

**OPPORTUNITIES AND CHALLENGES OF ECOLOGISING EXTENSION
SERVICE AT THE FARM LEVEL, MITHERU AGRO-ECOSYSTEM,
MERU SOUTH DISTRICT, KENYA**

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challenges of*



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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or any other award.

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DEDICATION

To God Almighty for His great grace. To my parents, family members and friends for their patience and immeasurable assistance offered while I battled to finish this work.

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ABBREVIATIONS AND ACRONYMS

ADC	Agricultural Development Co-operation
AFC	Agricultural Finance Co-operation
CAP	Community Action Plan
CBO	Community Based Organisation
CSO	Civil Society Organisation
DAO	District Agriculture Officer
DEMC	District Environmental Management Committee
FAA	Focal Area Approach
FAO	Food and Agriculture Organisation of the United Nations
FEW	Frontline Extension Workers
FFS	Farmers Field School
FTCs	Farmers Training Centres
ICRAF	International Centre for Research in Agro-Forestry
IFPRI	International Food Policy Research Institute
KARI	Kenya Agricultural Research Institute
KIRDI	Kenya Industrial Research and Development Institute
MDGs	Millennium Development Goals
NACADA	National Advisory Council Against Drugs-abuse & Alcoholism
NACC	National Aids Control Council
NAEP	National Agricultural Extension Policy
NALEP	National Agriculture and Livestock Extension Programme
NALEP-IF	National Agricultural and Livestock Extension Programme Implementation Framework
NASEP	National Agricultural Sector Extension Policy
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NCPB	National Cereals and Produce Board
NSWCP	National Soil and Water Conservation Programme

PRA	Participatory Rural Appraisal
PRSP	Poverty Reduction Strategy Paper
SA	Sustainable Agriculture
SMS	Subject Matter Specialist
SOE	State of Environment Report
SRA	Strategy for Revitalising Agriculture
STE	Short Term Expert
SWOT	Strengths Weakness Opportunities and Threats
UNEP	United Nation Environment Programme
UNCD	United Nation Conference for Sustainable Development
WCED	World Commission on Environment and Development

ABSTRACT

Environmental degradation remains a pressing challenge in most Kenya's agro-ecosystems, despite existence of extension service since pre-colonial period. The current extension service emphasises yield maximisation with environmental sustainability being largely driven by other players like civil society organisations. This study examined the opportunities and challenges of ecologising environmental thinking within the extension service at the farm level using Mitheru Location, Meru South District, Kenya as a case study. A total of 172 farmers were randomly selected and interviewed on pertinent issues in this regard. Key respondents like the extension officers were selected purposively by virtue of being the service providers. Both qualitative and quantitative data were collected and analysed using descriptive and inferential statistics. Pearson's correlation coefficient was particularly useful in assessing relationships between selected key variables in the study. The opportunities and challenges were crystallised for the purpose of intervention planning using SWOT analysis. Results showed that increasing land pressure was a critical limiting factor in implementing structural conservation measures like Cut Off Drains (COD) and planting trees for environmental conservation. To date extension services has only effectively reached 33% of the respondents. This low performance was attributed to the low numbers of extension agents compared with their large clientele. Among those receiving the extension services, 36% felt that it focussed mainly on animal production and 33% on crop production with little emphasis on environmental conservation. Farmers tended to adopt environmental conservation technologies, which were perceived to be easy to implement and offering immediate benefits such as agro-forestry. More educated farmers relied less on extension agents for information ($r=-0.22$, $n=172$, $p=0.01$) often sourcing from newspapers, radios and internet. These alternative sources of information were rated high in terms of integration of environmental conservation technologies ($r=0.27$, $n=172$, $p=0.01$). Field schools were the major approaches used in delivery of extension services. Their effectiveness in communicating ecological thinking remains limited because of the less time often allocated to environmental conservation. A SWOT analysis output of the National Agriculture and Livestock Extension Programme (NALEP) showed that farmers do appreciate farming as a business and extension agents are able to train farmers en-mass due to adopting group approaches, which translates into reduced costs and logistical challenges. However, the NALEP approach does not seem to be able to deliberately target resource-poor farmers, who are likely to shy away from group dynamics. Further, although environmental concerns have been integrated as cross cutting issues, the time allocated to them are minimal, which translates into little impact in terms of environmental conservation. Further, increasing political recognition of the inter-dependence of environmental quality and poverty alleviation stood out as a key opportunity in future intervention efforts while a key threat was increasing conflicts on scarce resources. From a policy perspective, deliberate efforts are needed to implement sustainability thinking in the entire extension package. This calls for a paradigm shift that views agro-ecosystems as primary life-support systems, with crop and livestock production activities as sub-components thereof.

CHAPTER 1: INTRODUCTION

1.1 Background

Environmental degradation is as old as human history and what differs is the degree to which human activities impact on the biosphere (World Watch, 2000, UNEP, 2002). Most of environmental problems result from social and economic development. In Kenya, like other African countries, environmental degradation of viable land is a major challenge in the management of natural resources and arable land. This is a great concern in Kenya where only less than 20% of the land is suitable for agriculture (Nyaga, 1999).

Agricultural technologies and food production can have serious negative impacts on the environment. This is particularly so because one of the demand on agriculture is the need to produce enough food to feed the ever-increasing world population albeit on a shrinking land and water resources. Population projection suggests that the world population will continue to increase from the present figure of about six billion people to between 11 and 14 billion people by the end of the 21st century (IFPRI, 1994). Therefore the major challenge of 21st century thus remains the production of adequate food for this increasing population. Unlike the Green Revolution (Rockefeller, 2006), care must be taken to safeguard the environment and contribute to sustainable development. As such, there has been a broadening of the extension service agenda to include environmental topics in most developing countries but primarily those directly related to productivity or compliance with environmental legislation (FAO, 1999).

One of the major challenges impending agricultural development and food security, in sub-Saharan Africa, is the limited human capital (Beynon et al, 1998). This is most visible in the extension services where a large proportion of the field staff lacks appropriate technical and human relations required to work effectively in the rapidly changing and complex agricultural environment (Mutimba et al, 2002). This is partly due to pluralism in extension provision adopted by National Agricultural and Livestock Extension Programme which encourages diversification of extension services provision and collaboration among stakeholders and extension providers (MoA, 2006). The term

“extension” is used here to mean ‘advisory services’ that help rural families to make the best possible use of the productive resources at their disposal particularly agricultural land (Kaimowitz, 2002). Extension services provide farmers with important information, such as developments in crop production technologies, environmental management practices, crop marketing among others as well as feedback mechanism from the farmers to the research centres, to provide opportunities for continuous improvement. Despite many years of campaign led on-farm soil and water conservation in Kenya, the findings of many PRAs suggest that there is general decline in soil fertility and crop yields (GoK, 1995)

Sustainable development of the environment depend on the level of awareness, knowledge, skills, altitude and values held by a community and hence the individual. Where people appreciate the value of their environment and possess the skills to eke a living out of it, wanton destruction is not likely to occur (UNCCD, 2002). The people’s right of access to environment information (right to know) can be of no consequence unless they also understand the implication of that information and use it to effectively participate in policy formulation, decision making and implementation. Therefore, qualitative and holistic extension service is what emancipate a people and equip them to utilise the environment sustainably in meeting their needs as well as preserving it for future generations (NAARE, 2000).

Despite the many years of extension services, land degradation and food insecurity are still pressing problems in Kenya and the declining effectiveness of the extension service has been identified as a major factor that is hampering growth of Kenyan agriculture (NEMA, 2004). In this regard, the Strategy for Revitalising Agriculture (SRA) has suggested reform of the extension service system in order to create effective linkages between research, extension and farmers, who are the ultimate beneficiaries of the services. In recognition of potential role of agriculture and natural resources management in bringing about sustained socio-economic growth, the Ministry of Agriculture continues to emphasize the need for improved agricultural development in the country (MoA,

2004). Sustainability however may not be realized without integrating and implementing environmental conservation strategies and approaches in extension services.

Kenya's small-scale farmers had traditionally benefited from two major types of extension systems. The first is the government extension system, which addresses both livestock and crop development aspects. The second is the commodity-based systems run by government parastatals, out-grower companies, and cooperatives that mainly focus on particular crop or product like tea or coffee (Muyanga and Jayne, 2006). Traditional extension services have been described as ineffective, inadequate, and considered key among the main cause of the poor performance of the agricultural sector in Kenya (MoA, 2005e). In the current dispensation of environmental awareness, a key concern is how extension agencies can be organizationally adapted to promote environmental and sustainable development at farm levels. Radical changes in the extension service will have to be made with deliberate efforts in this regard and not as a way of complying with set legislations as in the past.

Over recent years and particularly since the UN conference on Environment and Development (UNCD) in Rio in 1992, the role of community in sustainable development has caused excitement and confusion in almost equal measures among practitioners and policy makers. However, the world leaders signed up to Agenda 21 as the agenda for the twenty-first century, confirming that sustainable development requires community participation in practice as well as principle (Micheal, 1993, WCED, 1987). Activities that contribute to integrated promotion of sustainable livelihoods and environmental protection cover a variety of sectoral interventions involving a range of actors from local to global and are essential every level especially the community and local levels. Thus the phrase '*Think global and act local*', widely used since 1980 world conservation strategy and has since become part of mainstream environmental discourse. Therefore, sustainability has to make sense at local level if it is ever to reach global proportions (Jacobs, 1995).

Poverty, ignorance and disease were identified as the major constraints to social and economic development (FAO, 1999) and have occupied a central place in Kenya development since independence, yet the problem of poverty persist and is threatening the lives of more people than ever. According to GoK, (2000a) Meru South District is among the Districts in Eastern Province, which have a poverty head count that is above the Provincial mean of 58%. Population growth in relation to the limited and often fragile resource base is both a cause and a consequence of poverty (Andersen et al, 1999). As indicated in United Nations Millennium Development Goals numbers 1 and 7, Sustainable land management relates directly to eradication of poverty and hunger and ensuring environmental sustainability (GoK, 2003). This in essence will involve intensification of agricultural activities to meet the needs of the increasing population. However poor people often lack sufficient incomes or access to credit to purchase appropriate tools and materials, inputs such as fertiliser and intensive technology in order to practice environmentally sustainable food production techniques to protect natural resources against degradation or to rehabilitate degraded resources.

1.2 Problem Statement and Justification

Although the current extension service policy (MoA, 2005a) has integrated environmental concerns, observations at the farm level indicate that environmental degradation is still a persistent problem. This would imply that the extension messages reaching the farmers are either inadequate as far as addressing this issue is concerned or the farmers lack the capacity to implement workable solutions communicated to them. In Meru south district, population increase and the consequent need for more food and life sustenance continues to cause environmental degradation, particularly soil erosion. Population pressure has particularly forced people to clear forest for agriculture. Further increased use of external inputs such as agro-chemicals is associated with risks of environmental degradation and poor human health (CBS, 2001a). In recognition of this, the District Environmental Management Committee (DEMC) has mobilised resources to educate the public on environmental protection and conservation. However, observation

at the ground indicates that more still needs to be done since soil erosion is still evident, tree felling at farm level is rampant and general crop yields are declining.

The situation in Mitheru location has been worsened by subdivision of land making the area one of the most densely populated in the district. Tree felling, cultivation on steep slopes and river basins is also common leading to serious environmental degradation which current extension services have not been able to adequately address. Toward this end, this research sought to determine the root causes of this scenario using Mitheru location of Meru South district as a case study. The output was envisaged to contribute to policy options for actions plans towards sustainable agricultural practices and community development.

1.3 Objectives

The overall objective of this study was to assess the challenges facing extension service in addressing environmental management concerns and the opportunities available towards enhanced realisation of environmental benefits in the extension service at the farm level. The specific objectives were:

- i. To assess the extent of environmental considerations in current extension services at the farm level
- ii. To determine the constraints facing farmers in implementing environmental conservation strategies
- iii. To assess the challenges facing the extension agents in communicating environmental conservation strategies at the farm level

1.4 Research Questions

This study was guided by the following key questions:

- i. Do the extension services in Mitheru Sub-location address environmental considerations in agricultural development?

- ii. What is the general status of agricultural land quality in the study area?
- iii. What is the farmer's level of implementation of environmental management practices on their farms?
- iv. What hinders adequate and effective extension service provision for environmental management?
- v. What challenges do farmers face in implementing environmental management strategies?
- vi. What policy interventions should be taken into consideration to ensure extension services adequately address environmental issues and impact is felt at the farm level?

1.5 Assumption

Current extension service has tended to focus on yield maximisation at the expense of holistic environmental management at farm level, with the results of persistent environmental degradation and hence unsustainable community livelihoods.

1.6 Conceptual Framework

The main agricultural extension system in Kenya currently is the public sector system provided by the agricultural sector ministries through their personnel at various levels. However, over the past few years a pluralistic situation has emerged, with different types of extension service provider delivering a range of services to different categories of clientele. These include commercial companies in the horticulture and tobacco sectors, parastatals providing services for producers of specific commodities, Non-Governmental Organization's offering extension as part of their support for rural livelihoods, and producer associations providing services for their members. National Agricultural Sector Extension Policy (NASEP) seeks to build on this by providing a framework where extension service providers of all kinds can work together for the development of the agricultural sector and the livelihoods of those involved in production, value adding and marketing of the sector's outputs.

Though extension service is required to address both yield concerns and environmental issues, the emphasis in Kenya has tended to focus on yields maximisation. Observations on the ground suggest that while some improvements in yields have been realised, the state of the environment, particularly land continues to deteriorate. This could be attributed to among others commercialisation and privatization of some extension services, inadequate extension staff especially at the frontline level, inadequate funding from the government, transport constraints due to lack of vehicles or funds for maintenance hence low coverage and lack of harmonisation of approaches by various extension service providers. As a result, extension agents devote less time for cross cutting issues like environmental conservation, gender and HIV/AIDS, while emphasizing yield maximization as the core extension messages. Furthermore farmers are interested in extension messages, which lead to increase in yields because they translate it to monetary gain. As such farmers tend to ignore environmental dynamics in farming systems resulting into recurrent environmental degradation and food insecurity problems (Figure 1.1). The dotted arrow in the figure indicates intervention paths towards improved and sustained land quality and productivity hence improved ecosystem services and human well-being. This study sought to explore these linkages with the aim of suggesting ways of translating extension services into tangible environmental and community benefits at the farm level.

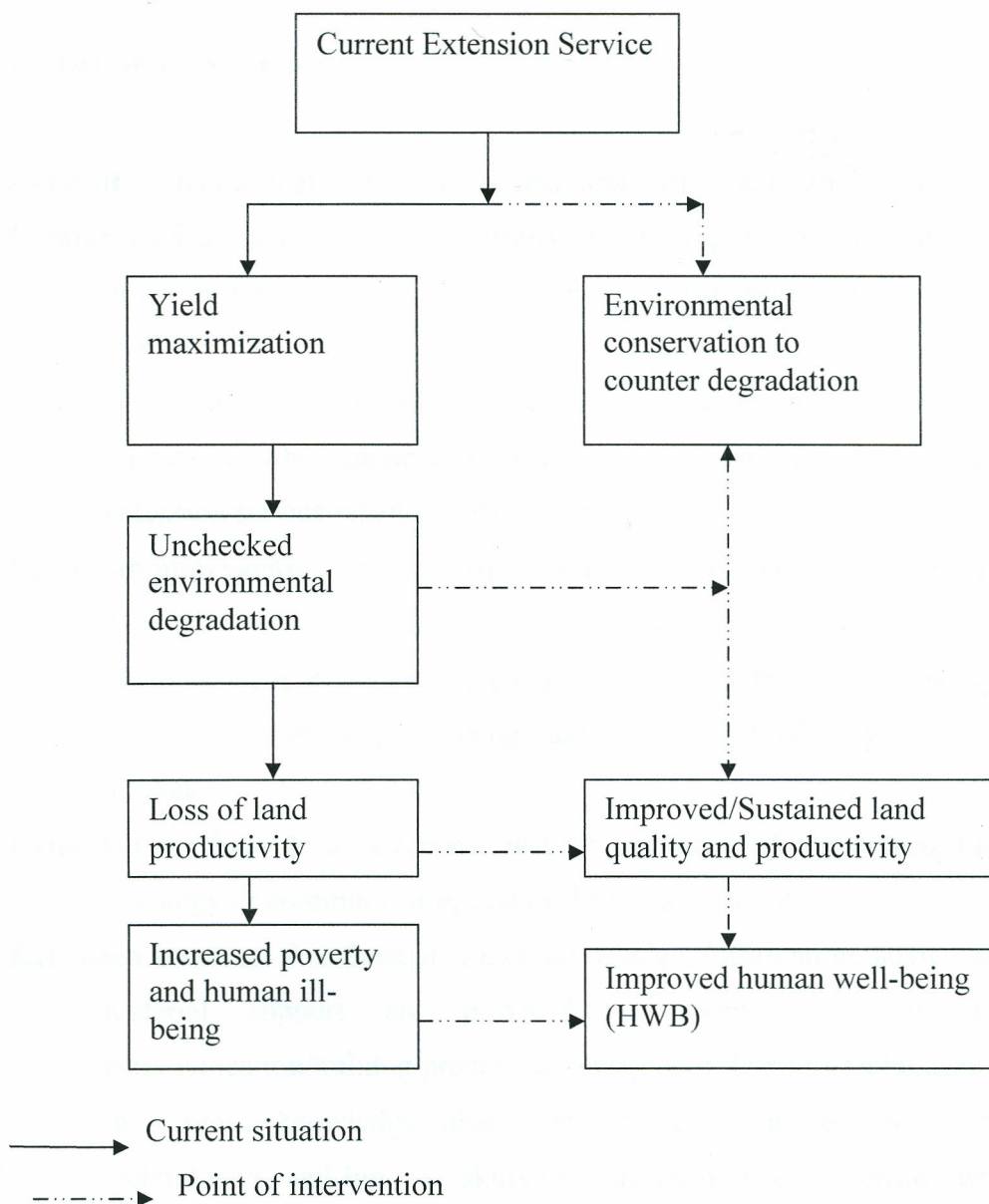


Figure 1.1 Current extension service-environment-HWB nexus (Source: Author)

1.7 Definition of Terms

Agriculture technologies: Knowledge and information that farmers access and use.

Commercialisation means that an extension service provided by a sector ministry will begin to operate on a commercial basis by recovering some or all of the service from the clients.

Extension agent is any person who delivers extension information or messages to farmers or who manages other extension agents in an organization providing extension service whether public or private.

Extension approaches: Style of managing an extension systems and includes, Farmers Training Centres, farmers field days, integrated rural development, farming systems, farm management, group, individual farmer, participatory, bottom-up, contact Farmer (e.g. Training and Visit), and multi-disciplinary pastoralist approach.

