THE SUITABILITY OF THE SHAMBA SYSTEM TO FOREST PLANTATION ESTABLISHMENT IN KIAMBU DISTRICT, KENYA: AN EVALUATION OF SOCIO-ECONOMIC ISSUES.

By

Joram Kimenju Kagombe.

September, 1998

THE SUITABILITY OF THE SHAMBA SYSTEM TO FOREST PLANTATION ESTABLISHMENT IN KIAMBU DISTRICT, KENYA: AN EVALUATION OF SOCIO-ECONOMIC ISSUES.

By
Joram Kimenju Kagombe.

Born in Thika District, Kenya

A thesis submitted in partial fulfilment of the examination requirements for the award of academic degree in

Master of Science (Tropical Forestry)- M.Sc., forest. Trop.

Faculty of Forest, Geo and Hydro Sciences
of
Technische Universität Dresden

Tharandt, Germany

Date of submission: 8th September 1998.

Scientific Supervisor: Prof. Dr Jürgen Pretzsch
Institute: Institute of International Forestry and Forest Products.

Lending ~~admitted~~/not admitted

Dresden September 1998

Chairman of Examination Commission

i.V.

Acknowledgement

The postgraduate study, the field studies in my home country and preparation of the thesis would not have been possible without the support of a number of individuals and institutions. It is my pleasure to acknowledge their help and valuable contribution in this study. I express my sincere thanks to Prof. Dr. Jürgen Pretzsch, the Director of the Institute of International Forest and Forest products, Tharandt, and Supervisor of my thesis for his guidance, advice and valuable contributions during the formulation of the proposal, analysis of data and final write up of the thesis. I would also like to thank him and the staff of the Institute Dr. H. Uibrig, Associate Professor and Dr. H Pohris for their advice and encouragement which contributed to making my stay in Germany enjoyable. I would also extend my thanks to Dr. Deegen, my co-supervisor for the contributions he made to my thesis.

I am grateful to the German Academic Exchange Service (DAAD), who provided me with financial support during the two years period of my study. Without their support, this work would not have been possible. I am also grateful to my employer, Kenya Forestry Research Institute (KEFRI), for giving me a study leave to enable me pursue my studies. I am equally grateful to the Director KEFRI for providing me with transport to go to the field and providing me with the other necessary logistic support during data collection phase.. I cannot forget my colleagues in KEFRI and Forest Department who read through my proposal and gave valuable contributions.

My special thanks go to the foresters, Mr. Muchoki and Mr. Kioko, both working in KEFRI who assisted me in interviewing the farmers in the field. I am also grateful to the farmers who participated in the interviews for their honest answers to the questionnaire and giving us their valuable time. Special thanks also go to the six foresters in charge of the forest stations in Kiambu; Mr. Irungu (Uplands), Mr. Ngahu (Kinale), Mr. Mbugua (Kereita), Mr. Kibuka (Kamae), Mr. Soi (Kieni) and Mr. Mwangi (Ragia) for their open and honest discussion on the shamba issue in the District. I would equally thank the District Forest Officer Kiambu, Mr. Ben Wandago for the great support he gave me during the fieldwork.

Finally I would like thank my Dear wife Beatrice, my daughter Edna and son Ephraim for their support and encouragement during my studies. They were a source of inspiration to me when I was low in spirit. They are the only ones who know what it means to miss a father and husband in pursuit of the objectives, which I have achieved through this study. To them I say, "I owe my success to you".

Dedication

Dedicated to my dear wife Beatrice, my daughter Edna and my son Ephraim for their support, love, encouragement and the pains they went through without the husband/father during my studies

Summary

A social economic evaluation of the suitability of shamba system in plantation establishment and improving the well being of the participating farmers was conducted in Kiambu district, Kenya. The study evaluates development of shamba system in Kenya through literature review and conducts evaluations of the current system through interviews with farmers using a questionnaire and interview with forest department officers (FD) using a prepared checklist.

Shamba system is critical to plantation establishment as shown by the consequences that followed its ban in 1987. It ensures low cost in plantation establishment and high survival of planted seedlings. It was found that methods used in shamba allocation are unfair and this can affect commitment of farmer to forestry. Farmers face serious damage of crops by wild animals and they expect assistance from FD in protecting crops from game damage. The regulations in shamba system are difficult to enforce without participation of the farmer especially due to declining number of FD staff.

Shamba system gives a high return to the participating farmer in the range of Kshs. 120,000 per hectare per year. It creates employment to farmers and ensures food security. Farmers gave a high value for the shamba. This value was Kshs 4295 for an empty shamba and Kshs 11000 for a shamba with crops. This means that the farmer has enough economic motivation to own a shamba. Problems faced by farmers include game damage, short period of cultivation before trees are planted, lack of finances, poor roads and unstable market prices. FD face problem of damage of seedlings by farmers and management problem.

The way forward for shamba system is to consider it as a form of Joint forest management where the communities will get shamba and in return participate in forest protection. The establishment of Forest village committee in areas with shambas can act as a forum where FD and farmer can discuss and solve various problems faced in the system before they get out of control. This will ensure a sustainable system of shamba, which will benefit the farmer and FD. A review of technical orders on spacing would increase the time farmer cultivates before canopy closure. The areas presently allocated for shamba are more than those applicable under sustainable production. This area need to be gradually reduced to only match the annual harvest in each station.

Shamba system has a great potential in being developed as one form of JFM involving the communities in forest management. Participation will ensure sustainability of forest plantations.

List of Abbreviations.

CBS	Central Bureau of Statistics
DFO	District Forest Officer
DO	District Officer
FAO	Food and Agriculture organisation
FD	Forest Department
JFM	Joint Forest management
KEFRI.	Kenya Forestry Research Institute
KFDP.	Kenya Forestry Development Project
KIFCON.	Kenya Indigenous Forest Conservation Programme
KWS	Kenya Wildlife Service
MD	Man-day
NRC.	Non Resident cultivation

Table of contents

List of Tables

List of Figures

List of photos

List of annexes

List of appendixes

1. Introduction, Problem of Research and Objectives.

1.1 Introduction

The Kenya forest sector is today characterised by the problem that the rate of forest estate clear fell does not match the rate of replanting. This results in a rise to backlogs in plantation establishment. For example, of the 170,000 hectares of government owned forest plantations, 20,000 (12%) are open land or were recently felled and not replanted. Backlogs in forest plantation establishment refer to delayed operations in tree establishment and tending. By 1995 there were a total of 17,657 hectares of planting backlogs, 13,386 hectares of thinning backlogs, 22,750 hectares of pruning backlogs and 2175 hectares of coppice reduction backlogs (Wanyiri report, 1995).

The aim of the forestry department (FD) plantation programme is to have a sustainable production of forest products that will satisfy the present as well as the future demand. This can only be ensured by timely replanting of harvested plantation area. Taking the total plantation area of 170, 000 ha and a 30-year rotation period for the main plantation species, it follows that the amount of area that should be cleared and consequently replanted every year should be 5667 hectares. This means that the existing backlog in plantation establishment is 3.5 times the expected figure if sustainability is to be achieved. In addition, silvicultural operations like pruning and thinning are supposed to be performed at a specified time in the tree rotation period for the desired objective to be achieved. Specifically if an operation like pruning which is supposed to produce knot free timber is delayed or not done at the appropriate period in the cycle, the product will be of low quality thus attracting a low market price.

In this work, it is hypothesised that the problems currently being experienced with forest plantation management can be associated with the system, forest department has traditionally adopted for plantation establishment. Since 1910 the FD has been establishing forest plantations using the shamba system. In its basic application, the shamba system can be considered as a temporal contact between a prospective farmer and FD. In this contract, the FD as the owner of the land is interested in the establishment of plantations at a low cost. It invites the farmer to assist in this process in exchange of allowing him/her to cultivate crops in the forest. The FD and farmer enter into a contract that specifies the obligation of each party in the agreement. In the agreement, farmer clears the allocated forest area and then cultivates subsistence crops for 18 months after which the FD plants trees in the plot. The farmer take care of the planted trees while cultivating crops for the next three years or until the tree canopy closes. The farmer then leaves the plot for another one to start the cycle once more. In the forestry concept, shamba system is a form of "taungya" planting system that was first used in Southeast Asia. In its Kenya version it had the built in defect that cultivators were allowed to reside in the forest. This is in contrast to the taungya system of South East Asia where farmers were not allowed to reside in the forest. This meant that the farmers could eventually acquire a squatter status.

