 2 = Female manager.....

3 = Both male and female..... 4 = Hired manager.....

5 = Other

A20. What sources of energy do you use?

1 = Firewood..... 2 = Kerosine..... 3 = gas.....

4 = Electricity ..... 5 = Crop residues..... 6 = Other .....

A21. Where do you obtain firewood?

1 = Forest..... 2 = Natural tree on farm ..... 3 = Trees planted on farm .....

4 = Village woodlot ..... 5 = Other .....

A22. How far is the forest from your home ? .....

A23. Quality of firewood used in the home ?

1 = Very good..... 2 Good.....

3=Medium.....

4 = Poor..... 5 = Very poor

A24. What rights do you have over the trees in your farm?

1 = User rights..... 2 = Can sell.....

3 = Can harvest..... 4 = No rights.....

5 = Other.....

A25. What is the total number of family members in the household?

.....

A26. Household composition

Family members	Sex	Age	Relationship to H/H	In school	Working full time onfarm	Working part time on farm	Not working on farm

A27. Type of housing.

1 = Mud walled with thatched roof

2 = Mud walled with corrugated roof

3 = Wooden wall with corrugated roof

4 = Stone walled with corrugated roof

5 = Stone walled with tiled roof

A28. Do you belong to any organised group?

1 = Yes ..... 2 = No .....

A29. If yes, what kind of group?

1 = Savings .....2 = Welfare group ..... 3 = Co=operative group.....

B CHARACTERISTICS OF THE FARM ING SYSTEMS

B1 CROP PRODUCTION

	crop 1	Crop 2	Crop 3	Crop 4
Number of stems				
Acreage covered				
Source of seeds/seedlings				
Cost of seeds/seedlings				
System under which grown 1 = mixed 2 = mono 3 = relay				
Is hired labour used				
On which activities is hired labour used 1= planting 2 = weeding 3 =prunning 4 = harvesting				
How much money was paid for hired labour				
Periods of high labour requirement				
Type of fertilizer used for planting 1 = DAP 2 = NPK 3 = other				
Amount				
Type of fertilizer used for top dressing 1 = CAN 2 = urea 3 = other				
Amount				
Amount of manure used				
Source of manure 1= own 2=purchased				
Type of chemical used for spraying				
Amount of chemicals used 1=copper 2=libacid 3=nordox				
Amount harvested in 1998				
Amount used at home				
Amount sold				
Who is in charge of crop 1= male 2=female 3 = both				

B2Tree production

Priority trees on the farm

	Tree 1	Tree 2	Tree 3	Tree 4	Tree 5
Number of trees					
Where planted 1=Outer boundary 2 = Inner boundaries 3 = Inter-cropped with crops 4 = On soil conservation structures 5= On homestead.					
Use of the trees- 1 = fruits 2 = fodder 3 = firewood 4 = shade, 5 = soil conservation					

Products sold 1=timber 2=poles 3=fruits 4=firewood					
Amount of product sold from each species					
Amount of money obtained from each					
Source of seedlings 1= own 2 = purchased					
If purchased how much money was spent?					
No of times pruned					
Person responsible for planting 1 = male 2= female 3 = both					
Person responsible for selling 1 = male 2 = female 3 = both					
Decision making on planting 1=male2=female 3 = both					
Decision making on disposal 1 = male 2 = female 3 = both					

B4. Rank the position of tree products supply in the household

Product	Good	Enough	Poor	Very poor

B5 Livestock production

	Cows	Goats	Chicken	Sheep	Pigs
Number					
Breeds					
System under which they are kept 1 = zero grazing 2 = tethering 3 = extensive 4 = both zero and tethering					
Type of enclosure					
Main purpose of the animal					
Current milk production					
Method of introduction on the farm					
Type of feed fed on the animals1=nappier grass 2=banana stems 3=bran 4=dairy meal					
Source of feed 1=own farm 2=purchased 3=neighbours					
Amount fed per month					
Amount of money spent on buying feed					
Do you use hired labour					
On what activities do you use hired labour 1=feeding 2=milking 3=marketing					

B6 Income generating activities

List the income generating activities the household is involved in in order of priority and the members of household involved.

Activity	Number of people	Male	Female

B7. Household expenditure

What farm products do you buy for home use and consumption?

Product	Quantity bought	Amount of money used

C. GENDER ROLES IN AGROFORESTRY

Now I would like to ask you about the activities performed in the household.