Extension method: Is a systematic way or technique of transferring knowledge and technology or communicating and exchanging information.

Extension services: Are those in which knowledge, information, advice and other non-material support are provided to clients. That is a two way communication/training process involving adult learning techniques whose aim is to improve knowledge, change attitude/behaviour, lead to adoption of new technologies, and improve skills for both farmers and extension workers, with a view of increasing and improving farmers incomes and productivity on a sustainable basis.

Extension systems: Extension services originating from institutions and organisation both public and private.

Green revolution: A series of technical innovations in food production that lead to a rapid increase in yields and production.

Human ill-being: A state of poverty which is lack or shortage of capital. It is deprivation of well being lacking material of a good life, physical weakness, vulnerable isolated and powerless.

Human well-being: A state comprising of basic material for a good life, freedom and choice, good health, good social relation and security.

National Agriculture and Livestock Extension Programme (NALEP): A framework. It is an umbrella framework for implementing agricultural extension projects in Kenya using the National Agricultural Extension Policy (NAEP) guidelines, both in private sector-based and public extension services.

National Agricultural Sector Extension Policy (NASEP): A revised. (NAEP) paves the way for more efficient and effective provision of extension through increasing commercialization and privatization of services and better co-ordination and regulation of services delivered by different service providers, thus contributing to the aims of the Strategy for Revitalizing Agriculture

Privatisation: It means that responsibility for providing an extension service will move from the public to the private sector which implies the public sector withdrawing from delivering a service and allowing the private sector to take over. Examples of extension services that are candidates for commercialisation and/or privatisation include advice and training to farmers growing commercial crops, and provision of market price information and marketing advice to clients who are adding value to agricultural and livestock products.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews various studies conducted in the area of environmental management in agricultural extension from global to local scenario. It highlights the achievements in the area and explores what challenges remain. The section starts with an overview of agricultural extension services, its history, practice and weaknesses in addressing environmental issues as reported in studies carried out in other areas. More specifically the chapter evaluates past studies in environmental management and agricultural extension with respect to integration of environmental considerations in agricultural development, farmer's level of implementation of environmental management practices on their farms, what hinders adequate and effective extension service provision for environmental management, challenges farmers face in implementing environmental management strategies and the adequacy of the Kenya's extension policy in addressing environmental issues at the farm level.

2.2 Overview of Extension Services in Agricultural Development

Extension services play an important role in dissemination of knowledge, technologies, information and linking farmers to other service providers (MoA, 2006). Extension is critical in transformation of subsistence farming to modern and commercial agriculture, which is key to promoting household food security, improving incomes and poverty alleviation (Alex et al, 2002). The vision of Kenya's extension service is to ensure that "Kenyan agricultural extension clientele demand and access appropriate quality extension services from the best providers and attain higher productivity, increased incomes and improved standard of living by 2015". The objective is to achieve a pluralistic, demand driven, efficient and effective extension service that is sustainable and responding to client's needs. It must respond and adapt to the changing macro-economic policies and the prevailing global trends (MoA, 2005c).

No single extension approach can be considered appropriate to address the needs of all agro-ecological zones and even those in use depend on factors such as agro-ecological zones (AEZ), farmer literacy level, enterprise mix, land tenure system, farmers'

resources, socio-cultural factors and farmers' needs. Over the years, the various extension players have used varying and multiple extension approach with varying levels of success. Such approaches have included progressive or model farmer approach, integrated agricultural rural development approach, farm management training and visit, attachment of officers to organisation, farming systems approach, farmer's field days and farmers training centres. Approaches emphasizing use of groups rather than individual farmers are recommended because of their relatively low cost in view of current low staff/farmer ratio in public extension service (MoA, 2001a). The move is towards participatory approach with a strong element of demand driven extension service (MoA, 2005a). However, there is variation in approaches depending on the extension system and cost effectiveness of the system (MoA, 2005e). The methods currently in use by both public and private sector extension providers include face-to-face extension on a one-to-one basis, on-farm demonstration, shows, field days, film shows, mobile training units, adaptive on-farm trials and mass media. Extension agents need participatory methods and communication skills to enable them effectively participate in passing various technical messages to farmers (MoA, 2005a).

2.3 Historical Development of Kenya's Agricultural Extension Services

The initial historical reference to extension in Kenya can be traced back to 1903, when the extension development activities started receiving attention through the then relevant department in the Ministry of agriculture, animal husbandry and natural resources. However prior to independence there were hardly any extension in African areas and the approaches used were coercive and regulatory approaches in de-stocking, soil and water conservation and strict control on livestock movement outside the African reserves. The coercion and regulatory approach included prohibition of production of high value agricultural production such as tea and coffee by Africans for fear of reduced quality of exports products and as such there was limited extension to Africans reserves. Land alienation resulted in badly eroded lands and consequently low agricultural productivity (Thomas et al, 1986). A change in extension approach came with the publication of 'A Plan to Intensify the Development of Agriculture in Kenya (Swynnerton, 1954), which

argued that communal tenure systems were an impediment to production decision-making on agriculture and proposed the process of land adjudication, consolidation and registration, and a vigorous programme of expansion of cash crops. In European farms, both commodity-based and general extension was available for settlers. Just prior to independence and after many settlers left the country, many farms were purchased for resettlement for Africans creating the need for more extension staff and prompting the Weir Commission on Agricultural extension (Muturi and Muya, 1994).

The vision of the Swynnerton plan in terms of neatly consolidated parcels for planning and technological innovations prompted the promotion of farm-based-extension approaches for the next 40 years. Many of these were implemented through donor-funded projects and programmes. The Whole-farm or Farm-management Extension Approach (WFEA) was a credit-tied approach in promoting introduction of cash enterprises in high potential areas in 1960s and 1970s (Harding, 1996). The farms were planned and farmers expected to apply farming business principles to repay input loans. The approach was not sustainable after loans were discontinued. This approach could not work in most areas where land was not consolidated (Holmberg, 1985).

The SIDA-supported Soil and Water Conservation Programme (NSWCP) started in 1974 and continued to 1999 starting with pilot districts in 1974 and increasingly incorporating more districts (MacDonald and Brown, 1999). The goal of NSWCP was to contribute to increased and sustainable agricultural production among small-scale farmers and pastoralists with a minimum or negative effect on the environment. The 'Catchments Area Approach' was started in 1987, with a catchments area being defined as 'an area with farming activities where farmers collectively agreed to conserve their individual parcels of land as well as communally utilized land.' Catchments planning were undertaken which included collection of data in a participatory manner (PRA), preparation of catchments maps/sketches, developing a conservation plan and development of catchments extension manual (GoK, 1995). By its closure in 1999, it had reached 1.7 million farmers throughout Kenya. This project was successful because of the participatory approach and NALEP has mostly borrowed from it (GoK, 2000b).

The World Bank-funded National Extension Project (NEP 1 and NEP1I) started in 1982 to 2001 (World Bank, 2003). It had three objectives namely the bridging of the gap between research and extension in speedy transfer of technology to farmers, raising technical knowledge of extension staff training in regular training and monthly workshops and increasing contact and follower farmers however in NEP II emphasis was put on farmer groups.

The NEP 1 and NEP 11 used mainly the Training and Visit (T&V) approach but incorporated other approaches to suit Kenyan conditions (Pretty, 1993). It covered 30 districts mostly in high potential areas. Its advantages were that extension agents spent more time with farmers with regular training which ensured that extension agents were up-to-date with technology, offered good logistical support and increased research extension linkages. However, it had several disadvantages such as lack of low cost technology relevant to small-scale farmers, use of fixed routes and contact farmers was not very effective, rigidity in the approach in relation to farmers changing needs, inadequate farmer participation, too much routine and repetitiveness and supply-driven approach and expensive to operate among others (Muyanga and Jayne, 2006).

The Farming Systems Approach to Extension started with pilot districts in 1991 and has been called by various names such as Farming Systems Research (FSR), Farming Systems Research and Extension (FSR/E), Farming Systems Development (FSD), Farming Systems Approach (FSA), On-farm Research with Farming Systems Perspective (OFR/FSP), On-Farm Client Orient Research (OFCOR), Cropping Systems Research (CSR), Agro-Ecosystems Analysis (AESAs) (MacDonald and Brown, 1999). These have the same goals and objectives, which recognize that farmers operated complex production systems, which need to be understood, need for identification of target group, technical and economic interactions, need for carrying out research in a farm environment and participatory approach to research among others.

The Kenya Agricultural Productivity Project under KARI has components on extension reform such as roles of various stakeholders, streamlining public extension, enhancing

capacity of non-public extension and increasing performance and sustainability and support to farmer/client Empowerment such as scaling up application of technology through farmers networks and build capacities of farmers' associations. The organization starts with Common Interest Group to Village Farmers Forum, Divisional Farmers Forum, and District Farmers Forum to the National Forum. This organization is similar to NALEP and they need to collaborate (MoA, 2006).

2.4 Evolution of Environmental Management at the Farm Level in Kenya

2.4.1 Pre-colonial era

A system of rational fallow shifting cultivation was used (Kenyatta, 1953). This allowed farmers to open up new fields every four or five seasons leaving the old one to lie fallow. The farmer was able to get a good crop while the land left fallow regenerated itself. The utilisation of land was neither haphazard nor unscientific. There existed an intimate knowledge of soil types and their sustainability for different crops. The farmers did not push their soils to produce crops that were ecologically unsuitable. Rather, to even out regional diversities and limitation, societies resorted to barter trade. What one area could not produce was acquired by trading one's surplus for the required produce from neighbouring communities (Kanogo, 1987).

Intercropping and crop rotation ranked high among the carefully thought out agricultural practices. Poor agricultural practices could not only jeopardize the ecological balance but would also result in reduced crop yield, thus food deficit leading to food insecurity at household level. Crop rotation was widely practiced because land was not a limiting factor. There was land set aside for various other uses such as firewood and public meeting places in addition to land for future expansion and buffer land between different ethnic groups (Kenyatta, 1953). Pre-colonial African communities did all they could to create sustainable co-existence with the ecosystem. Their selective utilisation of natural resources ensured that a workable environmental balance was maintained.

2.4.2 The colonial era

In the wake of colonial rule land tenure was redefined and huge tracks of land dubbed waste or unoccupied were seized by the state and leased or outright sold (Furedi, 1989). There was also introduction of waged labour, which drew men out of their families to earn wages. The commercialisation of labour coupled with commoditization of agricultural production and the alienation of land placed new tension on family members especially women and exerted pressure on land. The ecological imbalance was evident in early 1920s due to over utilisation of land in attempt to meet domestic and market needs coupled with inadequate rest period for the land (Kenyatta, 1953). As early as the 1930s the government had already started formulating ways of conserving the land. The colonial government viewed shifting cultivation as wasteful and embarked on a process of reorganising both the system of agriculture and tenure system. The constant use of rapidly decreasing land holdings resulted in the depletion of fertility of the soil. The pre-colonial fallow and shifting cultivation could no longer be practiced. Land was in short supply. Even where it was possible to practice shifting cultivation, the fallow periods became shorter and shorter as land holdings decreased over time due to constant subdivision. Crop rotation was no longer an option that was easily workable and this in turn had effect on soil fertility. There was growing concern over soil erosion and deteriorating natural resources in African areas, which became important enough to influence agricultural policy, even before the Second World War (Thomas et al, 1986, Muturi and Muya, 1994 and Mango, 2002). At the end of the Second World War, there was an atmosphere of crisis regarding the preservation of soil resources in the areas cultivated by Africans, many of which had deteriorated visibly during the war.

The colonial authorities addressed the problem of soil erosion by implementing district level bylaws specific to 'African-held land' and focused on coffee and cotton, cash crops that had been forced upon farmers. Farmers were not allowed to plough steep land, cultivate along stream channels or clear forests. Outside policies encouraged contour farming, tree planting on hillsides, terrace strip cropping and the de-stocking of herds, and certain areas were closed off to prevent grazing (Tiffen et al, 1994). Local chiefs, headmen and technical assistants were employed to ensure that these policies were

followed by the rural population (*ibid.*). The local administration and agricultural officials rigorously enforced these stipulations and stiff penalties were imposed on farmers who failed to comply.

With introduction of cash crops, which were neither edible nor intercroppable with any of the common staple crops, households were faced with increasing food insecurity. The colonial administration introduced into Kenya the concept of individual land ownership, which was alien to the traditional communal ownership system. One marked feature of adjudication consolidation and registration process of the 1950s was that women were not registered as owners of land thus decreasing their right over management of family holdings (Furedi, 1989). With increasing land shortage, the farming community was forced to plant crops on steep slopes. The cultivation of this fragile land portrayed farmers as ignorant, insensitive to or unwilling to adapt improved methods of agriculture. Soil erosion was evident due to over cropping and improved agricultural practices. The colonial government recruited male clan leaders to enforce soil conservation measures. This village patriarchs like the colonial government were insensitive to the intricate web of the peasant farmers simply because exhausted land could no longer be left fallow and the virgin land was non-existent. The farmers suffered a great deal in attempt to meet the demand of commercial and domestic production. This was evident during the period of the Second World War (Kanogo, 1987). In the period after the war, remedial soil conservation measures such as broad and narrow bench terracing, intercropping and reforestation of hilly slopes created much work than the colonial government anticipated.

2.4.3 Post Independence Extension

During the struggle for independence in the 1950s, resistance to coerced soil conservation became part of political agitation. Pro-independence politicians campaigned strongly against compelling people to construct soil conservation structures in their farms. Beside, the government was preoccupied with the consolidation of newly acquired political power and promoting growth and stability of economy (GoK, 1965). It was not therefore surprising that between 1963, when Kenya got independence, and 1972 continued government involvement in soil conservation became both politically and socially

untenable. More terraces disappeared than were being constructed, hence the term “lost years” (Holmberg, 1985, Gathuru, 1989 and Harding, 1996). Genuine concern and positive action had to wait a more conducive political atmosphere. Soil erosion consequently increased, causing such concern that a land use commission was set up in 1970, under the instruction of President Kenyatta, to address the increasing degradation of natural resources in the entire country, but it made slow progress.

Concern for the environment was placed on the global agenda in the early 1970s and Kenya, in a country paper at the United Nations Conference on Human Environment held in Stockholm in 1972, stated, in very clear terms, that land degradation was the major environment problem in the country (WCED, 1987). During the intervening two years, the government spelt out its policies and on soil conservation, which were translated into concrete programmes of action. This gave birth to the National Soil and Water Conservation Programme, launched in 1974 with support from the Swedish International Development Agency (SIDA) (Pretty, 1993). The main objective of NS&WCP was to increase and sustain agricultural production by introducing simple, cheap and effective conservation measures that could be carried out by the farmers themselves. The focus was on individual farms. Volunteer farmers were given extension advice and expected to adopt whichever beyond the initial extension phase.

In the 1980s, the Ministry of Agriculture, Livestock Development and Marketing adopted the Training and Visit (T&V) system to promote soil and water conservation techniques (MacDonald and Brown, 1999 and Pretty, 1993). However, extension agents were so overworked that they were barely able to give adequate conservation advice to farmers, let alone support for planning, surveying farms and installing conservation measures. Nonetheless, this approach did have a more positive impact than the former individual farm approach. T&V was replaced by the ‘catchment’ approach, which entailed groups of farmers suggesting how SWC policies might be implemented.

In 1987, it was decided that in spite of the commendable achievements of the project under the “free farmer’s choice” strategy, the programme could achieve more with

readjustment of the approach. It was felt that a strategy that addressed itself to the treatment of whole catchments would achieve results of the higher order, both quantitatively and qualitatively (Pretty, 1995 and Harding, 1996,). The benefits of the Catchment approach were viewed in terms of high visibility of the conservation effort, continuous treatment of farms, safe conveyance of excess run off in the high rainfall areas and water harvesting in Arid and Semi-Arid Lands (ASALs), implementation of soil conservation activities all year round, involvement of neighbouring farmers in decision making and implementation process and the development of a cadre of agriculturalists specialized in soil conservation. This latter aspect resulted in the formation of Divisional Planning Teams (DPTs) responsible for the planning and implementation of soil conservation measures within catchments. The DPTs are not engaged in other duties outside soil conservation. On the farmers' side are the members of the Catchment Committees elected by farmers.

Organisationally, DPTs moved to an identified catchment, discussed with farmers and local leaders the intended soil conservation activities publicized the intended activities. Encouraged the formation of Catchment Committees, conducted study tours to successful soil conservation areas, undertook PRA exercises and presented reports to the farmers, laid out the desired soil conservation measures, produced land use (soil conservation) plans and supervised implementation (GoK, 2000c). During the implementation process, the Catchment Committee acted as the vehicle for community participation in decision-making, implementation of conservation measures, monitoring, evaluation and maintenance of structures. The catchment approach to SWC came to an end in 1998 (Ericksen 1998).

In a promising move to marry the old approach with farmer needs, the National Agriculture and Livestock Extension Programme were launched in 2001. This SIDA funded programme retains the catchment approach (now called focal areas) but now follows a more demand driven holistic approach in which a range of technical experts are involved. Further, there is encouragement of common-interest groups so that there is more group training and mutual support.

2.5 Historical Impacts of Environmental Law in Kenya

In 1947 the United Nations Economic and Social Council adapted resolution 32 (VI) which inter alia recognized the importance of the world natural resources and techniques of conservation. This concern was enhanced by disastrous consequences of the Second World War and the rapid industrial growth after it. The world commission on environment and development equally recognized the need for environmental protection and man's right to a healthy environment. This commission pointed out that "All human beings have the fundamental right to an environment adequate for their health and well being and state shall conserve and use the environment and natural resources for the benefit and of present and future generation"(WCED, 1987). Sustainable development, which ensures that the needs of the present generations are met without compromising the needs of the future generation, calls for the change in economic and environmental policies and legislations as well as changes in institutions concerned with exploitation and management of natural resources, economic investments and population size and growth.

The law assumes a three dimensions rule in environmental management that is; it provides for the allocation of natural resources and the regulation of the exploitation and management. It also provides the sets standards, which are to be met, failing which, sanctions are provided. This is effectively carried out through a licence system where by, the licence holder is required to comply with the terms in the licence. Lastly, it establishes the mechanism for controlling the impact of human activities on the environment. This is carried out through the establishment of institutions, which are empowered to undertake measures to ensure environmental protection (GoK, 1983). Policy makers have the difficult task of making decisions, which promote development, but do not influence the environment. Therefore, environment legislation should seek to harmonise environmental conservation objectives and national development goals and aspirations. Environmental legislation should seek to deal with existing, future and recurring environmental problems, if sustainability is to be ensured.