From its inception in 1910 to date, there have been various changes in the management of shamba system, including a period between 1987 - 1994 when the system was banned. These changes have had direct impacts in terms of delay in plantation establishment, as well as success and failures of these plantations. The changes have also had direct socio-economic impacts on the farmers who are partners in plantation establishment process.

The purpose of this study is to trace the development of the shamba system in Kenya in order to study its impact on forest plantation establishment and on the socio-economic well being of the communities residing in the neighbourhood of the forest. The study will also evaluate the suitability of the current shamba system method to the FD and to the participating farmers. The aim is to develop a concept on how the shamba system can be implemented for the benefit of forest plantation establishment and for the economic benefit of the communities surrounding the forest. In this connection the Shamba system will be analysed as one way of community participation in forest management in government owned forest plantations.

1.2 Problem of research

Shamba system is currently the main method used for forest plantation establishment. There have been a lot of arguments for and against the system. This is in relation to the perceived benefits and harms it has on forest establishment. These arguments led to the ban of the system in 1987, only for it to be reintroduced as Non Resident Cultivation (NRC) in 1994. There are very few studies done on shamba system despite the debated pros and cons of the system. Shamba system as reintroduced in 1994 is being applied with some of the inherent problems from the former system. In addition, some new problems have developed since the conditions of NRC are different from the former system.

It is important to review the development of shamba system with special regards to what contributed to the failure and success of the system. The current system being practised will be evaluated for its suitability for plantation establishment and improving the sub-economy of the communities neighbouring the forest stations. The study will look into the financial analysis of shamba system since it is an important aspect for its success. The re-establishment of the felled plantation is one of the necessary preconditions of sustainable management of forest and so the proposed project will contribute to sustainable management of the Kenyan forest.

In the study, it is recognised that the current trend in forestry management is to move towards participation of communities in management of forest resources. It is difficult to police forests especially in areas where high populations surround it. The way forward is to involve the communities in conservation and protection. Shamba system or NRC offers one way in which the communities can be involved. However for it to succeed we have to take into account the practice and constraints faced by the farmer as well as FD in management of the system. This will guide in looking for joint solutions that will ensure

that the farmer and FD work jointly for the improvement of the system and hence better plantation establishment, as well as improving the social economic well being of the local communities.

The study is done in four out of the six forest stations in Kiambu district. The choice of the four stations is to bring out various situations and conditions under which shamba system is practised. While the system is very successful in some areas, it is not appealing in other areas. These different conditions will bring out results which are a good representation of the shamba system situation in the district and which can be applied with a bit of modification in other areas where shamba system is being practised.

1.3 Objectives of the study

In an attempt to solve the problems stated in the introduction and problem statements, the following objectives were drawn,

- Analyse changes that have taken place in shamba system in a historical view.
- Investigate how suitable the current shamba system is for plantation establishment.
- Investigate how suitable the current shamba system is on socio-economic situations of local community.
- Give a prognosis on improvements of the shamba system

The three working hypotheses for the study are:

- Historical changes in shamba system have affected its success in plantation establishment.
- Shamba system is suitable to forest plantation establishment.
- Shamba system improves the socio-economic situations of the farmer and the local community.
- Success of plantation establishment in the future depends on optimal utilisation of shamba system for continued benefits to the farmer and FD.

2. Research Methods and Data Collection Procedures

2.1 Research methods

A combination of different methods was used to collect socio-economic data, assess impacts of policy changes on plantation establishment and conduct a financial analysis of shamba system. The data collected was quantitative and qualitative data. The socio-economic data of participating farmers was collected through face to face interviews using a questionnaire. The set-up of the questionnaire was made using the guidelines provided by Czaja and Blair (1996). A sample of questionnaire used to interview farmers is provided in Appendix 1. Data collected from surveys were,

- Farmers skills and experience in forestry
- Shamba system practices
- Production output and costs in the shamba
- Interaction between farmer and FD
- Improvement on shamba system
- Personal information

The interview of FD officers was done using a prepared checklist of questions for discussion. This checklist is provided in Appendix 2. Three case studies were done on the cash flow of the farmer throughout the year. This was to enable compilation of financial analysis of shamba system. Detailed inputs and output for the farmer in the whole year was compiled. In addition data on yields and prices of the farm inputs and outputs were collected. The prices used in the calculations are the farm gate prices[1] as described by Gittinger (1995).

The secondary data collected were

- Literature on shamba system development from past publication and FD records.
- FD Staff strength from 1984 to 1997 in the study area.
- Planted and clear-felled plantation areas from 1985 to 1997 in the study area.

2.2 Selection of respondents and data collection procedures

2.2.1 Socio-economic survey of farmers.

The questionnaire used was translated to Kikuyu language which is the main local language spoken by the farmers in this region This was done to make it easy for respondents to understand the questions. It was pre-tested before the study and later modified. A total of 140 farmers were interviewed in four stations. The number of interviews per station were predetermined depending on the number of farmers, restraint in resources and extent of area under shamba system. The numbers selected in the four stations were 40, 36, 34 and 30 in Uplands, Kinale, Kamae and Kieni forest station respectively.

[1] Farm gate price is that price of an input or output at the farm boundary i.e. as it leaves or enters the farm.

In each station the area under shamba was marked using the existing forest blocks. Three areas were selected at random in each station. Farmers cultivating in these areas were selected by a combination of systematic sampling and convenience sampling. While it was felt that systematic sampling would have been the best method, there arose a problem since some of the farmers selected would not be available for interview. Majority of the farmers stays far away from the forest area and so it becomes difficult to trace them. The method that was finally adopted is where the researcher would visit the selected area without notifying the farmers and then sample using the farmers he will find working in the shamba at that particular day. The sampling was ensuring a minimum distance of 10 shambas from one farmer to the other.

Interviews were conducted in person. Before the start of the interview, the farmer was explained about the purpose of the interview and the persons conducting the interview. He/she was also assured of the confidentiality of the information given during the interview. As one step to assure this, the farmer was informed that the interviewer would not write the name of the farmer in the questionnaire. This was to build up confidence with the farmer in order to ensure participation. Due to the extent of the study area and time constraints, the author did the interviews with the help of two assistants. The two assistants have a Diploma in forestry management and a long experience in forestry research and so could easily understand the contents of the interview. Both of them work in KEFRI. Before the interviews, they were trained on the contents of the interview and the objectives as well as the approach to be followed. The questions in the interview were straightforward and the respondents did not require any special skills to answer the questions. It is hence considered unlikely that interview bias had any role in the study. The general impression is that the respondents understood the questions and they took the exercise seriously.

2.2.2 Interview with Forest Department officers

The author interviewed the six-forest officer's in-charge of the forest stations. They included the foresters in the four stations under study namely Uplands, Kinale, Kamae, and Kieni. In addition, two more foresters from neighbouring stations i.e. Kereita and Ragia forest stations were interviewed. Unlike the farmers, the numbers of forest officers were few and so the interview was conducted using a prepared checklist of questions instead of a questionnaire. As the case with the farmers, the first task was to build up confidence with the foresters. This was necessary since some of the issues being discussed were to touch on weaknesses in his station. The forester was asked to be free in discussing the problems with an aim of getting the solutions to problems in shamba system. In all the interviews, foresters understood the questions and took the exercise seriously.

2.3 Validity and Reliability.

In a survey research, it is the responsibility of the researcher to provide evidence on the validity and reliability of the survey instrument. Validity in measurement theory refers to a measure, which provides an accurate representation of what one is trying to measure (Mitchell & Carson 1989). In this connection an attempt was made within the

questionnaire to test the internal consistency of the information collected. Asking a question and then following it with a more probing one or asking for an explanation of the answer given did this[2].

Reliability refers to the degree of consistency with which instances are assigned the same category by different observers or by the same observer on different occasion (Hammersley, 1992a). This was done by trying to ensure that each respondent understands the questions in the same way and ensuring proper coding without possibility of uncertainty. According to Silverman (1993), this is achieved through pre-testing of the interviews, thorough training of interviewers and trying to use more fixed choice answers. The questionnaire was pre-tested and later modified.

2.4 Administration of the survey

Each interview with a farmer took 45 to 60 minutes for a questionnaire with 70 questions. The interview with FD officers took one to one and half hours. A one-day training was done to the interviewers where each question was explained in details and the objectives of the interview clearly spelt out. The author did coding of the data with special attention being made to avoid uncertainty. The survey was conducted between December 1997 and April 1998. This was a very wet period brought about by *Elnino*[3] weather phenomena.