C1. Activity profile

Activity	Household labour								Hired laour		
	MA	Time	FA	Time	MC	Time	FC	Time	MA	FA	Time
CROP..... Land preparation											
Weeding											
Pruning											
Harvesting											
Marketing											
Processing											

MA-Male adult, FA-Female adult, MC-Male child, FC-Female child

D. HOUSEHOLD MANAGEMENT OF RESOURCES.

D1 Major capital goods and implements in the household.

Goods/implements	Ownership 1= owned 2 = hired 3 = borrowed 4 = other	Number

D2. Access and control profile

Resource	Access		Control (Decision making on use and disposal)			Benefits
	M	F	M	F	Other	

D3. What resource constraints do you face in agroforestry production ?

D4. What do you think should be done to make these resources available?
.....
.....

E. SOCIO-ECONOMIC INFORMATION

E1. Important enterprises for cash production 1
.....
2..... 3
.....

E2. How much money did you spend in 1998 on the following ?

	Amount
Food purchase	
Purchase of consumer items	
Health services, Education	
Farm inputs	
Hire of labour	
Educattion	
Other	

E3. Do you have access to money lending facilities?
1 = Yes..... 2 = No.....

E4. Which ones?
1 = Banks..... 2 = Co-operatives..... 3 = Informal groups.....
4 = Other.....

E5. What did you use the credit for?
.....

E6. How many times have you been approached directly by an extension officer in the last 3 months/one year
.....

E7. What are the areas emphasized by extension officers in their discussions
.....
....

F. SOCIO - CULTURAL INFORMATION

F1. Are there any social activities, which interfere with the labour calender during the year?
.....

F3. Are there any taboos or beliefs about involvement in tree related activities?
1 = Yes ..... 2 = No .....

F4. Which ones?

Appendix 4.Time allocation studies

FARMER NAME..... EXTENSION UNIT.....
LAND SIZE .....

CROP .....ACREAGE .....

Date	Family labour				Hired labour				Inputs
	MA	FA	MC	FC	MA	FA	MC	FC	

Amount harvested. .....Amount sold .....Amount consumed .....
MA-Male adult, FA-Female adult, MC-Male child, FC-Female child

HOUSEHOLD EXPENDITURE

HOUSEHOLD OF INCOME

Source of income	Number of persons	Amount of income per month

Appendix 5.Questionnaire for group interviews

Village_____Loc_____Div_____District_____

History and process

1 Name of group .....

2 Type of group .....

3 When was group started? .....

4 Who conceived the idea for the group?.....

5 Why was the group originally formed (purpose)? .....

6 If the purpose has changed, what it the current purpose? .....

7 How was it determined who should comprise the original group members (who was included, who was specifically excluded and why)? .....

8 Is the group now registered? ____ 1 yes ____2 no

9 If yes, year first registered .....

10 If no, do you know the procedures for registering? ____ 1 yes ____2 no

11 If no, why haven't you registered? .....

12 f yes, year first enacted ..... If yes, year last amended .....

13 Does the group have bylaws? ____ 1 yes ____2 no

14 If yes, year first bylaw enacted _____ If yes, year last amended _____

15 Does the group now have its own bank account? ____ 1 yes ____2 no

16 If yes, year bank account opened .....

17 If yes, what is the main purpose of the account? .....

18 If no, why? .....

19 Is membership in the group:
1 open to anyone without limit
2 open to anyone but limited in number
3 restricted to certain types of people, but without limit in number
4 restricted to certain types of people, and limited in number

20 Who originated and decided upon these membership rules? .....

Structure/composition

21 What was the number of group members at the time of inception?.....

22 How many were men? ..... How many were women? .....

23 What is the current number of group members? .....

24 How many are men?..... How many are women? .....

25 Member characteristics

Name	Sex	Age	Education	Occupation	Spouse education	Spouse occupation	Position in group

What are the advantages of this overall pattern of diversity or similarity? .....

Leadership

26. How many chairpersons have there been since group inception? .....

27. How many chairpersons have there been in the last 5 years? .....

The future

29. What are the hopes and aspirations of the group, looking 5 years into the future?.....
30 What are the main problems/shortcomings facing the group and would hamper the group fromreaching these aspirations?.....