The agricultural Act (Cap 318) is the principle legislation on agricultural use of land. It is also the only legislation, which makes provision for the conservation of the soil and its fertility. Its main objective includes promoting and maintaining a stable agriculture, to provide for the conservation of soil and its fertility and to stimulate the development of agricultural land in accordance with accepted practices of good land management and good husbandry. The Agricultural Act empowers the Minister of Agriculture to make rules and regulation regarding the general development of agricultural land. Thus, under Section 48, the minister may make land preservation rules for the regulation, control, and prohibition of clearing land for cultivation and grazing or watering of livestock. This protects the land against flood, landslides, and formation of gully or destruction of roads.

According to Sessional Paper No. 10 of 1965, the heritage of future generation depends on the adoption and implementation of policies to conserve natural resource and create the physical environment in which progress can be enjoyed. However, despite this policy statement of intent, environmental issues were not placed high on the government's agenda during the 1960's because the government was pre-occupied with consolidation of newly acquired political power and with promoting growth and stability of the economy. Towards the end of the 1960's, however several factors combined to force the Kenyan government to put action about environmental management. The government realized any long-term sustainable growth of its then two major foreign exchange earners i.e. cash crops and tourism were highly dependant on good environmental management. The effects of environmental degradation that had begun in the colonial era were becoming manifest with increased population and rapid expansion in agricultural land use and deforestation (GoK, 1965).

In 1971, Kenyan government set up an ad hoc working committee on Human Environment to review knowledge of environment and conservation requirements of Kenya (WCED, 1987). The report arising from the work of this committee was presented to the United Nations Conference on Human Environment at Stockholm in 1972 and may have contributed to the decision by the United Nations General Assembly in December

1972 to locate the newly created United Nations Environment Program (UNEP) in Nairobi.

Despite, government efforts to increase its conservation activities according to GoK (1974), by mid 1980 major environmental problems had been identified. By 1989, many legislations and environmental institutions were in existence and public awareness of environmental issues had increased. Yet, environmental degradation remained a serious problem as observed by Kiriro and Celestous (1991) in this regard that, despite the growth in environmental awareness the capacity of the country to integrate environmental considerations into development process is still limited.

The dilemma that now faces Kenya is a crisis on how to reshape the environmental agenda to meet the rapidly rising human needs while at the same time arresting the current trend of environmental degradation. The major policy issue is how to achieve sustainable development without further environmental degradation.

2.6 Environmental Considerations in Extension Services

2.6.1 Lessons from the Green Revolution

Over a period of nearly four decades, beginning in the 1940s, annual crop production rapidly increased in poor countries around the world. Between 1960 and 1985 cereal yields, total cereal production, and total food production in developing countries all more than doubled dubbed the green revolution (Eversion and Colin, 2003). The green revolution is a series of technical innovations in food production that can lead to a rapid increase in yields and production. It was very successful in Asia where the growth in food production was able to surpass rapid population growth thus avoiding predicted massive food shortage (Ibid). In Africa, however the Green revolution has not had such continuing success. After de-colonization, production (mostly hybrid seed and fertilizer) led to yield and production increases in East and Southern Africa (Byerlee and Helsey, 1997). Maize development was one of the major successes started in African agricultural development (Gerhart, 1975).

In mid eighties however, population increased rapidly leading in a reduction of food production per capita and the risk of large food deficits (Argwings, 1992). However since the liberalization of maize sector in Kenya, maize yields and production have increased. Fertilizers had become more available and cheaper and more farmers used them, and this excessive use of fertilizer lead to environment degradation, which had negative impacts on crop production (Argwings, 1999). Historical transformation of traditional farming methods began with a single public-private experiment with Mexican wheal. It quickly spread to corns, beans and rice rippling across hundreds of millions of cultivated acres through Latin America and Asia (Eicher, 1995). The Green Revolution however did not bestow a uniform blessing of all other parts of the world. Even in south Asia where the green revolution years saw so much growth, portion of the region still suffer from wide spread hunger and rural poverty. Consequently, Sub-Sahara Africa, which contains 16 of the 18 most under nourished countries in the world, remains the only region where per-capita food production continues to decline year by year (Everson and Colin, 2003). Some of the reasons for this gigantic gap in the benefits of the green revolution include science, training of local practitioner, public-private cooperation and improvement in government policy and practice (Tripp and Rohrback, 2001).

This did not happen without environmental cost characterized by overuse of farm inputs such as pesticides and fertilizers, which ended up polluting the agro ecosystems. The roots of this major achievement of the 20th century were among others aggressive training of farmers and agricultural research. However, the benefits were not universal. The Green Revolution stopped at Africa. Sub-Saharan Africa, which contains 16 of the 18 most undernourished countries in the world, remains the only region where per-capita food production continues to worsen year by year (Rockefeller, 2006). The majorities of Africa's population leads a rural lifestyle and predominantly depend on the natural resources in generally fragile ecosystems for their livelihood. In addition, most health issues in rural households are primarily related to environmental factors, like biological agents (e.g. bacteria and parasites), disease vectors (e.g. mosquitoes) and chemical agents, such as pesticides and other pollutants. The fact that linkages between environmental conditions, people's livelihood, people's health and poverty have not been

adequately addressed in agricultural extension implies that environmental issues need to be given urgent consideration in disseminating agricultural information to avoid a situation which is more likely to extend both environmental degradation and poverty. There is thus need for a second green revolution aimed squarely at Africa and conscious of environmental protection.

A second green revolution called for now is for Africa as long as issues such as the following are in place, scientific development of more productive crops and fertilizers, cultivation of local talent in plant science, farming, agricultural policy and business, strong commitment from national government, public-private collaboration on infrastructure, water and irrigation, environment and building market for the inputs and output of revolutionized farm sector. However, this scenario is very different in Kenya especially in Meru South since the farming is largely subsistence. In good years, a small surplus might be bartered or sold locally, but due to lack of warehouse or processing companies to preserve excess crop for later sale and transportation to city markets over poor roadways is difficult, costly, time consuming and sometimes dangerous. There is no irrigation and lack of finances to buy chemicals and fertilisers and thus the farm depend on nature for water and fertilisers (GoK, 2005 and GoK, 2006). In a bad year due to any combination of pestilence, disease, environmental degradation, drought or other hostile weather, the farmers and their families will go hungry.

2.6.2 Agricultural and Environmental Degradation

In Africa, agricultural activity including cultivation and keeping livestock is still central to the livelihoods of many communities across the continent. Two-thirds of sub-Saharan Africa's population lives in rural areas and is dependent directly or indirectly on agriculture for food, income and employment (Minde, 2003). The pursuit of the attainment of the Millennium Development Goals (MDGs) in Africa will involve intensification of agricultural activities. However, there have been growing concerns worldwide that the agricultural intensification process to meet the needs of the increasing population leads to degradation of the environment generally and natural resources

specifically. Intensive use of fertilizers, pesticides, high yielding crop varieties and mechanical technology, as well as excessive stocking rates on pasture lands have led to increased deforestation, soil erosion, desertification, water-logging and salinization of soils, contamination of surface and ground water and other forms of natural resource degradation in recent decades (Ibid).

It is estimated that almost two billion hectares of land worldwide have been degraded in the past 45 years (Oldeman et al, 1990). This is equivalent to about 17 percent of the world's soil that are covered by vegetation. About 17 million hectares of forests are cut down each year, of which about five million are in Africa. The rate of deforestation is estimated to be 0.8% in Africa per year. This deforestation greatly accelerates soil erosion, siltation of water bodies, and flooding. Deforestation also leads to loss of forest products used directly by the poor for food or as a source of livelihoods.

Overgrazing and deforestation are the cause of almost two-thirds of the soil degradation worldwide (Oldeman et al, 1990). Overexploitation for fuel wood accounts for another 7 percent of degraded soils, while faulty agricultural practices are responsible for 28 percent of soil degradation. In Africa, overgrazing, deforestation and over exploitation for fuel wood result, to a large extent, from poverty and lack of opportunities for agricultural intensification. About 70% of soil degradation is caused by these activities. Overgrazing accounts for nearly half of the degraded soils in Africa, while faulty agricultural practices accounts for about a quarter. This again underscores the close relationship between poverty and environmental degradation (Ibid).

The combination of distorted economic policies, population pressure, and low income is leading to cultivation of ever more fragile lands as people struggle to survive. As a result, environmental damage is increasing and agricultural productivity is declining. This nexus among poverty, population and environment is already one of the most important social and economic issues for Africa's future (Cleaver and Schreider, 1994). With increasing population and large numbers of poor in rural areas, efforts to protect or restore the environment become increasingly important and urgent but also costly. It is also

generally agreed that agricultural intensification, per se, need not degrade the environment. It is the inappropriate or mismanaged agricultural intensification, such as overgrazing or untimely application of fertilizer that may lead to environmental degradation. The most serious environmental problem in Africa may not be inappropriate technological change in agriculture, but the many people who live in absolute poverty. Rural poverty, coupled with increasing population densities and inadequate agricultural intensification is responsible for much of the forced exploitation and consequent degradation of environmentally fragile lands leading to soil erosion, flooding, and loss of vegetative cover observed in many parts of Africa. Such degradation will therefore not be prevented by reducing agricultural intensification alone, but rather by a strategy based on alleviation of poverty (Ibid).

The number and proportion of the poor is expected to continue to increase in Africa in the foreseeable future (Pinstrup-Andersen and Pandya-Lorch, 1994). Leonard (1989) estimated that 60 percent of the poorest of the poor live in rural or urban areas of high ecological vulnerability. The linkages between environment, poverty and agricultural activities must therefore be properly put in perspective in Africa. Agricultural activities whether intensive or extensive, affect the environment. Environmental degradation, in turn can compromise current agricultural productivity, undermine future production and perpetuate poverty. Thus poverty may accelerate environmental degradation, while environmental degradation causes poverty. This results in a self-perpetuating negative cycle (Pinstrup-Andersen and Pandya-Lorch, 1994). Poor people often lack sufficient incomes or access to credit to purchase appropriate tools and materials, inputs such as fertilizer and intensive technologies in order to practice environmentally sustainable food production techniques, to protect natural resources against degradation, or to rehabilitate degraded resources. They often do not own the resources nor reap the benefits of conservation practices. They therefore have little incentive to conserve these resources.

There are other factors in Africa, which worsen the cyclic relationship between poverty and environmental degradation. The poor tend to lose their capacity to sustainably support themselves when their access to resources is diminished or available resources

are reduced. In such cases their engagement in environment degrading activities increases. For instance poor people in Africa are often displaced by population pressure, reducing their access to land. There may be misappropriation of common resources by other claimants. Activities such as construction of dams and creation of wildlife reserves that take land and water resources away from the poor may lead to increased reliance on fragile marginal lands such as steep slopes, hillsides or dry lands. This leads to increased cutting down of trees for agricultural activities and fuel wood (Leonard, 1989). These actions in turn lead to faster rates of soil degradation, loss of soil nutrients, flooding, siltation of rivers and other ecological problems. This initiates a vicious cycle of environmental degradation and poverty.

Rapid population growth is a key catalyst of poverty led environmental degradation, especially in marginal lands. In Kenya, for instance, population pressure in the fertile highlands has forced people to move into drier areas to settle near dependable water sources and to farmland that is more suitable for pastoralism. Pastoralists in turn have been displaced and forced to compete for land and water. Overall this situation has led to overuse and degradation of resources (Kates and Haarman, 1991). In Africa, perhaps more than in other continents, wars and civil strife, together with natural disasters such as droughts, worsen the situation of the poor. These calamities force the predominantly poor populations to become more mobile. Consequently the risk of environmental damage increases. This is partly due to the movement itself of people on already fragile land and partly from the choice of the final destination of the migrants. Due to their poverty situation, they usually end up in marginal lands that are not heavily settled. As populations concentrate in such areas, they invariably speed up the degradation process.

The poorest often suffer most from the consequences of environmental degradation because of their immediate dependence on the natural resource base for their basic necessities such as food, energy, water and housing. Much of the income of the rural poor is derived from natural resources and environment-dependent agricultural activities. Low and declining soil fertility is a serious problem in many low-income countries including most of Africa (Pinstrup-Andersen et al, 1999). Failure to combine appropriate

application of farming technologies with agro-ecological methods is likely to result in further declines in soil fertility and crop yields to the detriment of the livelihoods of small-scale farmers in Africa.

2.7 Constraints in Implementing Environmental Conservation Technologies

Traditional extension services have advocated for and propagated various environmental conservation technologies with various degrees of success. This depends on various socio-economic and environmental factors affecting farmers both at national and farm level. On the basis of empirical studies, it is difficult to draw conclusions about the most important factors that affect adoption of technologies. Reviews by Franzel (1999) indicate that several factors are likely to affect adoption of innovations especially related to agro-forestry which include biophysical adaptation of the innovation which looks at the ability of the innovation to adapt and be adapted successfully to the farm environment, profitability of the innovation which considers return to labour and land as well as financial profitability. Others include farmers awareness of the innovations, access to land, labour and water, access to social capital particularly where group action is needed, availability of essential inputs, access to financial capital, and the degree of risk and uncertainty.

Bunch (1982) highlights a number of considerations that should be made in communicating and choosing appropriate technologies for farmers. The technology must answer the farmers' needs so well that they feel its addressing them. An innovation must in some way attack the limiting factor or factors in the local farming systems if it is to increase the systems productivity. Considering that different farmers have different needs that need a solution, any programme must offer diverse options for all the farmers needs. A subsistence farmer becomes interested in an innovation only if it promises them a substantial and dependable increase in either food supply or income at local prices. Moreover resource poor farmers will tend to prefer labour intensive innovations as opposed to capital-intensive technologies that are preferred by farmers endowed with fairly large amounts of capital endowment. Environmental conservation technologies

must therefore yield increased food production and income generation at farm level for them to be adopted.

Technology for smallholder farmers especially must be able to use locally available materials and resources. When outside materials are indispensable, they must be easy to obtain on permanent reliable basis and must be inexpensive. Sustainable use of locally available resources is also important to ensure continuity in getting the intended benefits. Other factors include the ease at which the technology can be learnt. Technologies easy to understand are easily adopted than the complex ones. They must also be culturally acceptable and requiring minimum onsite supervision. According to Haverkort et al (1991), the role of women in agricultural production has often been neglected and many technical interventions have been inappropriate because they fail to meet women needs and priorities. Women have limited access to training activities due to their often-tight daily calendars. Top down approaches have been used for a long time with information flowing from the extension agents mainly to male farmers who are more available to attend community functions.

2.8 Factors Hindering Environmental Extension Services

In Africa poverty has been exacerbated by several major problems such as rural women who are largely responsible for feeding their families and lack access to land tenure and education. The impact of HIV/AIDS on productivity is enormous affecting the availability of family labour as well as the resources that are devoted to caring for the victims. It is also reported that Africa is the only remaining region of the world where per capita food production has remained stagnant over the past forty years (Buresh et al, 1997) and absolute poverty which is characterized by income of less than US\$ 1 per person per day is coupled with increasingly damaged resource base (Andersen et al, 1999).

Food security and its relationship to sustainable agricultural and rural development have increasingly become matters of concern for developing countries and for the international

community. While there are many complex factors that influence sustainable development and food security, it is clear that agricultural extension plays an important role in preparing farmers to increase farm production. According to Rogers (1996), poor training of agricultural extension staff has been identified as part of the problem of the relative ineffectiveness of much of extension in the field.

Implementing sustainable development and meeting the food needs of an increasing world population remains a major challenge of the 21st century. The technologies and management practices that slow down degradation and protect the resource base are often not available in many regions, or are not adopted when they are available (FAO, 1996). Another challenge extension services face is promoting sustainable development while at the same time ensuring the sustainability of extension services in the face of limited budgetary allocations from the government.

According to Roling and Engel (1989), there are three major lessons for agricultural extension. First, it is important to make new things visible. An important role of extension is to make visible the state of the environment and the extent to which present farming practices are untenable. In addition, extension can demonstrate the feasibility of sustainable practices. Even more important is to give farmers the tools for observation and to train them to monitor the situation on their own farms. The second lesson is the use of farmers' knowledge. The location-specific nature of sustainable agriculture implies that extension must make use of farmers' knowledge and work together with farmers. Often, indigenous practices, which have been ignored under the impact of chemical farming, can be fruitfully revived. Indigenous technology development practices and farmer experimentation can be an important "entry point" for introducing sustainable farming practices (Brouwers and Roling, 1989). The third lesson is an emphasis on facilitating learning. Instead of transferring technology, extension workers must help farming "walks the learning path". Extension workers should seek to understand the learning process, provide expert advice where required, convene and create learning groups, and help farmers overcome major hurdles in adapting their farms.

The problem with agricultural science and extension is that it has poorly understood the nature of indigenous and rural people's knowledge (Chambers et al, 1989). For many, what rural people know is assumed primitive, unscientific or overtaken by development, and so formal research and extension must transform what they know to develop them. An alternative view is that local knowledge is a valuable and underused resource, which can be studied, collected and incorporated into development activities. Neither of these views, though, is entirely satisfactory because of the static view of knowledge implied (Roling and Engel, 1989, Warren, 1991, Long and Long, 1992 and Scoones and Thompson, 1994). It is more important to recognize that local people are always involved in active learning, in inventing technologies, in adapting their farming systems and livelihood strategies. Understanding and supporting these, processes of agricultural innovation and experimentation have become an important focus in facilitating more sustainable agriculture with its strong locality-specific nature.

The idea of “sustainable development” emerged from policy discussions at the United Nations throughout the 1980s and was popularised in the lead-up to the UN’s high-profile environment and development summit in Rio de Janeiro in 1992 (Jacobs, 1995). Merging the language of long-term sustainability with environmental protection is inevitable for sustainability in development. This is also emphasized in the UN Millennium Development Goal number seven, which requires countries to integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. The notion of environmental sustainability as an alternative to limitless economic growth was justified since the environment and development are inextricably linked. International discussions have shifted from how to stem environmental destruction to finding new ways to sustain economic growth. Higher human and animal populations have resulted in additional agricultural activities and higher wood-fuel consumption rates leading to increased soil erosion, deforestation and soil and water contamination. Environmental destruction of landscapes, changes of streams and river courses, flooding, droughts and beach erosion affect development of sustainable agricultural production in various ways. To ensure sustainable agricultural

development, in Meru south district and in Kenya as a whole, problems relating to environmental management needs to be addressed. To address these problems effectively, the opportunities and challenges towards this course should be assessed which is the broad objective of this study.

2.9 Policy Trends in Extension Services Delivery in Kenya

The National Agricultural Extension Policy (NAEP) was published in 2001. Modalities for putting NAEP into effect were set out in the National Agriculture and Livestock Extension Programme Implementation Framework (NALEP-IF). Key policy goals of NAEP were the emergence of extension systems that are demand-driven by farmers and other clients and deliver high quality services, a greater role for the private sector in delivery of services, and progressive commercialisation and privatisation of public sector extension (MoA, 2001a).