2.5 Selection of study area.

Kiambu District was selected as a representative of the medium to high potential areas where most plantations are situated. The stations in the district where the study was based were chosen to give the different views of the farmers in the district. This was used to get the general view of the farmers in the district.

2.6 Analysis of data.

Data collected were coded and then entered into Special Programme for Social Sciences (SPSS) statistical programme. A frequency run was done for each of the questions in the study, first per each station and then for all the stations combined. The questionnaire had 70 questions and so some responses were bound to show significant difference between the stations and other no differences. The aim of the study is mainly to get the opinions of the farmers and being explorative study, no analysis is done for the statistical differences between the stations in each question. The data is sorted by topics in order to address specific issues under the study. The research outputs are presented in form of tables, graphs, pie and bar charts.

---

[2] For example in question 4 the respondent was asked whether he/she was involved in shamba system prior to the ban in 1987. A Yes response is followed by being asked whether he/she was staying in forest area (Question 5). The farmer is then asked whether there is a difference between the present and former system of shamba system (question 6) and if yes he/she is asked to explain the difference (Question 6 b). A valid answer should be consistent in all these questions

[3] Elnino refers to strange weather phenomena associated with heavy rainfall.

2.6 Report compilation:

This research report has been compiled by following the Linear- Analytical structure. This is a standard approach for compiling research reports in which the sequence of the subtopics is the issue or problem being studied, the method used, the findings from the data collected, analysis, conclusions and implication from the findings. The structure is applicable to exploratory, descriptive, or explanatory studies. The structure is comfortable to most investigators and probably is the most suitable when the researchers or a thesis or dissertation committee are the main audience of the study (Yin, 1988). The research report has been done using text, tables and diagrams. The guidelines on reporting have been adopted from Fink (1995) book on how to report on surveys.

The report adopts two levels of formatting, the normal text and a condensed text with smaller font. The condensed text is for explaining differences between the stations or any other secondary differences. The tables and figures numbering are done separately in each chapter. This form of presentation is adopted from Gregersen et al (1994).

3. The Development of Shamba System in Kenya

3.1 Evolution of shamba system

The evolution of the shamba system in Kenya gives the changes that have taken place since its inception. According to Poffenberger and McGean (1996), the current global crisis in forest management is embedded in the past historical process through which state forestry institutions evolved over the past century. These problems will endure into the future unless societies and their institutions understand the lessons of the past and act upon them. This section seeks to understand the changes and lessons learnt in Kenya.

3.1.1 Early efforts in plantation establishment.

D.E. Hutchins (Chief Conservator of Forest in Kenya, 1907 to 1911) started the forest plantation development in Kenya in 1910. It was part of ''compensatory`` plantation policy which was borne from concern about the sustainability of wood from indigenous forests. Indigenous forests had very low growth rate compared to the introduced exotic tree species, which had fast growth rates. The interest of the FD was to establish plantations at a low cost. The labour force for the establishment of these forests came from the Kikuyu people who were practising traditional shifting cultivation on land that had been included in the newly created forest reserves in the Central highlands (Logie and Dyson, 1962). The system of establishment was known as ''shamba system[4]``.

In shamba system, resident labourers agreed to work for wages for nine months of the year, and to cultivate plots of land that were allocated to them by FD. In the second year, food crops were inter-planted with forest trees, which the cultivator had to look after until they were big enough to survive, that is until canopy closure. New plots were allocated each year, and each family could hold up to a maximum of six acres (2.4 ha) on a 3 – 4 year cycle. In the forestry concept, this was a form of ''taungya`` planting system.

The word taungya was reported to have originated in Myanmar (Burma) and means hill (*Taung*) cultivation (*ya*) (Blanford, 1958). It was originally the local term for shifting cultivation but was used later to describe afforestation method. Taungya system was first developed by, Dietrich Brandis, a German forester working in Burma, India. When Brandis was working in Burma, India in 1856 there were several cases against villagers for encroaching on government reserves. He realised the detrimental effect of shifting cultivation on the management of timber resources and encouraged the practice of ''regeneration of teak`` (*Tectona grandis*) with the assistance of taungya based on the well known German system of *Waldfeldbau*, which involved cultivation of agriculture crops in forests (Blanford, 1958). Taungya consists of growing annual agricultural crops along with forestry species during the early years of forest plantation establishment. The land belongs to forestry departments or large-scale owners, who allow subsistence farmers to raise their crops. The farmers are required to tend the seedlings and in return, retain a part or all of the agriculture produce. This arrangement would last for two or three years, during which time

[4] Shamba is a Kiswahili word that means a plot for cultivating food crops

the forestry species would grow and expand its canopy (Nair, 1993). Taungya has been the second most important means of afforestation after the direct establishment in the tropics. Taungya system seeks to satisfy a social need (land for growing food and food production itself) and establishment of the plantation, thus its difference in establishment is largely social but not silvicultural (Evans, 1992).

As more areas were opened for plantations in Kenya, the number of people employed under shamba system increased steadily and by 1975 the number was estimated at 9000. The system developed in areas where the communities had a tradition of farming, fertile soils in the area and a high demand of land to cultivate. In 1966 there were 140,000 hectares of existing forest reserves mainly in Kenya highland, which were put under this system. The soils in these areas were generally productive under agriculture crops. The shamba system practised in 1960`s involved the integration of the cultivators into the FD. This was the main difference of shamba and taungya system. Under the shamba system as organised then, the resident workman agreed to work for FD for nine months each year, and to clear in his own time the salvage left after the indigenous bush cover is harvested. Each farmer was allocated 0.4 to 0.8 hectares each year. The FD would then plant the trees in the cleared land (shamba) after 18 months and then the farmer would keep the trees weeded for three years. After clearing the land the farmer would plant his crops, and have 18 months free of trees and then continue with his crops and trees for 3 more years, after which the canopy will have closed.

By tradition men carried out the initial clearing and women did the subsequent shamba cultivation. This allowed men to take up employment in the FD while women would look after the shamba. The FD guarantied the resident workman nine months of work per year, supplied a house and land for shamba cultivation, assisted in felling large un-merchantable trees during clearing, allowed the growing of annual crops (maize, potatoes, beans, peas, and other vegetables) and pasturing of 15 sheep. The resident workman duties included nursery work, planting, weeding, pruning, and house and road construction. The produce from the participant's shamba was considered as part of his emolument. An assessment made in the 1960s showed that depending on the distance from the shamba to the market, demand, state of the market, and after providing for the family needs, the surplus agriculture produce could be worth up-to 2.8 times the annual minimum agriculture wage applicable in the area (Wanyeki, 1978). The surplus shamba produce made a significant contribution to the national food production. In 1962 and 1963 the maize marketed by this 1% of the population contributed 6 - 10% of the total smallholder production and the potatoes production an even larger proportion of the national production established. The main key factors, which contributed to the success of shamba system, were:

Land hunger and the availability of hard working traditional shifting cultivators.

The facility with which shifting cultivation could be developed into shamba agri-silvicultural system.

Good fertile forest soils.

Increased government inputs in housing, social services (schools, health centres) and settled forest villages.

In 1969 and again in 1975 the World Bank arranged external capital funds to be made available to the industrial forest plantations. Part of these funds went to construct houses for workers in the forest as well as to provide the necessary social amenities like schools and health clinics. After the second forestry plantation project, the World Bank discontinued support for forestry compensatory planting scheme (World Bank Report, 1969 and 1975). This reduced the rate of conversion of natural forests to plantation and so the rate of opening new shambas.

3.1.2 Change in 1975

In 1975 a change was introduced in shamba system management which was to have serious consequences for plantation establishment. The resident workers, who had hitherto worked under the conditions imposed by the shamba system, were given permanent employment on civil service terms with a monthly salary and no stated daily minimum task. They could no longer be dismissed or evicted at the discretion of the forest officer in-charge of each station. They were required to maintain the shamba as before, but there was no way of enforcing the necessary weeding. The absorption of the workers to FD resulted in significant increase in cost of plantation establishment. It was estimated that out of 9000 shamba workers, only 6000 full time workers were required to meet the needs of the plantation establishment programme. Many of the young men who were employed were not interested in cultivating their plots, and those who did so tended to abandon them after a year or two before the trees were big enough to survive competition with weeds (World Bank, 1984).