Appendix 6. Farmers' perceptions on trees and their uses

Tree Local name	Botanical name	Uses	Advantages	Disadvantages
Mubera (Guava)	*Psidium guajava*	Fruits	Very handy even in strong winds	Competes with crops and easily becomes a weed
Mukodobia (Avocado)	*Persia Americana*	Fruits, firewood and sometimes timber	High yields of fruits	Has dense shade and competes with crops
Mutarakwa (African pencil cedar)	*Juniperus procera*	Timber and poles		Does not grow well with crops.
Mukoigo	*Bridelia micarantha*	Firewood	Very good for firewood, rafters and tool handles	Attracts birds and caterpillars
Mukungugu	*Commiphora eminii*	Demarcating land Live hedge Goat feed Support for climbing plants	It does not interfere with crops. Very quick growing	
Muringa	*Cordia africana*	Timber	Has very good mulch and does not interfere with crops.	Grows very high.
Mukinduri	*Croton megalocarpus*	Firewood	Shady and ideal for homestead	Not good for intercropping
Mutundu	*Croton macrostachyus*	Ripening fruits	Good for intercropping	Very irritating smoke when used as firewood
Kariaria	*Euphorbia tirucalli*	Live fence and boundary	Sap treats eye infections	
Muu	*Markhamia lutea*	Firewood, poles and banana props		Becomes bushy and takes up space
Kaiyaba	*Dovyalis caffra*	Live fence	Protection against intrusion	Very thorny and slow growing
Muembe	*Mangifera indica*	Fruits and firewood	Firewood dries fast and high yields of fruits.	Large canopy
Mubage	*Caesalpinia decapetala*	Live fence	Protection against intrusion	Thorny and not good for firewood.
Muthanduku	*Acacia mearnsii*	Timber and firewood		Difficult to control and competes with crops
Mugumo	*Ficus thonningii*	Firewood and ceremonial tree.		
Nyanya muti	*Cyphomandra betacea*	Fruits	Can be intercropped with cash crops.	

Source: Survey data (1999)

Appendix 7.Cropping and activities calendar

	Maize	Beans	Potatoes	Coffee	Tea
January		HA	HA	MA, WE, HA	HA
February	HA			PR	HA
March	LP,PL	LP, PL	LP, PL	SP	HA
April	WE	WE	WE	PR	HA, FE
May				PR	HA
June	WE	WE	HA		HA
July		HA		SP	HA,FE
August	HA, LP	LP	LP		HA
September	HA, LP	LP	LP, PL		HA
October	PL	PL	WE		HA
November	WE	WE	WE	HA	HA, FE
December	WE	HA		HA	

WE-Weeding, HA-Harvesting, PL,-Planting, LP-Land preparation, FE-Fertilizing, SP-Spraying, MA-Manuring; PR-Prunning

Appendix 8. Seasonal gross margin for farm enterprises

	Coffee	Tea	Maize	Beans	Potatoes	Livestock	Trees
Output value (per farm)	19 343	20 400	2 420	2 342	2 625	10 131	1 799
Output value (per ha)	71 009	77 627	4 865	3 921	10 302	-	-
Input costs (per farm)	1 663	3 569	1 029	301	751	3 252[1]	22
Input costs (per ha)	6 106	13 582	2 068	504	2 947	-	
Labour costs (per farm)	937	1 904	455	959	-		
Labour costs (per ha)	3 442	7 248	915	1 605	-	-	
Gross margin (per farm)	16 741	14 926	936	1 082	1 874	6 878	1 777
Gross margin (per ha)	61 459	56 796	1 880	1 812	7 355	3 563[2]	

[1] Costs include hired labour, feeds, veterinary services and costs of buying additional cattle.
[2] Gross margin per livestock unit.

Appendix 9. Summary of issues of interest from case study groups

Group name	Group membership	Activities	Benefits	Problems	Gender issues
Karia	Women-27	-Posho mill, commercial building, welfare activities, tree nurseries, goat keeping	Economic benefits, increased incomes, extension services, literacy skills, financial independence	High member expectations, domination by older women, marketing, capital	Cannot include men because men will dominate the group and impose their wishes on the group as well as take the group leadership. They have experienced improvement in hh gender relations.
Ngaru	Women-26	Tree nurseries, welfare issues, rice farming, fish farming, revolving credit scheme	Literacy skills, land acquisition from the government, increased hh income, increased fuelwood and tree product supply.	Very elderly members, marketing, lack of farming equipment, no title deed for their farm	Men would have already sold their plot if they were members and decision making is easier without the men
Kirimaini	Women-13 Men-9	Bee keeping, horticulture, credit scheme	Farmer mobilization for irrigation, improved product marketing, increased hh income.	Women's restrictions to join by men, non adherence to rules	Men can do the harder tasks such as construction of irrigation canals and there are lower chances for women membership
Kagongo	Women-21 Men-11	Horticulture	Increased hh income, improved marketing	Non adherence to rules	Lower chances for women membership.