The Economic Recovery Strategy for Wealth and Employment Creation (ERS-WEC) recognises the pivotal role played by the agricultural sector in economic growth (GoK, 2003). The sector contributes more than a half of the country's gross domestic product (GDP) and accounts for about 60 percent of export earnings and 45 percent of government. Consequently, the Agricultural Sector Ministries (ASMs) spearheaded the formulation of a Strategy for Revitalizing Agriculture (SRA). Reforming and strengthening the provision of extension services in the agriculture sector is among the six areas to be tracked as part of SRA implementation. This requires institutional and functional changes in order to improve extension system delivery. The SRA outlines ways to transform the agricultural sector to encompass profitable, commercially oriented and internationally competitive economic undertakings. For the sector to contribute to general economic growth and poverty reduction, the Economic Recovery Strategy (ERS) had set a target of an annual average growth rate of 3.1% for the agricultural sector to reach above 5% by 2007 (MoA, 2004). Government has therefore categorised extension service as one of the priority functions of the agriculture and rural development sector

and is catered for in the Medium Term Expenditure Framework (MTEF) budget approach.

The agriculture sector ministries engaged key stakeholders in the country to review the National Agricultural Extension Policy (NAEP), which was formulated in 2001 to come up with a more sector-wide policy as spelt out in the National Agricultural Sector Extension Policy (NASEP) (MoA, 2005e). The revised policy draws lessons from previous experiences and addresses challenges precipitated by economic liberalization, rapid changes in extension clientele expectations, and reduced public financing of extension services. The new policy spells out modalities for effective agricultural extension management and organisation in a pluralistic system where both public and private service providers are active participants. It also provides a point of reference for service providers and other stakeholders on matters of standards, ethics and approaches and guides all players on how to strengthen coordination, partnership and collaboration.

Given the changes that had taken place since 2001, which led to the formulation of SRA and the strategies for the sector ministries, it was inevitable that NAEP had to be revised. The revision of NAEP, which culminated in a broader sector wide policy, the National Agricultural Sector Extension Policy (NASEP), was preceded by a review of NAEP and NALEP in 2004 (MoA, 2005c). The review concluded that NAEP and its implementation faced important constraints, which NASEP seeks to address. Appropriate institutional arrangements and legal frameworks were not put in place, the policy was not widely owned by stakeholders outside (and in some cases within) the sector ministries, and resources needed to give effect to key policy provisions were slow to materialise. The National Agriculture Sector Extension Policy Implementation Framework (NASEP-IF), spells out the implementation strategy of this policy with clear outline of the institutional framework, management and financing strategies; and procedures for the extension services within the sector. The NASEP-IF also details the set up, resource sources and operational procedures of the stakeholder-driven Trust Fund for extension services in the country.

The National Agricultural Sector Extension Policy (NASEP) paves the way for more efficient and effective provision of extension through increasing commercialisation and privatisation of services and better co-ordination and regulation of services delivered by different service providers, thus contributing to the aims of the Strategy for Revitalising Agriculture. The NASEP Implementation Framework sets out the modalities for putting NASEP into effect. The long-term goal is to have private sector-led and fully commercialised extension service such as that already provided by private companies like British American Tobacco and the Kenya Creameries Cooperatives in Dairy. However, since the immediate application of this model is limited to high value and readily marketable enterprises, government will continue playing an active role in other enterprises and/or disadvantaged communities through offering fully subsidised public extension services; with the intention of gradually withdrawing and/or partially charging for the offered services (i.e. privatisation and commercialisation of services). Even in enterprises/areas where services are fully subsidised, government will increasingly outsource from the private sector and higher learning and research institutions (e.g. universities) as a means of building the capacity of the sector (MoA, 2005a).

Extension service providers will address all relevant crosscutting issues in their programmes such as HIV/AIDS, extension clientele and farmers' rights, sustainable environment and natural resources management, gender identification and targeting vulnerable groups and security, community conflict mitigation and resolution. For example all extension service providers will mainstream environment and natural resources-related issues in extension messages by imparting knowledge on good practices on water catchments management, soil and water conservation, agro-forestry and wetland utilization, appropriate land use allocation and management of economically viable production units (rational crop land and grazing/ranch sub-division), existing initiatives by other stakeholders on community-based natural resource management plans for land use, wildlife, fisheries, forestry, livestock, and importance of community disaster preparedness and link them with relevant institutions involved in early warning and disaster preparedness (Ibid).

CHAPTER 3: METHODOLOGY

3.1 Study Area Characteristics

Meru South district is one of the districts in eastern province. It borders Meru Central to the north, Embu to the south, Tharaka and Mbeere to the east, Kirinyaga and Nyeri to the west. It lies between latitudes 00 07' 23" and 00 26' 19" south and longitude 37 18' 37" and 37 28' 33" east. It occupies 1092 km² and this includes 360 km² of Mount Kenya forest. The district is divided into five administrative divisions namely Chuka, Magumoni, Igamba ngombe, Muthambi and Mwimbi. Meru South district lies between 5199 metres above sea level at the peak of Mount Kenya and 500 metres above sea level in the eastern part of the district. The cultivated area however lies between 2200 metres above sea level and 500 metres above sea level. The great range of altitude gives a diverse range of agro-ecological zones including tropical alpine forests (Figure 3.1).

The study area lies in the LH 1 agro-ecological zone also called the forest/tea-dairy zone, which is temperate and humid with an annual average precipitation of at least 80% of the potential vapour-transpiration and the UM 2 agricultural zone, which is also called the main coffee zone, which is temperate and sub-humid as shown in table 3.1. The district is humid with an average annual rainfall of 1250-2500mm (Jaetzold and Schmidt, 1983). The rainfall pattern is bimodal, with the long rains beginning March and end in May while short rains start in October and end in December. Annual average temperature range from below freezing on top of Mount Kenya, to over 27⁰C in the lower areas. The mean annual temperature is 25⁰C.

The district can geologically be separated into the volcanic western part and basement system in the eastern part. The volcanic part has ridges on the middle and lower slopes of Mt Kenya with uplands and scattered plateaus. The basement system shows several different landforms such as hills, uplands, plateaus and valleys. The soils of the ridges are derived from volcanic parent material and are very deep red clay (nitisols) and andosols). The soils of the volcanic plateau are moderately deep to shallow with various textures. The soils derived from the basement system rocks are predominantly moderately deep to shallow with loam to clay textures (cambisols, lavisols and regosols). The soils of the

hills are very shallow and rocky (leptosols). The exact natural vegetation reflects soil altitude, relief and climate.

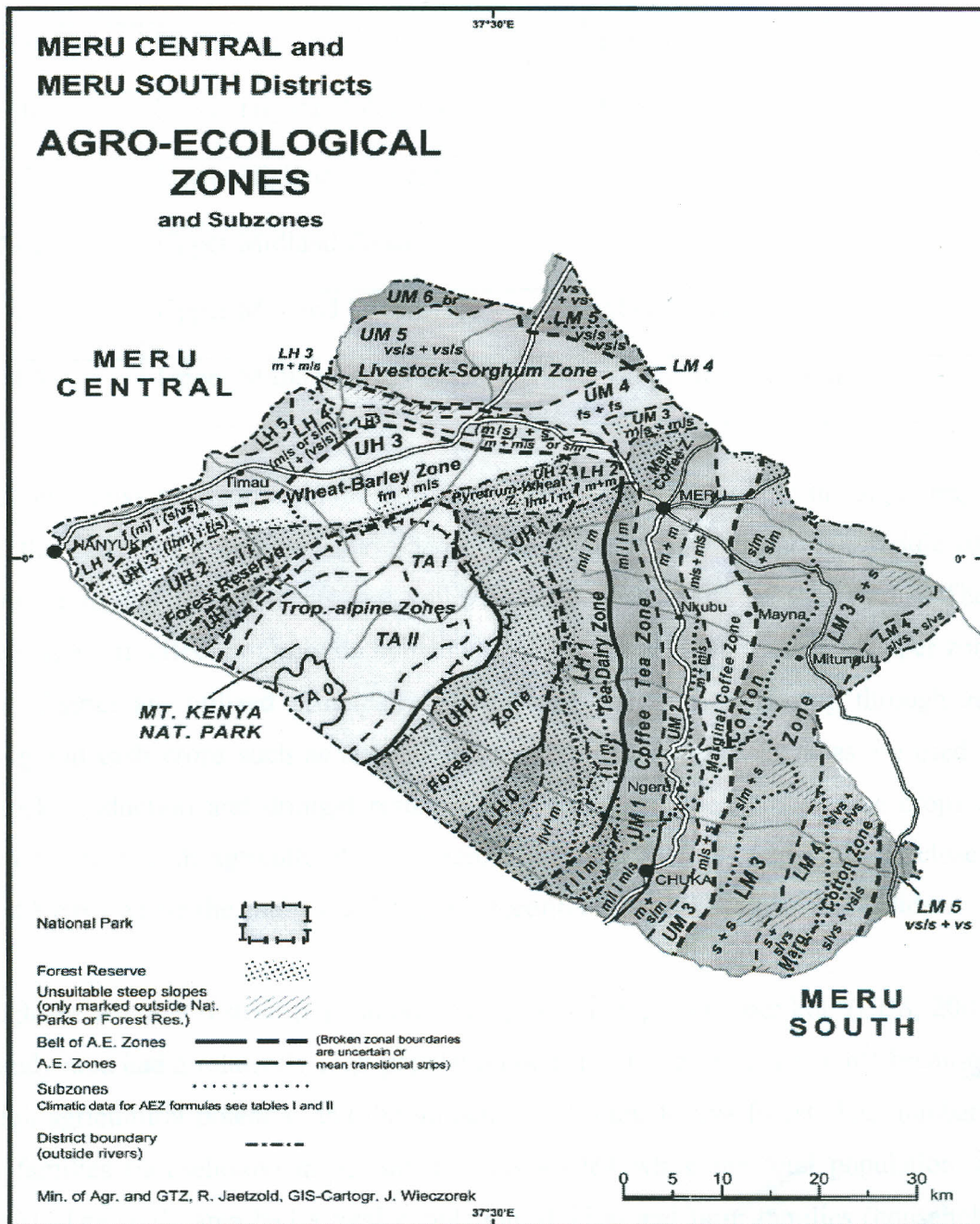


Figure 3.1 Agro-ecological zones of Meru South (Jaetzold et al, 2007)

Legend for figure 3.1

Symbols	Agro-Ecological Zones	Land use systems description
TA	Tropical Alpine TAO TA1 TA11	Snow
UH 0	Upper Highland Zone(0)	Forest
LH 0	Lower Highland Zone(0)	Forest
LH 1	Lower Highland Zone(1)	Forest/tea –Dairy zone
UM 1	Upper Midland Zone(1)	Tea/coffee zone
UM 2	Upper Midland Zone(2)	Main coffee zone
UM 3	Upper Midland Zone(3)	Marginal coffee zone

The diverse physical features in the district are Mount Kenya, slopes in the upper region, rivers that have cut V-shaped valleys and ridges from the mountain to the middle parts and the hills, uplands, plateaus and valleys in the lower parts of the district. These features have an effect not only on human settlement but also land use. The upper zones of the district are utilized principally for growing food, cattle rearing through zero grazing and cash crops such as tea and coffee while the lower drier areas are used for livestock production and drought resistant cash crops and food crops. Tree crops are grown together with agricultural crops across the region. The steeper slopes close to Mount Kenya where the study area lies are susceptible to soil erosion and landslides.

Though the average district population density was 188 persons per km² (CBS, 2001b) the study area had a relatively high population density (481 persons per km²) because of its high agricultural potential and the influence of Mount Kenya forest. The number of farm families (households) in the district was 46,984 while the total population was 205,451. The study area had a total population of 7366 and farm families (households) were 1710.

The study area is largely inhabited by the Meru community. The community has a clear history dating back to 1914 during wars between Chuka and Muthambi before the

coming of the colonialists. Several historical events have been reported in the community such as major famines, introduction of education, emergency wars, introduction of crops such as coffee and tea, ban of female circumcision by Njuri Njeke, food and politics of the area. Land tenure is mainly individual ownership with farmers owning title deeds. Several associations and groups exist in the community including the Faith Based Organisation (FBO), Women groups among others. The community also appreciates the need for registering their groups through the social service department. Decision making in the households involves both men and women. Women mainly do food crops decisions while cash crops decisions are by men.

The choice of the area was because Mitheru Location is an intensively cultivated region where effects of land and population pressure interaction may be among the most severe in the country. The area has been characterized by low farm production since the mid 1980's. This has been attributed to a number of factors including the ever-shrinking farm sizes due to land subdivision as the population pressure increases. It is a tradition that every parent provides a piece of land to his sons, as they become 18 years of age. Lack of improved seeds and innovative farming methods to counter the exhausted farms is seen to be a major problem. The government supported agricultural extension services, which were once vibrant, have also decreased drastically due to reforms among others. Previous environmental conservation approaches portrayed conservation efforts as legal requirements without making the farmer understand its implication on agricultural productivity. No formal study has been done in this area to understand the challenges farmers and agricultural extension agents go through in their bid to integrate environmental aspects in agricultural extension for sustainable development.

3.2 Study Design

This study was in nature descriptive and adopted a survey approach, borrowing heavily from SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) for both the extension service and the farming communities towards sustainable agricultural development and environmental management. The study adapted descriptive methods of

research as explained by (Handrick et al, 1993). A survey approach using Participatory Rural Appraisal tools was used to enhance community participation.

3.3 Target Population and Sampling Procedure

The target population consisted of key stakeholders in extension, thus: local farmers, community leaders, provincial administration, and public and private extension agents. Among the farming community, households and the farm were the basic unit of analysis and household head the unit of observation. Four villages within the location were randomly selected for the study using simple random sampling, thus: Mugona, Kanyakine, Kiini and Muthenge. A sample size of 172 respondents was randomly selected from the accessible population of the farming community for data collection. The sample size determination was based on baseline information for households in Meru South District (CBS, 2001b). This being a descriptive research ten percent of the accessible population was enough to obtain the desired results (Mugenda and Mugenda, 2003). Forty-three respondents were randomly selected from each of the four selected villages in the study area. Purposive sampling was used to identify key informants from relevant line ministries, civil society, contact farmers and local administration.

3.4 Data Collection Techniques and Instruments

Both quantitative and qualitative data were collected using questionnaires. A researcher-administered questionnaire was carried out to individual head of each household (Appendix 1). Each of the household sampled was visited with the help of the FEW and one key informant per village. This comprised the main survey. The head of each household was mainly the male unless where the woman was widowed. Both closed and open-ended questions were used. Open-ended questions were meant to give the respondents an opportunity to think critically on the questions asked and give chance for a wide range of responses. On the other hand, closed ended questions were meant to elicit specific responses without additional explanations.

Key informant questionnaire was used to collect data from extension service providers in the area chosen purposively to represent both private and public sectors. Data collected covered the full range of issues in line with the study objectives (Appendix 2).

Participatory Rural Appraisal tools included focus group discussions, key informant interviews, observations by the researcher and participatory transect walk. The FEW and key informants were used to invite the participants of Focus group discussions (FGD). The FGD began with an introduction, where the purposes of the discussions were explained to the participants. The FGD were conducted mainly to explain, reinforce and enrich survey results. One focus group discussion was conducted in each of the sampled villages and twenty-five participants per village were picked to form the participating groups. These included farmers, extension agents and community leaders. Each of the groups was engaged in a free discussion, which centred on land use, opportunities and challenges facing them in agricultural production systems and environmental management, messages and technologies received from extension agents and existing policies. The researcher took notes of group contribution while the FEW facilitated the discussion. However, in order to answer the research questions, probing questions were also used. Community leaders and other civic leaders were selected based on having in-depth knowledge on the issues in the study objectives and who had lived in the area for over ten years.

The quality status of the land/environment was assessed through participatory transect walks and observations. Participants in the transect walk included four local community members who had stayed in the area for over fifteen years and thus had in-depth knowledge on the issues observed. Responses were recorded on a pre-designed observation sheet. The key informants were interviewed through a tailor made interview schedule to verify the results from the questionnaire, FGD and observations made during transect walk.

3.5 Data Management and Analysis Method

The questionnaires were first examined to ensure it was complete and had been consistently filled in. Both quantitative and qualitative data from questionnaires was first cleaned and coded. The quantitative data was then entered into a Microsoft excel worksheet and copied to statistical package for social science (SPSS) for analysis. Data

was analysed using descriptive and inferential statistics. Descriptive analysis included frequency distribution and percentages were derived from the responses. Inferential analysis involved comparison of the relationship between various socio-economic factors such as age, gender, income, land size and farmer's education level and their perception on various issues in agricultural extension and environmental conservation using Pearson's correlation coefficient (r). The qualitative data was discussed under themes consistent with the objectives of the study. A SWOT analysis, content analysis and in-depth probing were also used to make sense of the qualitative data, including secondary data such as the extension policy documents.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of the data analysis in a systematic way consistent with the study objectives. Starting with an overview of socio-economic and environmental status of research area, results of the data analysis are presented for each objective. Discussions based on the information contained in the results are also made, conveying the meaning of the findings by linking to other sections of the study such as objectives and literature reviewed. Where applicable results supported by or contradicting other studies are also pointed out.

4.2 Overview of Socio-Economic and Environmental Status of Study Area

4.2.1 Socio-economic sphere

The average population density in the study area is 481 persons per km² (Central Bureau of Statistics, 2001) and has been increasing over the years. Increase in population is a major challenge to agricultural productivity in the area as much pressure for settlement is being put on available arable land. According to Kates and Haarman (1991), rapid population growth is a key catalyst of poverty led environmental degradation. However Tiffen et al (1994) felt otherwise '*More people, less erosion*'. Frequent subdivision of land parcels has led to uneconomical units (0.5acre) that would ultimately undermine food security and community livelihoods. There was a negative correlation between land size and population ($r=-0.30$, $n=172$, $p=0.01$). Land size was related to other variables as indicated in the table 4.1.

Sub-division of land into other independent farms gives rise to farms each with its specific shape, boundaries and its own requirements. This sub-division of land followed with de-stabilisation of the previous farm lay-out had a negative impact on the sustainability of the environmental conservation measures/structures. This problem was aggravated by lack of provision for follow-up and monitoring by the extension agents who are thinly spread on the ground.