When the resident workmen became licensed cultivators, they began to concentrate on their own crops paying less attention to the young trees. It became difficult to control them, or to persuade them to work in more remote and agriculturally less profitable areas. They also began to sublease the plots to the outsiders at higher prices and then ask for more new plots from the forest managers. This meant that large area of clear-felled plantations and existing natural forests were being allocated each year and total land under forest cover was being reduced. The knowledge that the outsiders had on tree establishment methods was inadequate as compared to the resident workmen. As a result shambas were poorly tended. The urge by farmers to get as many areas as possible resulted in some cases where excessive debris and old stumps were left in the cultivated plots. These stumps became the breeding ground of honey fungus, *Armillaria mellea*. This fungus causes heart rot, which results in the death of planted trees (Kiriiya, 1994).

The influx of people to the forest areas and high birth rate in the forest villages led to increase in population and so higher demand for more land for cultivation. The livestock

population also increased which led to animals feeding in the wrong places with some feeding on the young trees. The high demand of land meant that new shambas were being allocated every year, even if the tree planting for the previous year had not been successful. The reduction of forest area by squatters, forest labourers, and their extended families, retired forestry workers and licensed cultivators from outside the forest resulted in low production of wood and reduced density in the forest. Overstocking of cattle and sheep accelerated soil erosion and degradation on steep slopes where trees were firmly established.

In a World Bank report in 1988, it was indicated that there was a serious problem with cultivators destroying the trees planted under shamba system, through cutting roots and debarking, in-order to assure themselves of adequate supply of land. Seedling survival rate was reported to be 60-70% on average as compared to the normal 90%. In addition there was pressure from overgrazing in the forest, including from some newly established plantations. An estimated 1500 hectares of newly established plantations in Mt. Kenya were damaged. The population in one forest village was reported at 4000 families eking a living out of FD shamba system (World Bank, 1988).

3.1.3 Shamba system banned

In 1987 the government made a drastic radical change in policy as regards shamba system. The shamba system was banned through political pronouncements. The ban was a culmination of the events, which had lead to corruption of the arrangements that were necessary for proper functioning of the system. As explained above the change in policy in 1975 changed the resident workmen with licensed cultivators. This brought with it problems which led to reduced success in shamba system. In addition the population influx in the forest stations was exerting a lot of pressure on the forest resources. This was compounded more by the political nature of the squatter system especially in regard to being allocated land to settle in the forest. The earlier benefits of the system were overshadowed by the mentioned problems. These reasons led the Government to ban the shamba system.

The government then authorised the eviction of non-forest workers from the forest villages. This was followed by demolition of the houses, which had been put up (mainly timber structures) for the villagers. The removal of the people from the villages had to be done forcefully in some areas using the FD staff and Administration, since quite a number of people had no land outside the forest area where they could settle. In some few areas like in Kinale, these villagers were allocated part of the forestland where they settled. However in other areas, we do have forest squatters up to now. There are about 3300 households who became squatters when shamba system was abolished (Kenya Forestry Beyond, 2000, 1994).

3.1.3 Impact of ban on communities

The abolition of the forest village set-up resulted in closures of social amenities like schools and shopping centres. The forest workers who remained in the forest had to get accommodation outside the forest areas where their children could enrol in schools. This meant that they could work for only few hours since they had to walk long distances to the place of work in the morning and in the evening. The life in the forest area became quite expensive since food, which was formally readily available, was no longer there. The forest areas became importers of food rather than exporters. The farmers who had relied on the shambas lost their earnings.

The ban also meant that the surrounding communities neighbouring the forest areas lost one major benefit, which made them, associate with the forests. The people, who were formally engaged in shamba system as cultivators, middle-persons for marketing the produce, transporters and hired labour, all lost their employment. The contribution of the food supplied by shamba system to the national economy was also lost. All these losses affected the socio-economic wellbeing of the communities living within the forest reserves and their sub-economy in return.

3.1.3.2 Impact of ban to FD

The greatest effect of abolition of shamba on FD was the resultant backlogs in plantation establishment. The FD staff who remained could not prepare sites, plant seedlings, weed them and cope up with the clear-felling rate. Less than 20% of the clear-felled area was replanted and 80% of that which was replanted was neither weeded nor cleared of climbers due to shortage of labour (Kenya Forestry Master Plan, 1994). Other silvicultural operations were equally affected since the FD mobilised its staff mainly in planting operation. The analysis, based on FAO/Government of Kenya plantation inventory of 1989-92 revealed that:

54% of the area in the establishment phase was understocked

96% of the area in the maintenance phase had backlogs in silvicultural treatment

The above backlogs will have long time implications in terms of loss of produce from the forest. The supply of forest produce will not be met in future and the concepts of forest sustainability cannot operate under these conditions. Reduction of plantation forest will lead to more exploitation of the remaining natural forests, thus eroding the rich bio-diversity contained in these forests.

The decision to ban the shamba system came at a time when FD had not tried out any other system of plantation establishment. The system that they started trying were showing failures due to high weed competition, damage by wild animals and increased incidents of rat damage which was not noticeable before. The methods tried out included burning and slashing, pitting, planting immediately after clear-fell and spot weeding. However there

was no clear method which was prescribed for a particular species. The main constraints of these methods, which were being tried out, were low survival, lack of funds for operation and lack of labour. Serious weed competition and damage of trees caused by wild animals led to reduction of survival rate of the planted trees. Damage by rats, mice and rabbits caused high mortalities to juvenile trees. Trees, which survived this first damage at sampling stage, were subjected to later damage by bushbucks, antelopes and monkeys. Elephants damaged the mature trees. The cost of plantation establishment became very high. The number of labourers working for FD could not cope up with plantings, tending as well as other silvicultural operations. This resulted in poor survival sometimes down-to 30% or lower due to damage of the trees. The issue of labour shortage is really debatable since this is the time when FD was reported to be over-staffed. The inefficiency of the workers, lack of motivation and lack of proper supervision did contribute to the low area of established plantations.

The abolition resulted in loss of the advantages connected with the system both to the trees as well as to the communities neighbouring the forests. This state of affairs continued up-to 1994. By then vast empty areas of clear-felled forest existed. In some cases the private sector was involved in plantation establishment. The pulp and paper company, for instance has since 1987 carried out at its own cost a considerable part of the annual reforestation and early tending of the FD pulp wood plantation. It is also involved in forest road construction and maintenance. Upon the FD request, most of the large sawmills have since 1989 joined ranks on a ''harambee[5]'' basis to eliminate backlogs of pruning and thinning as well as replanting in FD plantation cycle (World Bank Report, 1990). This type of arrangement have had little impact since sawmills being a private enterprise would naturally require compensation if they have to undertake plantation operations in government forests. Furthermore, some silvicultural operations are being carried out too late that they will only increase cost without any resultant benefit (e.g. late pruning). The concern of the private sector in forest establishment is the sustainability of continued supply of raw materials. As for now, the government forest remains the biggest supplier of the raw materials to the private timber industries. The other source of the materials is the private farm woodlots planted as agroforestry trees in small farms. The private sector prefers government forest due to low cost of materials and low transportation cost since they can be able to get large quantities in one place.

3.1.4 Shamba system re-introduced

In 1994, the FD allowed limited allocation of shambas to pilot districts mainly in central province. It was re-introduced as Non-Resident Cultivation (NRC). Due to the earlier problems faced in shamba system, the government decided that future plantation establishment will be done through non-resident cultivation. The situation under which the farmers had to operate from was however different from the shamba system practised in 1987. The farmers had to operate from neighbouring agriculture reserve areas since the

houses in the forest were put down. This has resulted in farmers only choosing the land which is more accessible, mainly near the roads but those areas deep in the forest are not attractive due to poor infrastructure and game damage.