Table 4.1 Pearson's correlation coefficient between land size and other variables

Variable	(r) Values at n=172
1. Extension services related to marketing	-0.16*
2. Population pressure	-0.30**
3. Culture	-0.17*
4. Poor information transfer	-0.16*
5. Agro forestry	0.18*
6. Good farm layout	-0.18*
7. Contour farming	0.19*
8. Crop cover	0.19*
9. Mulching	0.19*
10. Zero grazing	0.19*
11. Terracing	0.19*
12. River banks protection	0.19*
13. Soil fertility improvement	0.20*

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

It was noted that only 24% of sampled 172 households were female headed while the rest were male headed (Table 4.2). The society is highly patriarchal where gender roles dictated that men are household heads who made decisions regarding the family resources including land.

According to Eulalia (2004), women in particular are viewed as powerless because of their non-valued and unmarketable laws of general family care and management of the household and its members. It was noted that even though 76% of sampled population was male headed, the real farm managers were women who could not make any decision on farm practices. This was also noted in female headed households who only made decision on routine family practices but when it came to major decision such as, land subdivision and ownership, terrace excavation, tree planting, sales of trees and livestock they had to consult a male member of the family or their sons. Women were left to take reproductive, hospitality and farming roles.

Table 4.2 Socio-economic characteristics of the sampled population

Item	% Frequency
Age:	
18-40	21
> 40	79
Gender:	
Female	24
Male:	76
Education:	
Pre-primary	25
Primary	38
Secondary	30
Tertiary	7
Occupation:	
Farming	93
Employment	6
Business	1
Income per month:	
< Ksh 1500	75
1501-4500	16
> 4500	9
Land Size:	
5 acres	26
2-5 acres	3
0-2 acres	71

As such, decisions regarding adoption of environmental conservation technologies were mainly made by men who did interact with land intimately as did the women. Degradation of the environment thus tends to occur as women adopt a wait and see attitude. Similar observations were made in Ndome and Ghazi by Waswa et al (2002). In addition, as long as re-forestation programmes are directed towards men who are not gatherers of wood for domestic consumption, deforestation will continue. Similarly as long as agricultural techniques and proper use of fertilisers are taught mainly to men, women are left ill equipped to handle issues of soil degradation and land management which leads to land degradation.

There was a positive correlation between farmer's age and length of stay ($r=0.40$, $n=172$, $p=0.01$). Farmers' age was related to other variables as indicated in the Table 4.3.

Table 4.3 Pearson's correlation coefficient between farmer's age and other variables

Variable	(r) Values at n=172
1. Length of stay	0.40**
2. Lack of knowledge	-0.16*
3. Culture	0.18*
4. Diseases	0.17*
5. Good farming practices	-0.20**

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

Most farmers due to old age relied on casual labour for the farm agricultural practices. The work done by casual labours was shoddy and not up to standard or exactly as taught by the extension agents. The constructed terraces were against the contours and such cases clearly demonstrated the implication of lack of follow-up on the part of the extension agents as much as it showed the failure of individual farmer to implement measures according to the extension agent's recommendations. Over 94 % of the farmers had stayed in the area for over 15 years. The results also indicated that the majority of the respondents were from the age group of over 40 years comprising of 79% of the sampled population. The other age brackets 18-40 represented the remaining 21% with no farmer from the sampled population with the age of less than 18 years. Most young people migrated to towns in search of paid jobs leaving the elderly to practice farming in the area. The ability of the aged category to implement environmental conservation would be hindered by various factors such as lack of technical knowledge on conservation measures.

Subsistence and cash crop farming are the main livelihood activities in the study area (Table 4.4). The main constraints to cash crops farming were declining soil fertility, inadequate extension services, poor payments, uneconomical land parcels especially under tea plantation and inadequate technical knowledge while those for subsistence farming were declining soil fertility, small land parcels, inadequate extension services and inadequate technical knowledge. Inadequate income leads to farmers not being able

to farm in a sustainable manner and consequently environmental degradation arising from poor farming methods. Inadequate extension services affect the production per unit area and poor market structure discourages the farmer investing in the improvement of the agriculture and resource management. This was especially affecting the banana farming due to pest and diseases and lack of market channel with brokers taking advantage of the situation.

Table 4.4 Classification of livelihood strategy and constraints

LIVELIHOOD	CONSTRAINTS
Cash crops farming (coffee, tea, bananas)	<ul style="list-style-type: none"> - Poor payments and high cost of farm tools - Inadequate credit facilities. - Poor administrative and management. - Inadequate extension services - Unfavourable weather conditions - Limited human labour - Uneconomical land parcels under tea plantation - Poor market structure - Pests and diseases - Lack of water for irrigation - Inadequate technical knowledge - Declining soil fertility,
Dairy farming	<ul style="list-style-type: none"> - Diseases and non-functional dips - Poor milk payment prices. - High cost of treatment - High cost of AI service
Subsistence farming (maize and beans)	<ul style="list-style-type: none"> - Small land parcels and declining soil fertility, - Lack of farm inputs e.g. seed, fertilizer etc. - Pests and diseases - Inadequate extension services and technical knowledge
Small micro enterprises	<ul style="list-style-type: none"> - Lack of credit facilities - Insecurity - Interferences from government by issuance of many licences

The community produces bananas, mangos avocados, and papaws where nevertheless, returns to farmers are undermined through poor marketing systems. Coffee acreage has generally declined over the years as farmers substituted it with other crops such as tea or bananas, as a response to low prices on the international market (Table 4.5).

Table 4.5 Yields (tons) and income (Kshs) of selected crops in Meru South District

CROP	YEAR	1996	1999	2002	2004
Maize	Yield	7526	1439	10394	13469
	Area	17,842	24,600	23,132	21,785
	Income	50,173,333	239,850,000	92,397,600	1,593,225
Beans	Yield	1,685	6,416	5,552	5,037
	Area	11,700	10,978	12,337	12,710
	Income	42,125,000	228,134,400	8,635,900	98,517,760
Coffee	Yield	17000	6549 (Cherry)	1179 (cherry)	5902 (cherry)
	Area	(Cherry)	90 (mbuni)	289 (mbuni)	99 (mbuni)
	Income	9,252 12,000,000	9,497 49,517,178	9,500 60,699,000	9,477 24,006,004
Tea	Yield	6,902	7,134	7,860	10,144
	Area	1,002	1,015	1,015	1,404
	Income	138,046,900	149,814,042	165,062,100	159,262,935

Source: DAO's Meru South District

Currently livestock production is at its lowest because farms cannot support large numbers of livestock as the case used to be in the early seventies when the sale of cows, goats and milk used to be the major source of income for the local farm. Indications are that a few cows that exist are of poor quality and often prone to diseases. Animal feeds are available at the local feed dealers but due to rising prices, few farmers can afford. Therefore although dairy cattle were kept in every household studied, very few households derive income from them since dairy farming is not viewed positively due to high investment costs and lack of sufficient marketing outlets. Low diversification plans coupled with the incomes of households are decreasing, with consequent negative impacts on the socio-economic spheres and also environmental management, particularly for investments that need money such as mechanical conservation measures.

Low farm production was attributed to lack of intensification of farming activities through modern technology and lack of credit for small-scale farmers to promote horticulture production and zero grazing units as suggested by key informants. According to Minde (2003), there have been growing concerns worldwide that the agricultural intensification process to meet the needs of the increasing population leads to degradation of the environment generally and natural resources specifically. Intensive use of

fertilizers, pesticides, high yielding crop varieties and mechanical technology, as well as excessive stocking rates on pasture lands have led to increased deforestation, soil erosion, desertification, water-logging and salinization of soils, contamination of surface and ground water and other forms of natural resource degradation in recent decades. But according to Cleaver and Schreider (1994), it is generally agreed that agricultural intensification, per se, need not degrade the environment. It is the inappropriate or mismanaged agricultural intensification, such as overgrazing or untimely application of fertilizer that may lead to environmental degradation. The most serious environmental problem in Africa may not be inappropriate technological change in agriculture, but the many people who live in absolute poverty. Rural poverty, coupled with increasing population densities and inadequate agricultural intensification is responsible for much of the forced exploitation and consequent degradation of environmentally fragile lands leading to soil erosion, flooding, and loss of vegetative cover observed in many parts of Africa. Such degradation will therefore not be prevented by reducing agricultural intensification alone, but rather by a strategy based on alleviation of poverty. Low production was also attributed to lack of irrigation water. This limits horticulture production and fodder availability during dry period. Gully erosion (Plate 1) at the roadside indicated inadequate water harvesting mechanism to harness water both for domestic use and irrigation besides conserving the soil.

There was a negative correlation between the level of education and receiving extension services ($r=-0.22$, $n=172$, $p=0.01$) as indicated in table 4.6. This was attributed to the increased growth in information industry where farmers especially with higher education levels could utilise diverse sources. This was more evident by the fact that more educated farmers tended to receive less services related to animal production ($r=-0.27$, $n=172$, $p=0.01$), crop production ($r=-0.24$, $n=172$, $p=0.01$) and environmental protection ($r=-0.25$, $n=172$, $p=0.01$). Further to these, more educated farmers rated high the level of integration of environmental management aspects in the extension services they received ($r=0.27$, $n=172$, $p=0.01$).

Table 4.6 Pearson's correlation coefficient between education and other variables

Variable	(r) Values at n=172
Extension services received	-0.22**
Animal production	-0.27**
Crop production	-0.24**
Environmental protection	-0.25**
Rating of the level of integration of environmental aspects	0.27**

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

Since extension service is demand driven, informed farmers sourced for the services best fitting their needs. With up to 68% of the respondents having attained at most primary education, the likelihood of poor capacity in decision-making on environmental conservation was high. There is negative correlation between extension services received and education ($r=-0.22$, $n=172$, $p=0.01$) as indicated in table 4.7.

Table 4.7 Pearson's correlation of extension services and selected variables

Variable	(r) Values at n=172
Education	-0.22**
Animal production	0.85**
Crop production	0.87**
Environmental protection	0.75**
Marketing of farm products	0.34**
Level of integration of environmental aspects	-0.72**
Income	-0.29**

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

About 25% of respondents lacked primary education and 38% had only primary education. This shows that they are not well equipped to make informed decisions to achieve proper environmental management. There is thus need to enhance implementation of the government policy on free education to increase literacy level in the area and in Kenya as a whole.

4.2.2 Ecological Sphere

Before 1970, the indigenous tree population was high since the trees were not seen to be of any economic value. At the same time, the exotic trees were few since they were being introduced. Between 1970 and 1980, there was a tremendous decline of indigenous trees due to increased demand for timber and fuel wood because of increase in population. At the same time, a vigorous campaign for people to plant trees was launched which resulted into increase of exotic trees. In 1980 to 1990, there was a sharp decline of both exotic and indigenous trees due to high demand of timber in Nairobi and Mombasa and high demand of charcoal in major towns the trend that continued to 2006. It was observed that economic pressure has forced many people to cut down their trees and sell them to timber merchants so that they can get money for purchase of basic needs. Bush clearing and cutting down of indigenous trees to make way for farming has contributed to not only loss of biodiversity but also land degradation where proper farming practices are not adopted.

PRA data revealed that in 1960s, soil fertility was high because there was low cultivation (shifting cultivation); making of trash lines by farmers and manure was not sold. In 1970s there was observed decline in soil fertility in some farms due to soil erosion, bare soil, more houses, low farm incomes and more roads. This has affected soil texture and thus agricultural production. However, the community observed that there are currently slight improvements of soil fertility in some areas due to better farming methods like use of manure and soil conservation activities. This may explain why the soil fertility is perceived to have generally declined.

4.3 Extension Service Dimension

Up to 33% of the farmers indicated received extension services routinely, which were offered on demand, and farmer's capacity to meet the cost of looking for agricultural extension officers. As would be expected, only the middle and high-income farmers access these services. With this change in service delivery, the majority poor farmers remain vulnerable to the effect of degradation of the land. Extension services in the area have currently focused on crop production (33%), animal production (36%) and environmental conservation (26%) at limited extent (Figure 4.1). As observed from the

transect walk (Table 4.8) environmental degradation is rampant partly due to the lack of expertise among extension agents on interrelated factors that affect agricultural production like environmental management, post-production technologies, marketing and finance. Farming as a business requires a range of different kinds of advice and information, ranging from production, environmental conservation through enterprise and post-harvest management, to processing and marketing for sustainability.

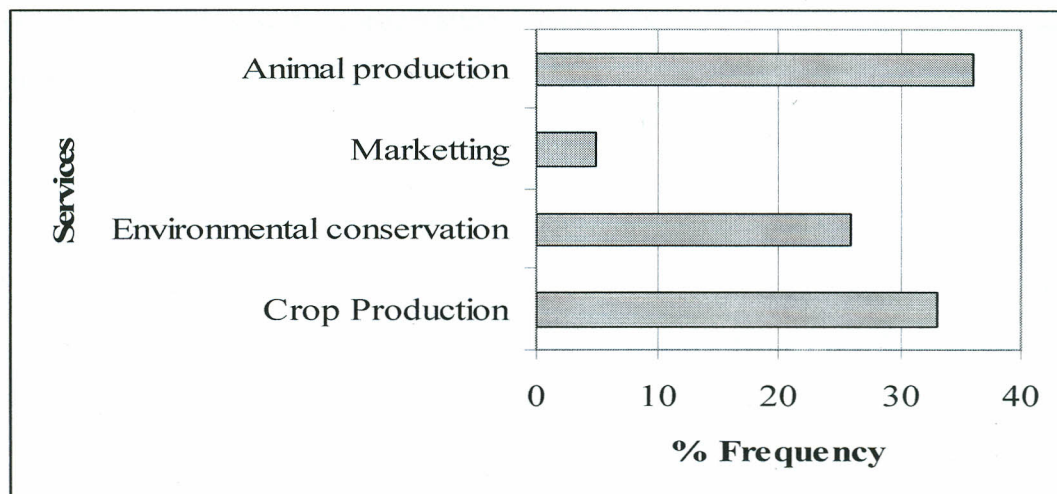


Figure 4.1 Extension services received by farmers in the area

Since the Farmers Field School (FFS) was the main approach used in the study area there was high correlation between farmers receiving one extension service and receiving another. Farmers receiving extension services on animal production for example were more likely to receive crop production ($r=0.97$, $n=172$, $p=0.01$), environmental protection ($r=0.74$, $n=172$, $p=0.01$) and marketing ($r=0.32$, $n=172$, $p=0.01$). During the FGD the farmers said that Kenya Tea Development Authority (KTDA) normally held one FFS once per year and most of the extension providers are invited to offer extension services to farmers in their respective field of expertise. The farmers felt that extension services received did not adequately address environmental issues of concern in the study area. However, the extension agents said that the scenario was because the agricultural extension is centralised and structure very hierarchical and bureaucratic. Budgeting and flow of funds are also very hierarchical with funds either being received late or

chronically short of funds for all activities planned for. The number of extension staff has generally declined due to retrenchment and a freeze in government employment. Natural attrition through retirement and deaths especially related to HIV/AIDS has also adversely affected the quality and scope of extension service in the study area. Currently the ministry of agriculture has responded by relaxing the tradition of each administrative location being staffed with a Frontline Extension Worker (FEW). The FEW now cover more than one administrative location unlike the way it used to be. The T&V, which was popular in soil and water conservation, cannot be effective due to shortage of staff on the ground.

Table 4.8 Transect walk from Mt Kenya forest to Mitheru Farmers' Coffee Society

Mt Kenya			Mitheru Area		
Natural vegetation	Scattered trees & bushes a lot of grass	Scattered trees (Gravellia rubusta), Sparse grass, & no bushes	Scattered tree (Gravellia rubusta & blue gum, grass), grass lots of grass.	Dense population of trees, bushes and grass	Dense population of trees, bushes and grass
Settlement pattern	Densely populated	Densely populated	Densely populated	Densely populated	Densely populated
Soil types	Loam soil	Loam soil	Red loam	Red loam	Red loam
Topography	Very deep slope	Slightly sloppy	Gentle slope	Gentle slope	Almost flat land
Land use	Not effectively used	Not effectively used	Land fairly utilized	Land fairly utilized	Land fairly utilized
Social amenities	One school, shopping centre, health centre	A small shopping centre, one school	A school & shopping centre	One small shopping centre & a school	No shopping centre, Administration centre, a school
Crops	Tea, coffee, bananas, beans & maize Mango avocadoes	Yams, maize, coffee, tea Bananas Mango avocadoes	Coffee, tea, banana, maize, potatoes Mango avocadoes	Coffee, banana, maize, beans, sweet potatoes, yams	Bananas, coffee, Beans, sorghum, cassava, avocadoes, macadamia
Challenges	Deforestation, soil erosion, no water, low yields, land slides, small land sizes neglected coffee farms	Low yields small land sizes water problem, lack of gainful markets	Poor sanitation, deforestation, water problem Soil erosion Small land sizes	Poor fodder roads, no clean water, soil erosion, no gainful markets.	Poor feeder roads, no clean water, soil erosion, no gainful markets
Opportunities	Utilize local rivers Disaster management	Source for better markets Plant more trees	Use organic manure Plant more trees	Use organic manure Plant more trees	Utilize local sources of water. Plant more trees

Several approaches are used to communicate extension services to farmers in the area (Figure 4.2). Farmers' field schools are the most commonly used approaches in communicating extension services, which accounted for 38% of all respondents. It is an innovative, participatory and interactive learning approach. It is learning by doing, and farmers learn by carrying out various activities on what they want to learn. The field is the primary learning material, and extension workers are facilitators not teachers. Farmers learn principles rather than packages. A day is set aside for farmers to gather and have training together as a group. However, the method falls short of practical demonstration since the group is usually large and individual attention impossible. Unfortunately, approaches known to give individual attention to farmers and adequate practical training such as demonstrations and training and visits were reported by only 1% of the respondents each.

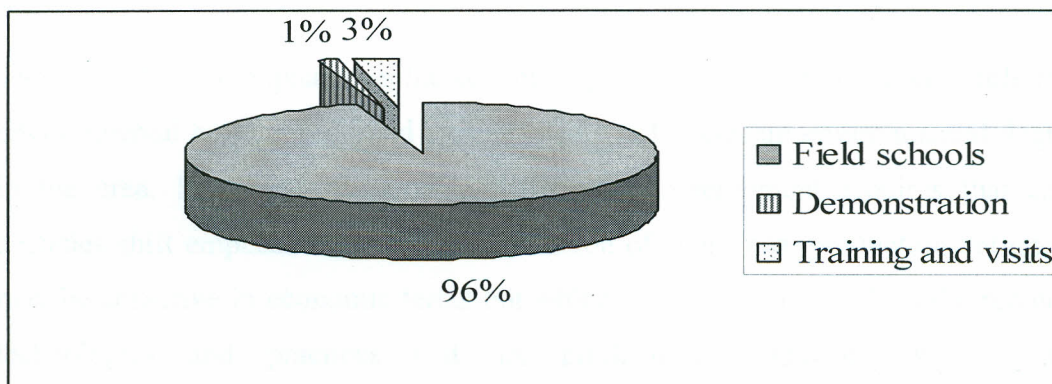


Figure 4.2 Approaches used to communicate extension services

Although T&V has advantages which includes:-extension agents spending more time with farmers, regular training which ensures that extension agents are up-to-date with technology, offers good logistical support and Increased research extension linkages it was not used because of it lacks low cost technology relevant to small-scale farmers, its use of fixed routes and contact farmers making it very ineffective, rigidity in the approach in relation to farmers changing needs, inadequate farmer participation, too much routine and repetitiveness and supply-driven approach and expensive to operate among others.