The NRC as introduced in 1994 has different form of administration. The local administration was incorporated in issuing and overseeing plots. The local District Officer (D.O.) is the chairman of the NRC plot issuing committee. The idea was to use the local administration to identify the needy cases in the society. This has not worked very well. There are complaints of the NRC being interfered by the administrators as well as the politicians. In the areas where it has been re-started, plantation survival is once again going up-to 90% and this provided hope for the future plantation development. According to a World Bank midterm review report for KFDP, the gradual reintroduction has greatly improved both survival and growth of the young plantations. However difficulties still exist in areas which are not covered by NRC mainly in areas which have high incident of game damage. By 1996 there existed 11000 hectares of replanting backlogs, 8500 hectares of pruning backlogs, 5000 hectares of first thinning backlogs and a further 1000 hectares which required coppice reductions (KFDP Midterm Review, 1996)

3.2 Importance of shamba system and its way forward in Kenya.

The issue of shamba system in Kenya attracts different opinions by both professional and politicians. The shamba system was based on squatter labour. The squatter status of the labourers had become a source of strong political pressure to excise forestland for permanent agricultural settlement and the government decided that future plantings would be done by non-resident labour (Ochieng et al, 1980). It is important to understand the reasons that led to the original ban in order to avoid a repeat of earlier misuse. Shamba system is not applicable in all forest areas especially in areas where the farmer stands to loose due to crop damage. There is need for the FD and researchers to study the system again in order to solve the problems faced by the farmers and FD in implementing it. According to a document from Kenya Forestry Master Plan, the issue of shamba system can be resolved by instituting a socially more desirable agroforestry system that does not entail political pressure to excise forestland. The system can resemble shamba system, but with its legal, political or social connotations which will guide the forest managers in its implementation (Kenya Forestry Beyond 2000, 1994). A midterm review report of KFDP sees the shamba system as the compromise solution to the pressure by the surrounding communities to excise the forestland. The land use pressure in areas where the plantations are situated have to be understood as a fact of life with increasing rural populations and high demand for food. The report recommends that the economics of land-use in plantations should be examined (KFDP Midterm Review, 1996).

The shamba system has an advantage of providing land for subsistence cultivation and thus relieving the pressure on forestland both for encroachment and cultivation, and from

[5] Harambee is an adopted Kiswahili word for joint efforts in raising funds for a particular project.

unsustainable exploitation by land-less people. This can act as a solution to the landless people who live within neighbourhood of forest areas. Beside the 3300 households who became squatters when shamba system was abolished, there exist 4000 households of traditional forest dwellers and 530,000 households living at a distance of less than 5 kilometres from the forests (Kenya Forestry Beyond 2000, 1994). The shamba system benefits to the rural communities would go a long way in achieving the government efforts of poverty alleviation as is spelt out in the current National Development Plan. In the plan, it is stated that poverty reduction will be given great emphasis especially considering that 11 million Kenyans live in absolute poverty and majority of them live in rural areas (National Development Plan, 1997-2001). It can be derived from the above discussion that shamba system was and is still important for plantation establishment as well as improving the well being of the surrounding communities.

One benefit of shamba system is low cost of plantation establishment. Taking a wage of Kshs[6]. 80.00 and the current task rates, cost of establishment of plantation per hectare, compounded at 15% to the end of 30-year rotation, was found to be approximately Kshs. 277,000 for NRC areas and 753,000 for non-NRC areas. This means NRC is critical to economic development of plantations (World Bank Supervision Report, 1996). The FD has reduced their staff for the last four years through the retrenchment programme, which has an aim of reducing government expenditures. This means only a skeleton staff remains in the stations. To be able to establish the plantations, NRC will be important. A second benefit of shamba system is increased tree growth. Growth of the trees planted under shamba system has been reported to be higher than in unattended tree plantations (Pudden, 1953. Konuche and Kimondo, 1990). This is contrary to the earlier view, which claimed that growing trees under taungya reduces the growth (FAO, 1967b). The disadvantages of shamba system to the trees include tree damage by the farmers, squatter problem, and high demand of plots due to high population, which leads to abuses of the system.

On the other hand shamba system has benefits to the communities in terms of employment, and increasing the food supply and so food security. These two lead to improvement of the well being of the communities surrounding the forest areas. Shamba system reduces the pressure on the forest and makes the local communities to identify themselves with the forest. The problems the system has in its application to the communities include issue of squatter problem, FD not considering the plight of the farmers, wildlife damage, problems of infrastructure, poverty problems in the communities and issue of the sustainability of the shamba system.

[6] Kenya Shilling. 1 DM = 32 Kshs. As per July 1998

4. Description of study area and Respondents

4.1 Description of study area

4.1.1 Location and size

The study was conducted in Kiambu District, which is located in Central province in Kenya. Kiambu District borders Nairobi City and Kajiando District to the south, Nakuru District to the west, Nyandarua District to the Northwest and Thika District to the east (See Figure 1). It lies between latitudes 0° 75′′ and 1°20′′ South of the Equator and Longitudes 36°54′′ and 36°85′′ East. The district has a total area of 145.3 square kilometres. Table 4.1 shows area per division.

Table 4.1: Area of Kiambu district by divisions

Division	Area (Km^2)
Lari	564,7
Limuru	290,6
Kikuyu	239,7
Kiambaa	191,7
Githunguri	171,6

Source: District survey office, Kiambu, 1996

Lari is the largest in area and most of it is under forest cover. Kiambu district is divided into 5 administrative divisions, namely Kiambaa, Limuru, Githunguri, Kikuyu and Lari. It has a total of 22 locations and 90 sub-locations (See Figure 4.1).

4.1.2 Topography and climate

The four areas of study are situated in the upper highlands of Kiambu district in Lari division. This is an extension of Aberdare Ranges. It lies at an altitude of 1800 metres above sea level and is dominated by highly dissected ranges. The upper parts are very wet and steep and are important water catchment areas. The soils are of high fertility, well-drained, very deep, and dark reddish brown to dark brown, strongly calcareous. The climate in Kiambu is influenced by altitude. Annual rainfall varies from 845 mm in Ruiru, situated on 1555 metres above sea level to 1373 mm at Kereita forest, which lies at an altitude of 2438 metres above sea level. Distribution of rainfall is also influenced by altitude, because the leeward part of the escarpment receives less rainfall than the windward side. The rainfall regime is bimodal, with long rains occurring in between April and May while the short rains fall from October to November. Temperatures are determined by altitude. Average temperatures range from 20.4° C in the upper highlands to 34° C in the lower midland. The hottest months are January through March, while lowest temperatures are experienced in July and August. Rainfall is reliable and favourable for agricultural activities. The four areas covered in the study are almost productive throughout the year.