No single extension approach can be considered appropriate to address the needs of all agro-ecological zones and even those in use depend on factors such as agro-ecological zones (AEZ), farmer literacy level, enterprise mix, land tenure system, farmers' resources, socio-cultural factors and farmers' needs. Approaches emphasizing use of groups rather than individual farmers are recommended because of their relatively low cost in view of current low staff/farmer ratio in public extension service (MoA, 2001a). The move is towards participatory approach with a strong element of demand driven extension service. However, there is variation in approaches depending on the extension system and cost effectiveness of the system (MoA, 2005b). Extension agents need participatory methods and communication skills to enable them effectively participate in passing various technical messages to farmers (MoA, 2001a). The majority of respondents (60%) felt that the level of integration of environmental management aspects in extension services often received is unsatisfactory (Figure 4.3).

They cited biased emphasis on the economic production of the farms with little regard to environmental conservation and attributed this to the current environmental degradation in the area. Promoting sustainable agricultural development requires that extension agencies shift emphasis from the maximization of short-term production outputs, which may be attractive in economic terms but which cannot be sustained, to the promotion of technologies and practices that are productivity enhancing without negative environmental consequences (IFPRI, 1994). Quite often environmental concerns have been treated as merely additions to existing agricultural extension messages in increasing production and technology transfer. There should be promotion of environmental concerns as part of the overall production process and goals of farmers.

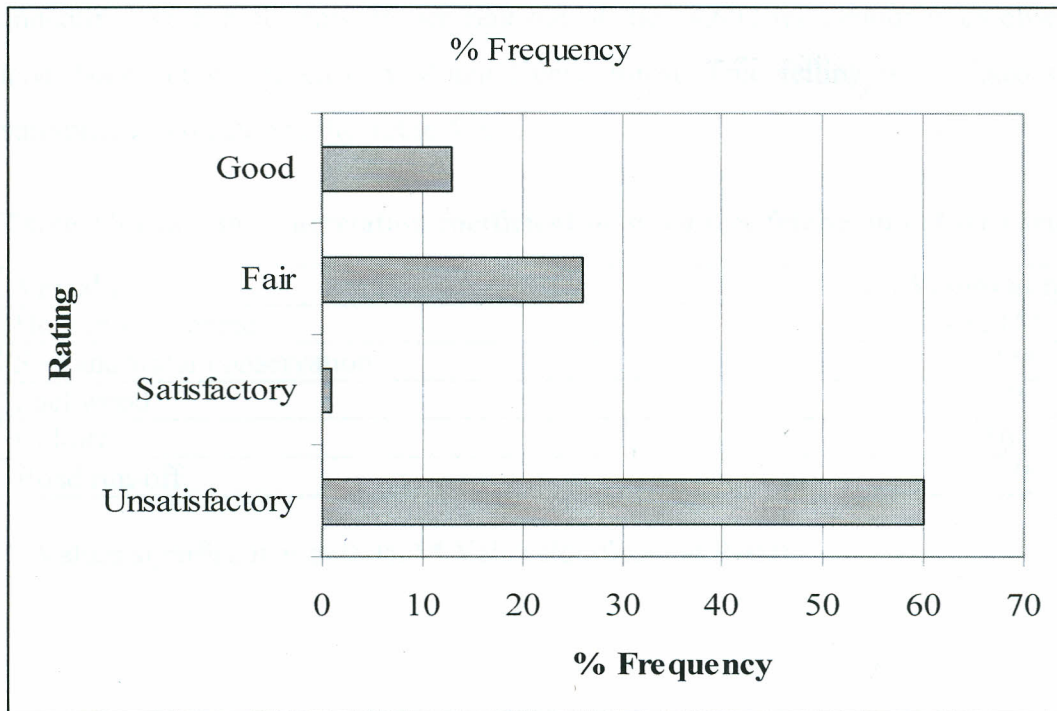


Figure 4.3 Opinion on integration of environmental management in extension services

4.4 Environmental Consideration in Extension Services

4.4.1 Main Causes of Environmental Degradation in the Area

The major cause of environmental degradation were tree felling, population pressure, poor agricultural practices, social cultural factors, gender imbalances and steep slopes, poverty and unemployment and drought as evident from figure 4.4. On farm tree felling accounted for 83% of the total respondent's views regarding the major causes of degradation. Respondents who felt that this activity was a major cause of environmental degradation also felt the same about other related causes such riverbank cultivation ($r=0.23$, $n=172$, $p=0.01$) culture ($r=0.16$, $n=172$, $p=0.05$) and need for fuel wood ($r=0.16$, $n=172$, $p=0.05$). There was heavy dependence on fuel wood, timber and other tree products. The magnitude of forest destruction is very high. According to KWS (1999), the results of aerial survey in the neighbouring Mitheru forest indicated that poaching of

indigenous trees is highest in the case of Camphor (*Ocotea usambarensis*) at 6,700 trees annually, which represents 46 per cent out of the 14,600 indigenous trees observed to have been cut in the eastern Mount Kenya forest. Tree felling was related to other variables as indicated in the Table 4.9.

Table 4.9 Pearson's correlation coefficient between tree felling and other variables

Variable	(r) Values at n=172
Household income	-0.21**
Soil and water conservation	0.21**
Fuel wood	0.17*
Culture	0.16*
Road run-off	-0.17*

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

Population pressure is viewed by 73% of the respondent as the main cause of environmental degradation. Respondents citing this aspect as a cause of environmental degradation also cited other interrelated aspects as summarized in the table 4.10, which were largely because of increased pressure on agricultural land and the need to improve food security through intensification, provide household energy through fuel wood and increase household income through tree felling for charcoal and timber. The area has one of the highest population densities in Kenya estimated at 188 persons per km^2 (CBS, 2001b). This has resulted to demand for fuel wood, building materials and other tree products to meet community demand. This has also resulted to encroachment of the forest and accelerated rate of felling of tree (Plate 2) than community initiative in afforestation efforts.

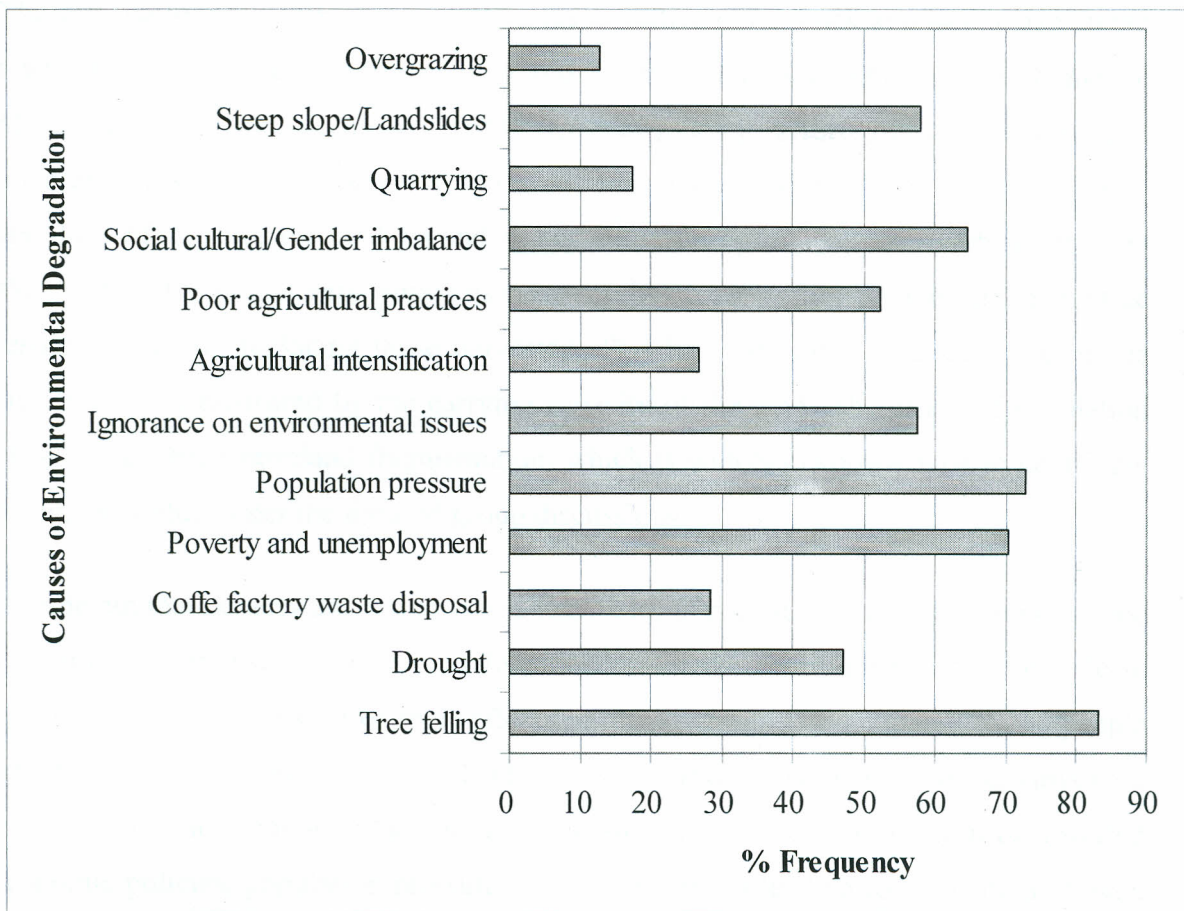


Figure 4.4 Main causes of environmental degradation in the area

Table 4.10 Pearson's correlation of population pressure and selected variables

Aspect	(r) values at N=172
Fuel wood	0.15*
Improper use of pesticides	0.17*
Poor farming practices	0.28**
Tree felling	0.20*
Culture	0.16*
Poor law enforcement	-.18*

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

The demand for cropland has pushed farmers to cultivate riverbank and wet lands without regard to Agricultural rules and regulations (Agricultural Act 318) and Environmental Management Coordination Act (EMCA, 2000). Any effort by the Government interventions is often interpreted as a move to take away land from the farmers and often lead to conflict since the land act and survey act has no provision for riverbank or steep slopes. Poverty and unemployment has also resulted to, too many people demanding tree resources without replacing those harvested. This has just added to already precarious situation when measured by the carrying capacity of the land. The effect of population pressure has been farmland fragmentation, which is widely acknowledged to contribute decline in yields as per the focused group discussions.

It came out that poverty and unemployed exert a lot of pressure on the environment since the farming community derive their livelihood from the environment but give little in return. They are not aware of their effects on the environment compared to the people who have other sources of livelihood. This nexus of poverty, population and environment is one of the most important social and economic issues. The combination of distorted economic policies, population pressure and low income is leading to cultivation of even more fragile lands as people struggle to survive.

Social cultural/gender imbalance factors especially gender inequalities were cited by 65% of the total respondents as causes of environmental degradation. Customarily, women do not own land and lack information about their legal rights. Their economic disempowerment is due to lack of access and/or control to resources such as land and family assets. Participation in decision-making especially regarding agriculture and environmental conservation remains minimal. During circumcision, the initiates must stay in fresh dwellings increasing demand for timber for construction. Thus, selling of trees, to provide timber for this purpose, leads to further environmental degradation.

Landslides and steep slopes were also identified to be a major cause of environmental degradation by 48 % of all the respondents (Plate 3 and 4). The majority of the landslides were said to coincide with the heavily logged areas in the slopes of Mount Kenya. Most of Landslides are associated with the El-Nino event of 1997-98. The high occurrence of

landslides in heavily logged areas suggests a possible correlation with extensive cutting of trees through trigger effect.



Plate 1: Gully erosion at the roadside
Near Kiini dispensary



Plate 2: Tree felling at the banks of
Nithi River near Mount Kenya forest

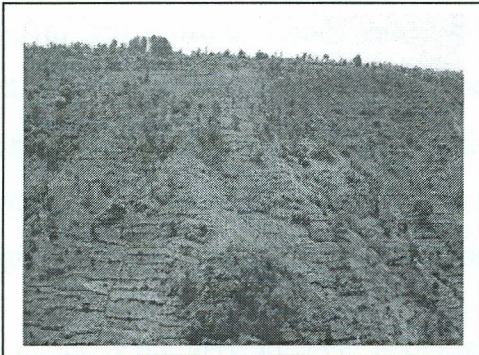


Plate 3: Steep slope cultivation along
The Nithi River

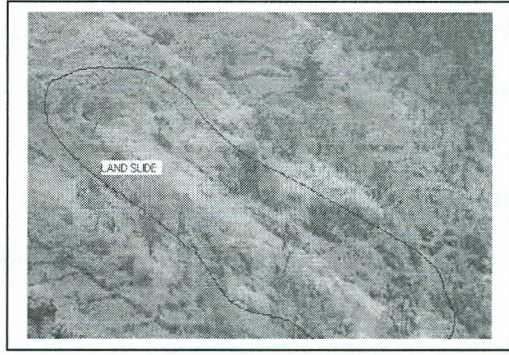


Plate 4: Landslide along Nithi River

The local population was largely ignorant on environmental issues, lacked a formal approach to environmental issues, and were not aware of any formal arrangements towards environmental conservation. Most of the farmers as long as they get their livelihood from the farm do not care to replenish the soil for better yields. The farmers are also ignorant of the global effect of their local environmental degradation. Poor agricultural practices such as ploughing in the sloping land by the farmers in the study

area is due to insufficient agricultural awareness and lack of adequate financial base to seek the information. Unfortunately, many bad farming operations encourage erosion.

In the past few years, the area has experienced drought conditions on a very irregular basis and due to inadequate information on disaster management, it is difficult for the farmers to adequately plan for the drought when it strikes. It is quite evident that around the coffee factory premises, there is a strong stench of decaying coffee pulp. Wastewater further finds its way into the rivers making the river heavily polluted. The farmers find it difficult to use the coffee pulp due to the strong smell. The factories lack disposal mechanism of the waste. The inappropriate and mismanaged agricultural intensification such as overgrazing and untimely application of fertilizer lead to environmental degradation.

Rural poverty coupled with increasing population densities and inadequate agricultural intensification is responsible for much of forced exploitation and consequent degradation leading to soil erosion, floods and loss of vegetative cover. Rampant quarrying and ballast harvesting is also common in the area. Since most quarrying is on individual farmers land, they are not licensed and the extension agents cannot come in strongly to stop it. This is because there is no direct policy that prohibits quarrying. The extensions only give advice mainly on crop and animal production but not on quarrying.

Overgrazing is not very apparent but given that almost all the farmers keep a cow or two in a $\frac{1}{4}$ acre of land, it is almost impossible to raise enough fodder for the animals in the farm and the farmers then move to common areas or the forest to look for fodder. This goes along way to cause environmental degradation due to excessive removal of soil cover to feed the dairy cow. It was also realized that most farmers sell the manure to earn a living than putting it in the farm to replenish the depleted nutrients.

During the Focus Group Discussion the farming community felt that exposure to air pollution in the household is a major source of diseases such as pulmonary, cardiac, vascular and neurological impairment. They said that the most affected group is elderly, women and young children who spend most of their time in the kitchen. Smoking by men was also reported as a cause of air pollution in the household. Most men were reported to

have died young because of uncontrolled smoking. The farming community felt that a research to review the relationship between indoor air pollution and health hazards as an intervention for reducing exposure and diseases was paramount in dissemination of preventive measures and policies. According to WHO (2006), in developing countries, women spend most of their time near the fire and thus exposed to high levels of indoor pollution for between three to seven hours per day over many years. Young children are often carried in their mother's backs during cooking and consequently, they spend many hours breathing smoke.

4.4.2 Environmental Conservation Technologies Farmers have been Taught.

Although various environmental conservation technologies have been taught to farmers in the area the most frequently taught included agro forestry and zero grazing (Figure 4.5). Since the technologies were largely taught using FFS, it emerged that respondents taught one technology like agro forestry for example were more likely to be taught another (Table 4.11). Community members not receiving one technology were more likely to miss many more increasing the risk of environmental degradation.

The extension agent reported that agro-forestry is an extension approach that encompasses all enterprises of the farm holding and especially because it promotes and enhances complementally and supplementary and avoids advance competition among enterprises. According to Roling (1995), agro-forestry enables the land to support a much higher population density, than traditional agriculture and is a valuable component of the whole farm extension approach, a very important concept in Kenya. This was more preferred by farmers since it offered tangible benefits to the farmers in terms of fuel wood and timber as well as fodder, which increased milk production. About 39% of the respondents reported been taught riverbanks protection.

Other technologies taught included good agricultural practices such as contour farming and mulching mentioned by 29 % of the respondents. Though many farmers were taught contour farming, no evidence of its practices at the ground was observed. Mulching is common in the tea bushes but the cover is still collected for firewood. Good farm layout is not well practiced due to small land sizes because the farmers attempt to utilize every

farming area available. These methodologies are relevant to the problems of environmental degradation in the area as confirmed by observation survey. Other technologies included soil and water conservation measure such as gabions and cut off drains.