Figure 4.1: Map of Kenya showing Location of Kiambu District

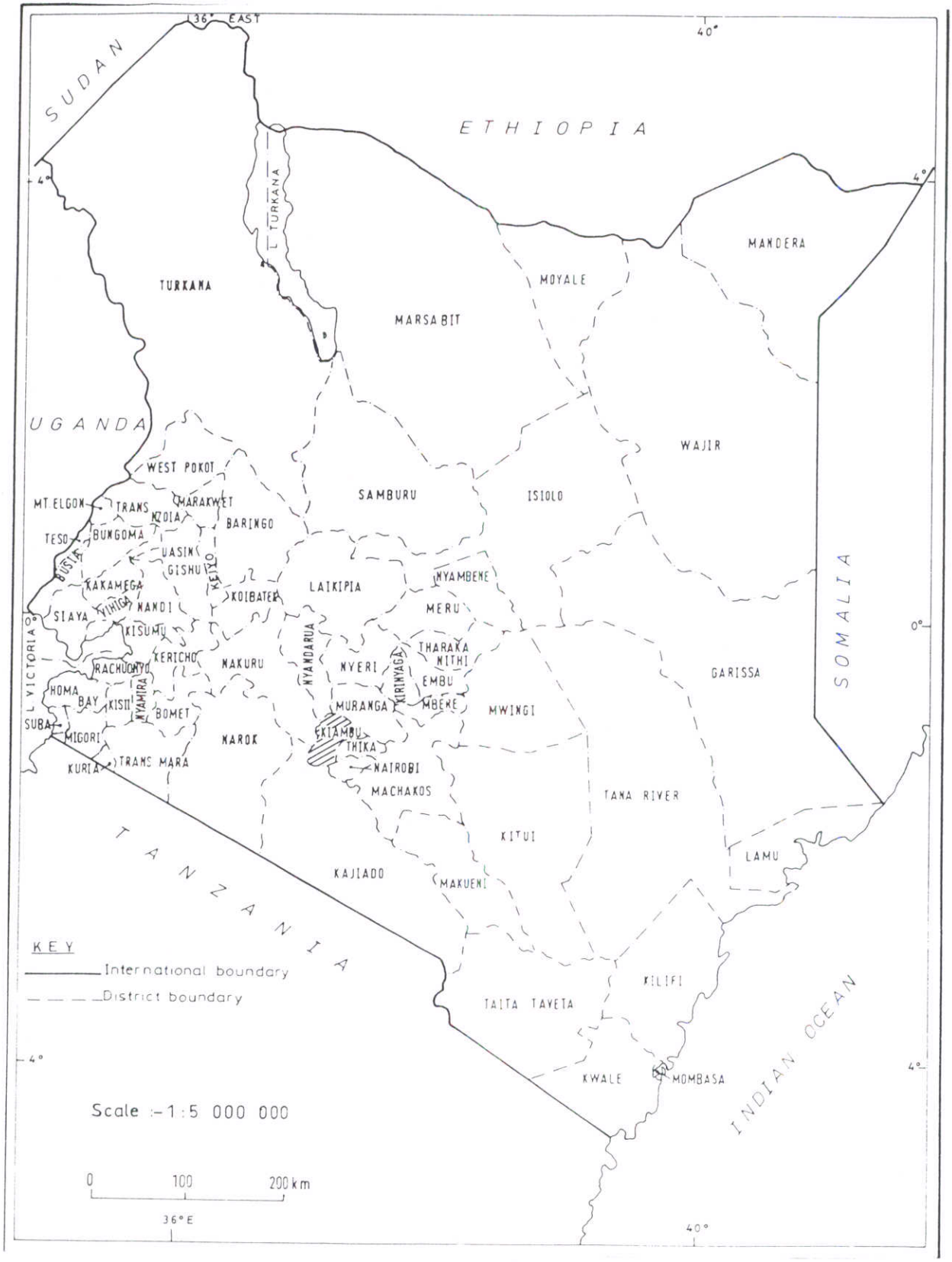
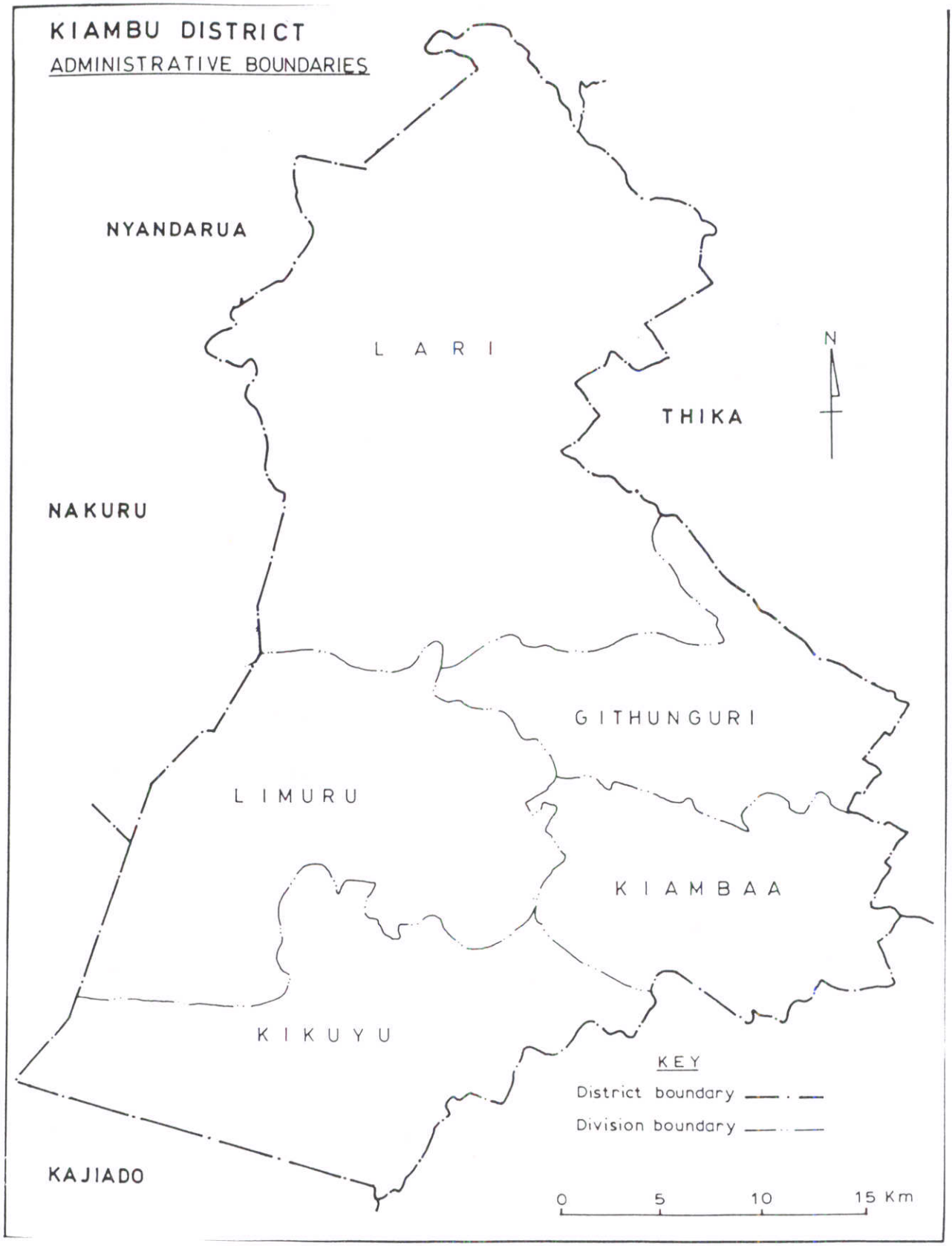


Figure 4.2: Kiambu District Administrative Boundaries



4.1.3 Demographic and settlement patterns

4.1.3.1 Population size.

The district had a population of 575,968 persons in 1989[7] with an estimated growth rate of 2.0 %. If the same growth rate prevails, this population was projected to rise to 724,606 in 1997, 767,209 in 1999 and 812,535 in 2001. Table 4.2 shows the population projection by age-cohorts for 1997 to 2001.

Table 4.2: Kiambu District population projections by age cohorts 1989-2001

Age cohorts	1989	1997	1999	2001
0-4	88,165	110,918	117,271	124,411
5-9	85,791	107,931	114,307	121,060
10-14	79,104	99,519	105,398	111,624
15-19	66,473	83,628	88,568	93,800
20-24	60,949	76,679	81,209	85,905
25-29	50,524	63,563	67,318	71,295
30-34	32,508	40,897	43,314	45,872
35-39	26,403	33,216	35,179	37,214
40-44	20,764	26,123	27,666	29,266
45-49	16,156	20,326	21,527	22,771
50-54	12,147	15,283	16,185	17,141
55-59	8,513	10,710	11,343	12,014
60-64	7,073	8,900	9,424	9,982
65-69	5,806	7,305	7,736	8,193
70-75	4,574	5,750	6,088	6,447
75-79	4,079	5,128	5,430	5,749
80+	6,359	8,000	8,473	8,973
Age NS	580	730	773	818
Total	575,968	724,606	767,209	812,535

Source: District Statistical Office, Kiambu, 1996

*Age NS = Age not stated

The table shows that the district has a large proportion of youthful population. The ages 0-24 represent more than 50% of the total population. This means an increase in demand of facilities. The age groups 0-14 and 60-80+ represent 49% of the total population. This is dependant population, which is not economically active, and so a lot of funds have to be spent to support this group.

4.1.3.2 Population Structure, Distribution and Density

The sex ratio is 1:0.99 for male: female. A comparatively high female population is actively engaged in subsistence farm sector as unpaid family labour. Population in Kiambu is not evenly distributed. Some divisions like Kiambaa, Githunguri and Kikuyu have more people than Limuru and Lari, which are sparsely populated. This is because of better infrastructure and job opportunities in the former divisions. Table 4.3 shows population densities per division and the projected increment.

[7] Last population census was done in 1989. Another census will be done next year (1999).

Table 4.3: Kiambu District Population Density per Division (Persons per Km²)

Division	Area (Km²)	1989	1997	1999	2001
Kiambaa	191.7	711	895	948	1004
Githunguri	171.6	686	863	914	968
Kikuyu	239.7	601	757	801	849
Limuru	290.6	310	391	414	438
Lari	564.7	155	195	206	219
Total	1,458.3	395	497	526	557

Source: District Statistical Office, Kiambu, 1996.

Kiambaa Division is the most populated division while Lari division is the least populated. Lari division is the largest, covering 39% of the total area but it is the least populated. This is because large part of the division is forested.