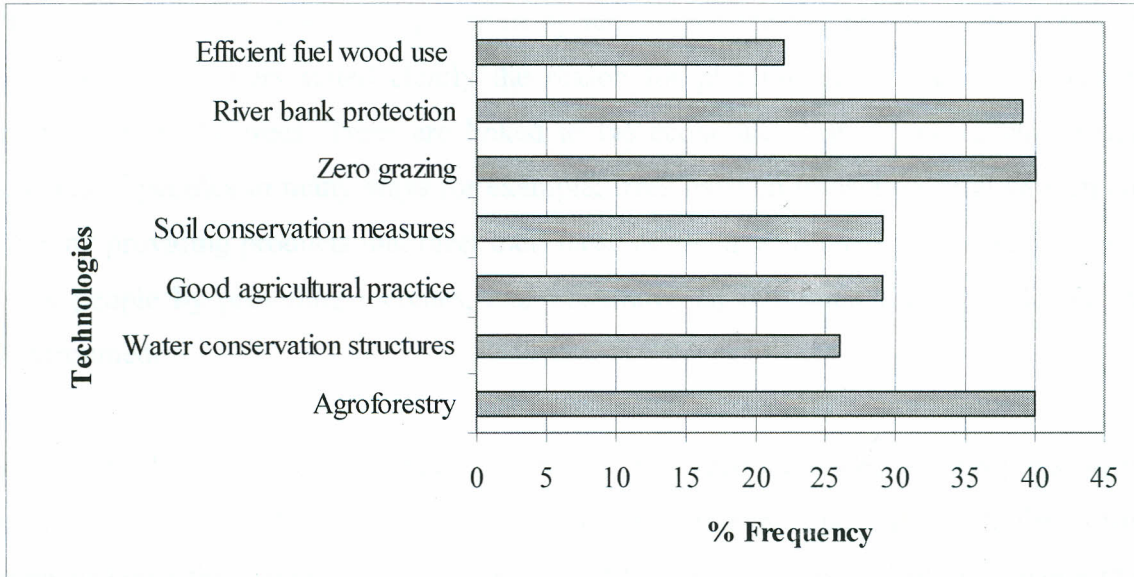


Figure 4.5 Environmental conservation technologies farmers have been taught

Table 4.11 Link of agro-forestry to other environmental conservation technologies

Aspect	(r) Values at N=172
Good farm layout	1**
Contour farming, Crop cover, Mulching, Terracing, Zero grazing, River bank protection and roof catchment	0.95**
Soil fertility improvement	0.93**
Afforestation	0.73**
Fuel saving technologies	0.63**
Cut off drains	0.66**
Retention ditches	0.18*
Grass strips	0.29**
Crop rotation	0.23**
Gabions construction	0.27**

*=Values significant at $p=0.05$, ** Value significant at $P=0.01$

4.4.3 Environmental Conservation Technologies Most Frequently Practiced

There was a clear tendency by farmers to adopt technologies which gave individual tangible benefits to the household. All farmers (100%) seemed to prefer using zero grazing and agro forestry in environmental conservation on their farms (Figure 4.6). To meet the high demand of wood fuel at household level farmers intensify tree planting in their plots of land. The most preferred system is boundary planting of the *Grevillea robusta*. The farmers stated clearly the reason for planting these trees is the benefit accrued from the trees. Trees are linked to the economic, cultural and environmental aspects of peoples in many ways for example; trees have an impact on rural women and men by providing products that meet their basic needs, trees affect the economic lives of rural people by providing incomes, and trees have an important role in enriching the environment.

However, the way products and services are managed depended on people's social economic status, gender, age and social cultural environment. The majority preferred fruit trees to boost their household food security and income. It was realised that while men preferred trees, which give timber for sale, women preferred trees for fruits and fodder. Agro forestry in particular was cited to offer multiple solutions to community problems such as improving soil fertility, providing timber and firewood as well as soil and water conservation. The bias of agro forestry for economic gain other than environmental conservation is a major challenge the extension agents face in communicating environmental conservation technology.

During the focus group discussion, the farmers indicated that trees have an impact on both rural men and women by providing products that meet their basic needs, affect their economic lives as well as protecting and enriching the environment. It was also evident that gender played a great role in tree preferences based on what the trees are most useful for and the difference men and women needs. Women preferred fruit trees for both income and household food security. Women work has been closely linked to household nutrition and women cash income earning is also directly linked with the household food situation. Their choice of trees was thus towards meeting household food security. The

fruits are extensively used to help meet dietary shortfalls and to supplement household income during particular seasons in the year known as 'hunger periods' when the stored food supplies have dwindled and new crops are beginning. The fruits are also valued during the peak agricultural labour period, when less time is available for cooking.

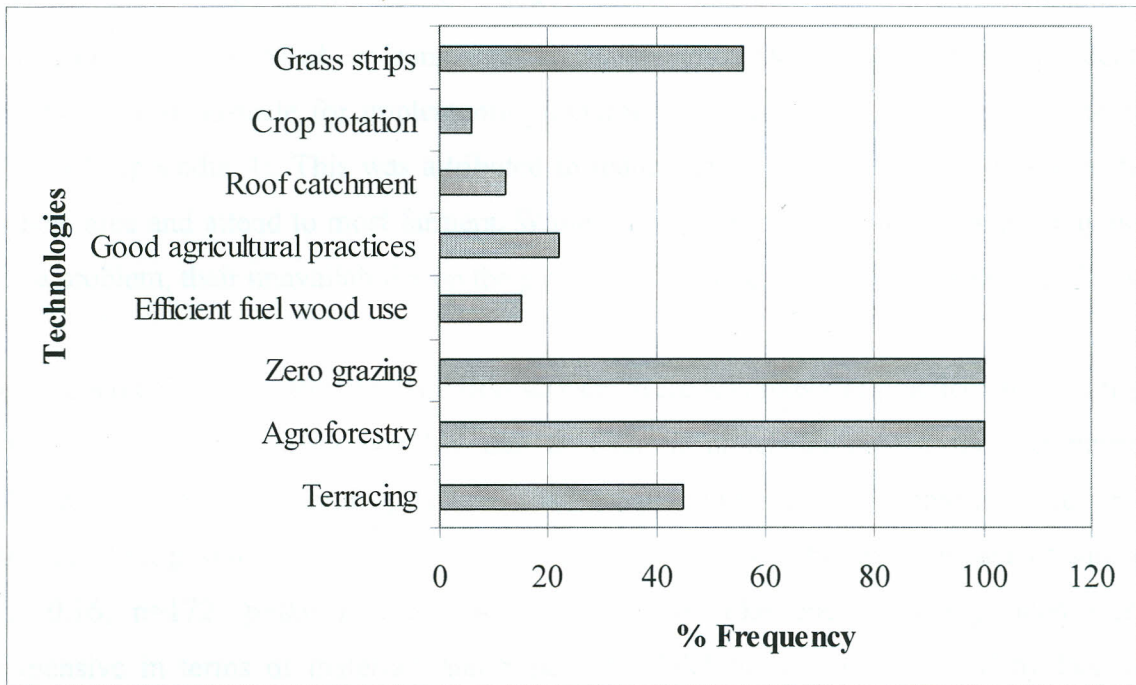


Figure 4.6 Environmental conservation technologies most frequently used

Community members did not always practice what they were taught. They seemed to prefer technologies resulting to immediate tangible benefits. These included agro forestry, zero grazing and fuel saving technologies. All community members interviewed seemed to prefer using zero grazing and agro forestry in environmental conservation on their farms. Unlike the free grazing system, zero grazing offered an opportunity for nutrient cycling within the farming agro ecosystem. The researcher observed that the advice by the extension agents to leave crop remains on the farms was greatly not followed since the remains especially from maize were used as animal feeds. The resultant manure is sold for cash reducing even more the chances for nutrient cycling.

Terracing was adopted by 45% of respondents and was done especially where it provided room for Napier planting for feeding livestock especially when reinforced with grass strip. Napier grass is widely used for reinforcement since it can also be sold to supplement household income.

4.5 Farmers' Problems in Implementing Environmental Conservation Measures

Inadequate knowledge of environmental issues was cited by 75% of all the respondents as the biggest obstacle for implementing environmental conservation measures (Figure 4.7 and Appendix 4). This was attributed to inadequate extension workers to cover the whole area and attend to most farmers. While the critical mass extension agents may not be a problem, their unavailability on the ground was caused by lack of transport facilities.

Farmers receiving inadequate extension services were less likely to practice crop rotation ($r=-0.23$, $n=172$, $p=0.01$) possibly due to lack of understanding of its importance. Reforestation was hindered by lack of seed for planting and raising tree nurseries ($r=-0.17$, $n=172$, $p=0.05$). Practicing fuel saving technologies was hindered by lack of capital ($r=-0.16$, $n=172$, $p=0.05$) since some technologies like energy saving jikos were expensive in terms of materials and expertise. Mulching was discouraged by lack of firewood ($r=0.15$, $n=172$, $p=0.05$) since it was collected and used as firewood adversely affecting soil fertility improvement.

Social cultural factors such gender imbalance on the other hand accounted for 75% of farmers. In a highly patriarchal society in the study area, women farmers found it difficult to adopt environmental conservation technologies where husbands are not willing or not near. Since they traditionally do not own land they lack bargaining power as far as its conservation and general development is concerned. During the focal group discussion marginalisation of women and youth in decision-making was cited as a major problem faced in implementing conservation measures.

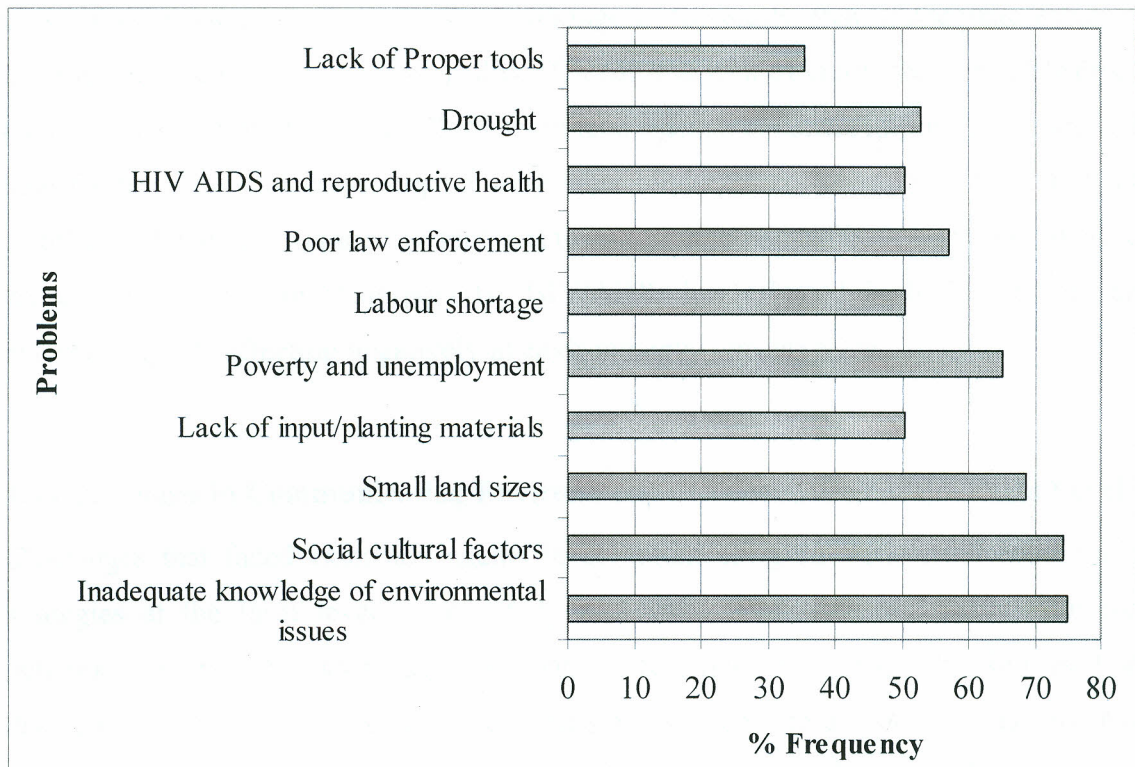


Figure 4.7 Problems faced in implementing environmental conservation measures

According to Waswa et al (2002), meaningful progress of sustainable development cannot be made without active involvement of women and youth at critical levels of decision-making. Momsen (1996) observed that although women are acknowledged as equal partners in the development process, their marginalisation continuous unabated particularly in agricultural development decision making in developing countries. This is based in part on the assumption that environment management is technical and scientific and dubs women non-scientific with no capacity to make informed decision (Wickramosinghe, 1997). Gender inequality in the provision, access and utilisation of extension services in Kenya has been fairly documented. Kabutha (1999) for example argues that despite the fact that women are central to Kenya agricultural productivity, they are not major beneficiaries and focus of agricultural extension services.

Poverty and unemployment were seen as big challenge (65% of respondents). The low agricultural productivity environmental degradation and diminishing small pieces of

uneconomical land led to severe food shortage in the study area. Inadequate extension methods, high cost of input, low quality of seeds and lack of credit facilities all worsens the poverty situation in the area. With small land sizes, it becomes impossible to set aside land for terracing and grass strips among other hindering conservation efforts. Drought coupled with lack of irrigation water leads to low productivity of both crops and livestock enhancing already prevalent poverty. HIV/AIDS has affected both the farmers and extension agents affecting negatively in environmental conservation.

4.6 Challenges in Communicating Environmental Conservation at the Farm Level

Challenges that faced extension agents in communicating environmental conservation strategies at the farm level in the study area were few extension staffs, Poor road network, very poor transport facilities, inadequate office space at the division level and delayed disbursement of funds. The extension workers cited that they usually have inadequate resources such as transport to be able to handle the large number of farmers. They complained of a large farmer to extension agent ratio since the government does not employ adequate agricultural extension agents. This prevents them from giving individual attention to farmers often preferring meeting them in groups such as farmer's school days. Mass staff transfers of extension agents hindered follow-ups within the farming community. Six out of the nine agricultural extension agents interviewed had worked in the area for less than 5 years.

The literacy level of farmers is also low as discussed earlier and this affected the understanding and adoption of conservation technologies. To many farmers environmental conservation is not a priority. They value economic gains more than conservation efforts of their land resources. Some felt that the government is reluctant in enforcing the law on environmental conservation leading to cultivation practices that facilitate environmental degradation such as cultivation of riverbeds and quarrying, which is not licensed. Some technologies such as gabions construction were said to be expensive to implement and thus not widely adopted by the community whose members are low-income earners. Others require communal action and the whole community must

be mobilised to adopt them. This requires time and resources which when coupled by other factors of high farmers extension agents ratio becomes very challenging. They felt that transport needed to be improved by providing at least one motorbike for each location and new vehicles for the divisions and the district headquarters, retrain field staff especially the Junior agricultural assistants for increased capacity and competency and Veterinary department be mainstreamed in NALEP budgets and plans.

It is important to view extension for sustainable development in an institutional strengthening context, including the enhancement of extension organizations in both the public and private sectors. These organizations include extension agencies of ministries of agriculture, non-governmental organizations (NGOs) and farmers' organizations. The tasks facing them in achieving sustainable agricultural and rural development require that their organizational capability be strengthened. For example, farmers' organizations need to be strengthened not only to receive but also to provide service to one another so that the extension messages do not reach only a few elites in the village level.

4.6.1 Positive and Negative Impacts of NALEP

Rating of NALEP by agricultural extension agents along several selected items along a likert scale, the programme has had both positive and negative impacts in the area (Table 4.12). Among the positive impacts identified by the extension, agents are enhanced participation of farmers in identifying their own problems and solutions through PRAs. Formation of common interest groups ensures that the farmers are trained in their owned desired field meeting their own production goals. Concentration of extension services in a focal area ensures that adequate resources and work force are concentrated in an area for year, however this results to neglect of other areas during that year. Enhanced collaboration through stakeholder forums ensures exchange of ideas experiences and avoids duplication of efforts.

Table 4.12 Rating of extension agents on the impact of NALEP

% Rating	Strongly agree	Agree	Disagree	Strongly disagree	Unaware
Economically biased	56	44	0	0	0
Environment biased	0	0	44	56	0
Has good mix of environment and economy	0	0	34	66	
Has little effect at farm level	56	44	0	0	0
Its farmer unfriendly	44	56	0	0	0
Difficult to implement	55	45	0	0	0
Programme must be reorganised	23	77	0	0	0

The negative impacts included development of dependency syndrome during the 1 year of focus. Once attention is shifted to another area, the farmers are unable to continue with production activities on their own. Generalisation in terms of potential capabilities of households denies the vulnerable poor individual attention thus failing to address their needs.

All respondents either strongly agreed or agreed that the programme is economically biased emphasizing more on economic production at the expense of environmental conservation. None of the respondents felt that the programme either is biased to the environmental conservation or has good mix of environment and economy. All respondents either strongly agreed or agreed that the programme is farmer unfriendly and have little effect at the ground. It was no surprise that all extension agents felt that the programme must be reoriented to adequately address the needs of its clients, the framers. NALEP extension needs to focus on holistic development targeting Environment, conflicts, communication, capacity building sustainability with maximum utilization of the existing structures within and outside government such as resource management committees and local elders.

4.6.2 SWOT Analysis of National Agriculture and Livestock Extension Programme

A SWOT analysis output of the National Agriculture and Livestock Extension Programme (NALEP) showed that farmers do appreciate farming as a business and extension agents are able to train farmers en-mass due to adopting group approaches. This translates into reduced costs and logistical challenges (Table 4.13).

Table 4.13 SWOT analysis of NALEP

<p>Strengths</p> <ul style="list-style-type: none"> ● Natural capital: Well endowed with a large reservoir of natural capital e.g. tea, agro-forestry and water ● Social capital: A resilient local community of cultural groups local elders sub-area and local government with developed mechanism in the existing ecosystem ● Human capital: the area has a stock of human capital that has useful indigenous knowledge on the use of natural resources ● Local micro-climate for tapping rivers to practice agro-forestry and other environmental conservation measures 	<p>Weaknesses</p> <ul style="list-style-type: none"> ● Fragile eco-systems ● Laissez-faire exploitation of resources ● Weak local governance institutions ● Declining authority of traditional governance structures ● Poor physical infrastructure ● Poor industrial infrastructure ● Migration of educated labour ● Cultural practices that hinder uptake of new ideas ● High population pressure ● Inadequate capacity building
<p>Opportunities</p> <ul style="list-style-type: none"> ● Good political will ● Increasing local community interest in extension services ● Improved research in agriculture, agro-forestry and soil and water conservation ● International interest, NGO, faith organisation to integrate environmental issues ● Government commitment to implement MDGs ● Changing attitudes of policy makers ● Global issues especially on climate change ● Desertification and biodiversity are urgent national issues ● Increasing political recognition of the importance of poverty-environmental quality-livelihood linkages 	<p>Threats</p> <ul style="list-style-type: none"> ● Insufficient data on pollution, environmental degradation and environmental value ● Lack of nation-wide system of monitoring ● Lack of compliance especially by private enterprises ● Environmental authorities under resourced ● Increasing conflicts over scarce resources (human versus human, wildlife versus humans) ● Food insecurity ● HIV/AIDS ● Over-reliance on farming for livelihood ● Poor financial infrastructure ● Rapid population growth ● Frequent disasters such as land slides ● Local and national political will ● Lack of a system to protect indigenous intellectual property rights

However, the NALEP approach does not seem to be able to deliberately target resource-poor farmers, who are likely to shy away from group dynamics. Further, although

environmental concerns have been integrated as cross cutting issues, the time allocated to them are minimal, which translates into little impact in terms of environmental conservation.