4.1.3.3 Land use patterns of Small Farm sector

Majorities of people in the district are small-scale farmers who grow various types of cash and subsistence crops and keep livestock in their small farm holdings. There exist a total of 72,938 small farm holdings (Kiambu District Development Plan, 1997-2002). The main crops grown by small-scale farmers include maize, beans, Irish potatoes, sweet potatoes and arrowroots. The main cash crops grown include coffee, tea, pyrethrum and other horticultural crops. Maize and beans form the staple food crop for the local population. Land in Kiambu is optimally utilised. Out of the district total area of 1458.3 Km², 1422 Km² is arable land. The smallholdings are intensively cultivated. In table 4.4 the type of crops grown on the small holder farms is shown.

Table 4.4: Characteristics of Small Farm Sector

Division	Farm area Km²	1989 No HH	**No. HH/Km**	No. of small holdings	Main food products	Main cash crop grown
Kiambaa	150	33,000	220	9,085	maize, beans, potatoes	Coffee, tea, bananas, flowers
Kikuyu	100.7	18,198	181	20,110	maize, beans, potatoes	Coffee, horticultural crops (Kales, cabbages, tomatoes, passion fruits)
Lari	120	16,274	136	16,708	maize, beans, potatoes	Pyrethrum, potatoes, horticultural crops (carrots, kales, cabbages
Githunguri	153.78	20,225	132	20,333	maize, beans, potatoes, bananas	Coffee, tea, tomatoes avocados, bananas
Limuru	229	17,478	76	6,700	maize, beans, potatoes	Flowers, horticultural crops

***HH** – Households

Source: District Agriculture Office, Kiambu, 1996.

Kiambaa division has the highest number of households/km followed by Kikuyu, Lari, Githunguri and Limuru. This information show that though Lari division is the least populated division, it still has a high density of households in-fact more than Githunguri and Limuru. This means Lari has less number of persons per household. This information is important in understanding the land pressure on forested area. Production of most

subsistence crops is intensive. Potatoes and bananas are the only crops that play the dual role of food and cash crops.

4.1.4 Infrastructure

A total of 539.1 kilometres (Km) of road network exist in Kiambu district with 392.6 Km of bitumen standard, 93.4 Km gravel and 53.1 Km earth road. Some unclassified feeder roads supplement the road network. The road conditions in the district are generally good **except** for Lari division, where roads are generally impassable during the rainy season. The roads in Lari require special attention given the high potential of the area especially in horticultural produce. Most roads in the forest stations are impassable during the wet season.

4.1.5 Welfare indicators

The welfare can be assessed using the employment levels. The labour force figures given in the table 4.5 show that male dominate except in unpaid family labour. Female constitutes about 49.6% of the labour force but majorities of them are engaged in the unpaid family labour. Family labour takes 40.4% of the total labour force.

Table 4.5: Employment by sector and sex in Kiambu as at 1994.

Sector	Total for each Sector (%)	Males	Males (%)	Female	Females (%)
Public sector	12.1	44739	8.7	18398	3.4
Formal sector own Business	2.3	7269	1.4	4551	0.9
Formal sector employee	8.1	32414	6.3	9260	1.8
Informal sector own business	12.6	42646	8.3	22253	4.3
Informal sector employee	7.2	27277	5.3	9848	1.9
Casual labour	8.1	24755	4.8	16678	3.3
Unpaid family labour	40.4	26840	5.2	180308	35.2
Other sectors	8.7	19449	3.8	25159	4.9
Total	100				

Source: Welfare monitoring survey II (C.B.S), Kiambu, 1994

The following points summarise other important welfare indicators,

- Most of the income is derived from agriculture and livestock sectors as well as from commerce, trade and services.
- Land size - About 33% of the available land is under large-scale commercial farming where tea, coffee, and pyrethrum are grown. The remaining 67% of available agriculture land are under small-scale holdings. The mean size of a small farm sector is 0.76 hectares (1.88 acre). Individuals, co-operatives, and companies own large-scale farms. Some of the companies are foreign owned. The income derived from small-scale farms determines the well being of the people.

- Major staple food grown in the district includes maize, beans, bananas, Irish potatoes, sweet potatoes, cassava, and pigeon peas. The major cash crop is coffee, tea and pyrethrum.
- Vegetables grown in the district include kales, cabbages, tomatoes, French beans, carrots and onions. Fruits such as passion fruit, avocados, mangoes, macadamia, citrus, apples, plums, pears and peaches are grown. Pineapples and cut flowers are grown on commercial basis.
- Distribution of income: Income inequalities do exist between various entities of the district economy. The average earning of large-scale farmer is far much higher than for the small-scale farmer. Trade and services sectors tend to attract much income. Since they are located in urban areas, the income in urban areas is higher than rural areas.
- Food availability: Kiambu district is not self sufficient in maize and beans, which are the main staple food. These products are obtained from other districts. The district is however self sufficient in Irish potatoes, bananas, roots and tubers for domestic consumption. The district also produces enough vegetables (kales, cabbages, tomatoes and spinach) and milk to meet the district demand and for sale. On the whole majority of people are well fed.

4.1.6 Study sites

The study was done in 4 out of the 6 forest stations in Lari division, Kiambu district. As stated above all the forested areas in the district fall within this division. Kiambu district has a total area of 49,800 hectares (ha) of gazetted forest. The stations covered in the study were Uplands, Kinale, Kamae and Kieni. Each station has its own set of problems although some problems are experienced in more than one station. Collection of the experiences in these four stations will be useful to stations with similar characteristics where shamba system is being practised. The following is a brief description of each of the stations studied with special emphasis on constraints faced in plantation establishment.

Uplands forest station

It is located to the west and is the nearest to Nairobi City. It is 50 Km from Nairobi City on the main Nairobi -Nakuru highway. It borders a reserve area. It has a total area of 3500 ha. Area under established plantations is 870 ha. Total area under shamba system is 375,2 ha comprising of 95.6 ha, which have been planted with trees, and 279.6 ha that have not been planted. Part of the area of the station acts as the experimental sites for Kenya Forestry Research Institute (KEFRI). The station is well served by road networks. The major market for the crops is Limuru and Nairobi. There exist an established marketing system for crop products by middlemen who transport the produce to Mombasa.

Kinale forest station

It is the second next to Uplands. In between them is Kereita forest station, which is also partly covered in this study. Kinale is also located in Nairobi -Nakuru highway. It borders a recently settled area. A section of Kinale forest was excised in 1988 to give room for settling squatters who had been evicted from the government forests. This opened up this station which was not bordering any reserve area before then. The farmers who were settled were given five acres of land each. Kinale has a total forest area of 10505 ha, of which 1003 ha are under plantation. Total area under shamba system is 399.7 ha comprising of 213.1 ha with trees and 186.6 ha without trees. The Nairobi- Nakuru highway bisects the station. The main market for produce is Limuru and Nairobi. There exist a market for produce at the Nairobi - Nakuru highway and also middle-persons buy produce to take them to Mombasa.

Kamae forest station

It is located in the western part. It is 5 Km off the main Nairobi-Nakuru highway. It borders a reserve area to the west and Kieni forest station to the Northwest. It has a total forest area of 3025 ha of which 1200 ha is under established plantations. Total area under shamba system is 215 ha comprising of 160 ha with trees and 55 ha without trees.

Kieni forest station

It is located on Nakuru - Thika road, 10 Km from Nairobi- Nakuru highway. The station is in the middle of the forest, with bordering reserve area being 8 Km either way. This makes it unique from all the other stations. Its location in the middle of the forest make it vulnerable to game attacks beside the fact that those farmers have to operate from far. It is one of the stations where farmers face serious problems of game damage. The first group of farmers who got the shambas after the ban had to leave their plots due to game damage. Farmers have to protect their crops if they expect to have any harvest. Prior to the ban of shamba system in 1987, there used to be a forest village where farmers were staying while tending their farms. It has a total forest area of 13724 ha, with 1553 ha falling under established plantations. The area under shamba system is 367.8 ha made up of 77.8 ha of planted area and 290 ha of unplanted area. Main markets for the produce is Thika town and other neighbouring centres.

4.2 Description of the respondents

4.2.1 Participating farmers

The total sample consisted of 66 (47.5%) females and 71(51.1%) males, which translates to a ratio of 1 female to 1.08 males. The average age categories for all the stations were age group 20-29 (26.6%), 30 – 39 (24.5%), 40 – 49 (20.9%), and 50 – 59 (20.9%). This varied from station to station. The age's category for the stations is given in the table 4.6.