4.6.3 Content Analysis of NALEP

The objective of NALEP is to enhance the contribution of agriculture and livestock to social and economic development. Results of content analysis of the NALEP aspects implemented in the study area are summarised in the table 4.14.

Table4.14 Summary of NALEP content analysis

Design Implementation activities	By who	Observe Implementation At farm level	Constraints
Institutional setting	Private sector GoK, NGO Other programmes Farmers Media Stakeholders at all levels DPM	Inadequate staff Poor collaboration in technical matters Poor net working with other stakeholders improper policy guidance	Few staff Net working mechanism not in place NALEP principles not well understood
Extension policy rural development and poverty reduction strategy	All stakeholders Short term expert	Not implemented	Policy not yet internalised
Gender concerns	Stakeholders NGOs Ministry of Gender Research CSOs	Not implemented	Social cultural barriers
HIV/AIDS	MOH, NACC, local administration NGOs, churches, CBOs Research institution and universities	Campaigns not adequate	Inadequate health centres

Design Implementation activities	By who	Observe Implementation At farm level	Constraints
Environmental concerns	Short term experts Collaborators NEMA and other stakeholders		
Extension service staff mobility and office infrastructure	Relevant ministries Relevant GoK stakeholders Private sector	Poor transport facilities	Few vehicles Few motorcycles Few drivers
Capacity building	Training institution Private sector facilities	Only for Kenya Tea Development Authority	Training needs not identified
Approaches for targeting the rural resource poor and vulnerable groups	Service providers Stakeholders Other funding sources	Approaches not promoted	Approaches not identified and tested
Appropriate technical packages in agriculture and livestock	Stakeholders Research institutions Donors NGOs Practitioners Extension providers Relevant ministries and service providers Legal rights stakeholders	Inadequate extension services	Few staff Indigenous knowledge not harnessed
Research-extension-farmer interaction	Farmers KARI Universities ICRAF Private sector	Researchable issues not identified	Farmers not equipped with skills of Researchable issues

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The major drivers to environmental degradation in the area included increased population pressure hence decreasing land sizes in the face of increased emphasis on maximising productivity both by farmers and extension agents at the expense of environmental conservation. Consequently the ecosystem and the Mitheru community were in a crisis and the increasing degradation of the environment threatened the livelihoods of the community, which depend on the natural environment. As a coping strategy, the community has engaged in activities, which endanger the environment such as tree-felling (for timber and charcoal for sale to buy food, pay school fees and for emergencies such as hospital bills), farming on steep slope and riverbanks cultivation (which were mainly under arrow roots, sugarcane and vegetables such as sukuma-wiki and tomatoes).

Very few farmers (33%) receive extension services largely from the government. However, these extension agents are faced with challenges such as inadequate resources and their limited number. Since the farmers see farming as a business, extension workers tend to concentrate on crop production and livestock production at the expense of environmental conservation issues. Farmers in the area were largely unsatisfied with the level of integration of environmental management aspects in extension services they often received. They felt that more should be done in this regard. They recommended increased training and visits by extension agents, on farm demonstration, and increased projects and programmes related to environmental conservation.

Constraints facing farmers in implementing environmental conservation technologies included lack of awareness of how environmental degradation affects social and economic welfare of the society. This was evident from the widespread farming of the hilltops, sloppy lands and riverbanks cultivation. Farmers in the area practiced environmental conservation technologies, which offered immediate economic benefits as opposed to those with long-term benefits. Farmers for example practiced agro forestry since they get fruits, firewood, timber and fodder, as opposed to gabions construction,

retention ditches and cut-off drains. Lack of deep feeling for the welfare of the land was a great risk of land degradation because most of the farmers regard the land merely as source of sustenance and income. This was evidence by the fact that the environmental technologies taught by the extension agents were only implemented by the farmers only for their economical benefit such as zero grazing, agro forestry and grass strip (Napier).

There is need to address the economic status of the vulnerable poor farmers. Inadequate income leads to farmers not being able to farm in a sustainable manner and consequently environmental degradation arising from poor farming methods. To install mechanical conservation practices such terraces and gabion construction for example is beyond the means of most farmers. Unfortunately, even conservation practises which farmers can carry themselves such contour farming and appropriate agronomic practices, they are unable to do so because of lack of technical know how due to inadequate trained extension agents to transmit the needed information. In addition Extension services programmes were mainly attended by men due to conflict of gender calendar. The training was conducted between 10am and 1pm a time when most women are attending to major reproductive roles especially preparing lunch for the primary school children. Households headed by women thus lagged behind in terms of technology adoption

The existing environmental and extension policies and the existing institutional framework to implement them are largely inadequate in addressing the problem of environmental degradation. This is evident by the fact that increased loss of soil due to erosion, cultivation of river banks and sloppy land and lack of adoption of environmental conservation technologies by farmers are happening at a time the government claims to have revised its policies such as NAEP to make them more effective.

5.2 Recommendations

There is need for increased farmers training and on farm demonstration of environmental conservation technologies. Community programmes on environmental issues should be put in place to increase general awareness of environmental conservation and its practice. There is need for improve social economic and livelihood status of the community to

avoid dependence of the community on environmental resources such as fuel wood, charcoal, timber and others. Implementation of poverty reduction strategy paper (PRSP) and medium term expenditure framework (MTEF) which refers to environmental fiscal reform (EFR) approaches to address environmental objectives relevant to the poor will improve human-well-being.

The government should improve facilitation of the existing field staff and deployment of more extension staff qualified on environmental issues so that farmers can be given adequate attention and assistance in implementing environmental conservation technologies. There is need for an integrated approach of environmental issues in all ministries since environmental issues are cross cutting and affect all government ministries. Increased collaboration and networking with all stakeholders involved in environmental conservation and management to avoid duplication of initiatives and increase efficiency in resource use. The extension team should consist of professionals trained in several discipline such as agronomy, civil and mechanical engineering, soil science, hydrology, economic, and rural sociology. Each professional should receive rudimentary training in discipline other than his own to gain appreciation of contribution of the other to the overall task.

Environmental conservation requires careful policy design, taking account of issues relating to equity, fiscal and environmental effectiveness, administration feasibility, efficiency and political feasibility. There is need to lobby for policies that address social-cultural beliefs and practices, which limit women's access and control of land and other capital assets. There is need to lobby for implementation and enforcement of the existing environmental policy and law at the farm level

Bottom up policy formulation should be enhanced and avoid using farmers to rubberstamp already formulated policies. Taxes on natural extraction such as quarry, forest and on-farm tree felling will lead to increased environmental conservation. Issues relating to fiscal and market based policies for poverty reduction and environmental management needs to be explored.

5.3 Recommendations for Further Research

- i. There is need to carry out a similar study in other areas in Kenya so as to compare results and make conclusions and recommendations based on a wider scope to influence policy interventions.
- ii. There is need to assess the profitability and overall benefits of adopting various environmental conservation technologies in order to boost their adoption.
- iii. There is need to adequately evaluate gender issues in dissemination and adoption of environmental conservation technologies so that the needs and concerns of all gender groups are considered to avoid gender bias.

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APPENDICES

1. Farmers Questionnaires

I. General information/Socio-Economic Data

1.

Date: _____
Sub-Location: _____
Village: _____
Questionnaire No: _____

2. Age (years): under 18 [] 18-40 [] Over 40 []3. Household head gender Male [] Female []

4. Level of education

Primary [] Primary Level [] Secondary Level [] Past Secondary []

5. Main occupation

Farmer [] Casual labourers [] Business [] Employed []

6. Income per month

Below Kshs 1500 [] Kshs 1500-4500 [] Above Kshs 4500 []

7. How long have you stayed in this area (years)?

0-5 [] 5-10 [] 10-15 [] Over 15 []

8. What is the size of your land under cultivation?

0- 2 acres [] 2-5 acres [] over 5 acres []

II. Environmental considerations in extension services at the farm level

9. Do you receive any extension services in your farm?

Yes [] No []

10. If yes, from who?

Government/public extension services [] Product specific/ private services []

11. Which service do you receive (please tick)

i. Services related to animal production	
ii. Services related to crop production	
iii. Services related to environmental conservation	
iv. Services related to products marketing	
v. Any other (specify)	

12. Which approach is used to communicate extension services to you?

Demonstration [] training and visits [] farmers field schools []

Others (specify) _____

13a. How would you rate the level of integration of environmental management aspects in extension services you often receive?

Rating	Please tick
i. Very good	
ii. Good	
iii. Fair	
iv. Satisfactory	
v. Unsatisfactory	

b. If unsatisfactory, Why? _____

14a. Do you think more need to done in this regard? Yes [] No []

b. If Yes why _____

c. If No why _____

III. Challenges facing farmers in implementing environmental management strategies at the farm level

15. Please list in order of importance (from 1= most important) what you consider to be the main causes of environmental degradation in you area

Level of importance	Cause
i.	
ii.	
iii.	
iv.	
v.	

16. Please list the environmental conservation technologies you have been taught.

i.	
ii.	
iii.	
iv.	
v.	
vi.	

17. Of the above methods, which ones do you frequently use? (Please list in order of importance).

18. Why do you prefer these methods?

i.	
ii.	
iii.	
iv.	
v.	
vi.	

19. What problems do you face in implementing environmental conservation measures on your farm?

i.	
ii.	
iii.	
iv.	
v.	
vi.	
vii.	
viii.	

20. What do you think are the causes of the problems? _____

21. What do you think can be done to correct this situation?

2. Extension Agents Questionnaires

1. General information/Socio-Economic Data

Date : _____
 Area : _____
 Questionnaire No : _____
 Extension service provider Public [] Private []

2. Gender Male [] Female []

3. Level of education _____

4. How long have you worked in this area (years)?

0-5 [] 5-10 [] 10-15 [] Over 15 []

5. How long have you been in the extension service [] years

II. Challenges facing the extension agents in communicating environmental management strategies at the farm level

6. Please list in order of importance (from 1= most important) what you consider to be the main causes of environmental degradation in you area

Level of importance	Cause
vi.	
vii.	
viii.	
ix.	
x.	

7. Please, list in order of importance the environmental conservation technologies you communicate to the farmers.

	Method
i.	
ii.	
iii.	
iv.	
v.	

8. Why do you prefer communicating these methods?

vii.	
viii.	
ix.	
x.	
xi.	

9. What challenges/problem do you face in communicating environmental conservation messages at the farm level?

Rate	Challenge/ problem
i.	
ii.	
iii.	
iv.	
v.	

10. What do you think are the causes of these problems? _____

11. What do you think can be done to correct this situation? _____

12. In your own opinion, what do you consider to be the positive and negative impacts on the environment as far as NALEP is concerned?

Positive impacts	Negative impacts

13. How would you rate the NALEP on the following items and scale 5-1?

5=Strongly agree 4=Agree 3= Disagree 2=Strongly disagree 1 Unaware

	5	4	3	2	1
1. Economically biased					
2. Environment biased					
3. Has good mix of environment and economy					
4. Has little effect at farm level					
5. Its farmer unfriendly					
6. Difficult to implement					
7. Programme must be re-organised					

3. Problem Analysis

Problem	Causes	Indicators	Coping Strategies	Opportunities	Constraints
1. Lack of technical know how	<ul style="list-style-type: none"> - Poor extension methods - Failure of the community to attend barazas/field days etc and also to seek knowledge 	<ul style="list-style-type: none"> - In appropriate technologies used on farm - Lack of knowledge in farming by the communities 	<ul style="list-style-type: none"> - Use of local knowledge - Copying from neighbours 	<ul style="list-style-type: none"> - Improve on extension services (Multi-disciplinary) - Encourage farmers to farmer training 	<ul style="list-style-type: none"> - Lack of resources e.g. transport, lunch etc.
2. Improper use of fertilizers	<ul style="list-style-type: none"> - Low yield - Low farm produce prices - Poor soils 	<ul style="list-style-type: none"> - Lack of appropriate fertilizers in the farms - Low yields 	<ul style="list-style-type: none"> - Use of farm yard manure 	<ul style="list-style-type: none"> - Use of enriched farm yard manure and compost - Train the community on fertilizer use. 	<ul style="list-style-type: none"> - Lack of resource slow implementation
3. Poor Soils	<ul style="list-style-type: none"> - Poor farming practices - Erosions - Improper use of fertilizers 	<ul style="list-style-type: none"> - Inadequate soils conservation measures - Lack of crop rotation - Low yields 	<ul style="list-style-type: none"> - Use of grass strip and diversion ditches - Use of manure and fertilizer used in tea bush 	<ul style="list-style-type: none"> - Community mobilization to maintain soil fertility - Use of appropriate fertilizers 	<ul style="list-style-type: none"> - Resources and slow implementation
4. Poor farm planning	<ul style="list-style-type: none"> - Over dependence on tea - Low soil fertility to support other crops 	<ul style="list-style-type: none"> - ¾ of the farm planted with tea - buying of food crops 	<ul style="list-style-type: none"> - Re-organizing the land use by diversifying - Use of manure to improve fertility - Cultivation of food crops on the valley bottom. 	<ul style="list-style-type: none"> - Train the community on diversification - Improve soil fertility - Improve marketing of the produce 	<ul style="list-style-type: none"> - Lack of resources - Lack of good market for other produces e.g. horticulture.
5. Low yields	<ul style="list-style-type: none"> - Erosion - Improper use of 	<ul style="list-style-type: none"> - Lack of conservation 	<ul style="list-style-type: none"> - Use of grass strips - Use of manure 	<ul style="list-style-type: none"> - Appropriate soil conservation - Use of enriched 	<ul style="list-style-type: none"> - Slow implementation

Problem	Causes	Indicators	Coping Strategies	Opportunities	Constraints
	<ul style="list-style-type: none"> - fertilizers - Poor farming methods - Pests and diseases - Poor seeds 	<ul style="list-style-type: none"> - measures - Mono cropping - Destroyed crops by pests - Use of local seeds 	<ul style="list-style-type: none"> - and fertilizers - Use of ITK for pest control 	<ul style="list-style-type: none"> - manure - Train ITK - Proper crop husbandry 	<ul style="list-style-type: none"> - Lack of resources for the people
6. Lack of diversification	<ul style="list-style-type: none"> - Poor soils - Lack of exposure 	<ul style="list-style-type: none"> - Over dependence on tea 	<ul style="list-style-type: none"> - Introduction of other crop on the farm - Use of manure to improve soils - Importation of foods from other areas 	<ul style="list-style-type: none"> - Educate the community on proper farm planning. - Train on soil fertility improvement 	<ul style="list-style-type: none"> - Lack of resources - Slow implementation
7. Lack of crop rotation	<ul style="list-style-type: none"> - Lack of options - Small plots left for rotation 	<ul style="list-style-type: none"> - Mono-cropping - Tea and coffee occupying $\frac{3}{4}$ of whole farm 	<ul style="list-style-type: none"> - Inter-cropping - Soil improvement 	<ul style="list-style-type: none"> - Introduce options for the farmer - Train on crop rotation and intercropping 	<ul style="list-style-type: none"> - Resource for the staff
8. Unprotected springs	<ul style="list-style-type: none"> - Under-utilized - Lack of river bank protection - Small sizes of the farms 	<ul style="list-style-type: none"> - Disappearance of the water resources 	<ul style="list-style-type: none"> - River bank protection - Facing with local materials 	<ul style="list-style-type: none"> - Improve on riverbank protection and proper spring protection 	<ul style="list-style-type: none"> - Materials e.g. wire - Retracing the non existing springs

4. Data Summary

1. Socio economic characteristics of the sampled population

Age (Years)	18-40	Over 40		
Frequency	36	46		
%Frequency	21%	79%		
Gender	Female	Male		
Frequency	41	131		
%Frequency	24%	76%		
Education Level	Pre Primary	Primary	Secondary	Post secondary
Frequency	43	65	52	12
%Frequency	25%	38%	30%	7%
Main Occupation	Farming	Employed	Business	
Frequency	160	10	2	
%Frequency	93%	6%	1%	
Income	Below 1500	1501-4500	Above 4500	
Frequency	129	28	15	
%Frequency	75%	16%	9%	
Length of Stay in the Area	0 to 5 Years	5 to 10	10 to 15	Over 15
Frequency	3	3	3	163
%Frequency	2%	2%	2%	94%
Size of Cultivated Land	Over 5 acres	2-5 acres	0-2 acres	
Frequency	45	5	122	
%Frequency	26%	3%	71%	

2. Services Received by Farmers from Agricultural Extension Agents

2.1 Number of Farmers Receiving Extension services on Their Farms in the Area

Response	Frequency	% Frequency
Yes	57	33
No	115	67

2.2 Services Received by Farmers from Agricultural Extension Agents

Extension services	Frequency	% Frequency
Animal Production	62	36
Crop production	57	33
Environmental conservation	45	26
Marketing	9	5

2.3 Approaches Used To Communicate Extension services

Approaches	Frequency	% Frequency
None	103	60
Field schools	66	38
Demonstration	1	1
Training and visits	2	2

2.4 Farmers rating of the Level of Integration of Environmental Management Aspects in Extension services Received

Rating	Frequency	% Frequency
Unsatisfactory	104	61
Satisfactory	2	1
Fair	44	26
Good	22	13
Very good	0	0

3. Challenges Facing Farmers in Implementing Environmental Management Strategies at Farm Level

3.1 Main Causes of Environmental Degradation in the Area

Cause	Frequency	% Frequency
Tree felling	143	83
Drought	81	47
Coffee factory waste disposal	49	29
Poverty and unemployment	121	70
Population pressure	125	73
Ignorance on environmental issues	99	58
Agricultural intensification	46	27
Poor agricultural practices	90	52
Social cultural factors	111	65
Quarrying	30	17
Steep slope	100	58
Overgrazing	22	13

3.2 Environmental Conservation Technologies Farmers Have Been Taught

Technologies	Frequency	% Frequency
Agro forestry	68	40
Water conservation structures	44	26
Good agricultural practice	49	29
Soil conservation measures	50	29
Zero grazing	68	40
River bank protection	68	39
Efficient fuel wood use	38	22

3.3 Environmental Conservation Technologies Most Frequently Practiced

Technologies	Frequency	% Frequency
Terracing	77	45
Agro forestry	172	100
Zero grazing	172	100
Efficient fuel wood use	26	15
Good agricultural practices	37	22
Roof catchments	20	12
Crop rotation	10	6
Grass strips	96	56

3.4 Problems Faced In Implementing Environmental Conservation Measures

Problems	Frequency	% Frequency
Inadequate knowledge of environmental issues	129	75
Social cultural factors	128	74
Small land sizes	118	69
Lack of planting materials	87	51
Poverty and unemployment	112	65
Labour shortage	87	51
Poor law enforcement	98	57
HIV AIDS and reproductive health	87	51
Drought	91	53
Lack of Proper tools	61	35

End