Table 4.6: Age category in study area given as percentage of total respondents

Station	20-29	30-39	40-49	50-59	60-69
Uplands	22,5	32,5	15	25	
Kinale	22,2	25	33,3	13,9	5,6
Kamae	48,5	12,1	18,2	12,1	9,1
Kieni	13,3	26,7	16,7	33,3	

Source: Socio-economic survey by author, 1998

The projected district age categories by 1997 were under 20 (55.4%), 20-29(19.3%), 30-39(10.3%), 40-49(6.4%), 50-59(3.6%), 60-69(2.2%) and 70 and over (2.6%). The location of the forest station seems to influence the age group of farmers attracted to the areas as shown by the example below:

> This can be explained by the example of Kieni and Kamae, which are two neighbouring stations. While in Kamae the largest population was drawn from age group 20-29 (48.5%), in Kieni the largest population was of age group 50-59 (33.3%). The explanation to this is that the young people avoid getting shamba in Kieni and prefer Kamae which has better social facilities like schools where their children can learn, shopping centres and decent life. In Kieni there are no social facilities and life is hard. Old persons are known to persevere in hard condition more than the young ones.

Results indicated that 84 (60.4%) respondents had attained primary school level of education, 28 (20.1%) had secondary school level of education, 16 (11.5%) had no formal education, 4 (2.9%) had college certificate level and 1 (0.7%) had diploma certificate level of education. This means that majority of the farmers are literate.

The mean family size was 7 family members per respondent. The family size gives the number of persons benefiting from shamba produce in each area and amount of harvest which go to feed the family instead of entering the market system.

4.2.2 Foresters Interviewed.

The six foresters interviewed had a Diploma in Forest Management and at least 10 years experience in forest management. The foresters interviewed were; Mr. Irungu (Uplands forest station), Mr. Ngahu (Kinale forest station), Mr. Kibuka (Kamae forest station), Mr. Soi (Kieni forest station), Mr. Mbugua (Kereita forest station) and Mr. Mwangi (Ragia forest station). The foresters in Kinale, Kamae and Kieni had stayed for at least 5 years in that station. The foresters in Uplands, Kereita and Ragia were less than one year in that station. However the forester in Ragia had been transferred from Uplands where he had stayed for three years.

5. Suitability of the current shamba system practice to plantation establishment.

The suitability will be evaluated by skills held by the participating farmers which make them understand the system better and so be in a position to implement it for the betterment of plantation establishment, benefits/losses of the system to the FD, constraints/problems faced in administration and implementation. In addition a comparison will be made between the current system and the one practised before the ban.

5.1 The Farmers Skills in Forest Management

In attempting to decide whether the current Shamba system of forest establishment is suitable or not, it is necessary to know if the farmers have the necessary skills to be successful co-partners. This is because, if the FD will mostly be working with farmers who have no experience with forest tree establishment and tending, there is no chance that the current system can succeed in reducing plantation backlogs. In order to assess the knowledge of farmers as successful co-partners to the FD, the following evidence from the questionnaire was used. The farmers knowledge in tree planting and tending (Q3), where the farmer learnt about forest management techniques (Q2), whether the farmer was involved in the shamba system before (Q4) and the period the farmer has been owning his current shamba (Q7).

It is assumed that farmers with formal knowledge on forest management will be better partners to the FD compared to those who learnt forestry informally. This is because in a formal learning school, one is bound to get better quality education. It is also assumed that farmers who were involved in the former shamba system and farmers who have been owning their shambas for a long time will make better partners to the FD and will be able to take better care of the planted trees.

The results suggest that the majority of farmers have sufficiently good knowledge to make successful co-partners to the FD. As can be seen from Table 5.1, at least 70% of the interviewed farmers had some basic knowledge on tree planting.

Table 5.1: Knowledge farmer has on tree planting and tending (%)

Know-how in tree planting and tending	Upland	Kieni	Kamae	Kinale	Average
No knowledge	30	20	18,2	16,7	21
Has knowledge on tree planting	25	26,7	36,4	36,1	31
Has knowledge on tree planting and can relate it to the weather	30	36,7	15,2	27,8	27
Well versed with tree planting and tending	12,5	16,7	18,2	16,7	16
Misunderstood the question	2,5	0	12,1	2,8	4

Source: Socio-economic survey done by author, 1998

Majorities of the farmers in the four study areas combined (54.7%) learnt forest management informally. 50.4% of the farmers interviewed were not involved in the shamba system before the ban. This suggests that approximately half of the farmers in the entire study area might have not much experience with techniques of forest management. Finally, results show that majority of the farmers have had the farms for the past 1-2 years (see table 5.2). This suggests that the majority have experience with the shamba system.

Table 5.2: Period which farmer has had current shamba in each station (First three preference in each station)

Time period	Uplands (%)	Kinale (%)	Kamae (%)	Kieni (%)	All stations (%)
Under 1 year		30,6	42,4		20,6
1 –2 years	43,6	52,8	21,2	16,7	34,5
2 - 3 years	33,3	16,6	12,1	30	23,7
Over 3 years	20,5			33,3	

Source: Socio-economic survey by author, 1998

From this evidence, the following conclusion can be drawn:

The farmers generally appear to have some skills, which can make them good partners to the FD in plantation establishment. It should however be noted that, the farmers' lack of formal training in forestry and lack of past participation in the shamba system could be factors, which could hinder an optimal operation of the shamba system.

5.2. Comparison between the present and former shamba system

In an attempt to decide the suitability of the current shamba system, the farmers who were involved in shamba practice prior to the ban were asked if they feel there is a difference between both systems (Q6) and then asked to explain the difference. This was to get the information of some of the changes which have taken place and which the farmer perceive that they can affect the suitability of the current system.

The results showed that in the perception of the farmers, there is a difference between the old and the present system. 75.2% of the respondents said there is a difference and 24.7% said that there is no difference. The three main differences reported by farmers in all stations is increased use of chemical fertilisers (8.6%), time taken before the trees are planted has reduced (7.2%), size of shambas have decreased (5.8%) and allocation methods have changed (5.8%). The differences reported in each station are summarised below:

- In Uplands the two main differences were in allocation method where the former system was free allocation as opposed to the present method where the shambas are sold (10%) and reduction in the size of the shamba (7.5%).
- In Kinale, the two main differences were in time taken before the trees are planted which has been shortened from the past 18 months, to cases where trees are planted immediately after the shamba is allocated (13.9%) and reduction in the size of the shamba (11.1%).
- The main difference in Kamae is that there has been increased use of chemical fertilisers, which was not the case before (21.2%) and a change in allocation method where shambas are sold instead of being given free as in the past (6.1%).
- In Kieni station the two main changes is the increased use of chemical fertilisers (10.7%) and change in the place of residence of the farmer (7.1%).

The results give the differences which have taken place and which can affect the applicability of the current system of shamba even for those old farmers who used to cultivate before the ban.

5.3 Benefits/Losses to FD

The benefits and losses may be evaluated through assessing the fairness in methods used in shamba allocation (view of farmers and foresters), survival of seedlings planted in the shamba, game damage to trees and crops and methods used in protection.

5.3.1 Fairness in method used in shamba allocation

5.3.1.1 Farmers view on allocation

The method used in shamba allocation determines how the farmer gets the shamba and this can in turn affects the farmer's commitment to forestry. The assumption here is that a farmer who gets the plot in a fair way will be more committed partner and so will be able to take better care of the planted trees. To get this information the following evidence from the questionnaire was used. The way the farmer knows the availability of the shamba in the forest area (Q8a), how shambas are usually allocated (Q8b), how farmers got the present shamba (Q8c) and whether farmers are satisfied with the way the shambas are allocated (Q11a).

Results suggest that FD is the main player in informing the farmers of shamba availability. 62.2% of the farmers in the four stations were informed about availability of shambas by FD staff, 12.3% were informed by local leaders and 12.3% speculate after trees are clear-felled.

Balloting is the main method usually used in shamba allocation followed by selling and issue by FD (see table 5.3a). Balloting is the method which is supposed to be used in plot allocation in areas where plot demand is higher than the supply while FD can issue plots to interested farmers in areas where the demand is not high.

Table 5.3a: Usual method of shamba allocation in each station (%).

Method used	Uplands	Kinale	Kamae	Kieni	All stations
Balloting	38,5	58,3	42,4	65,5	53.9
Selling	33,3	38,9	36,4	13,8	33.2
Issued by FD	15,4	0	18,2	13,8	9.3
Others	12,8	2,8	3,0	6,9	3.6

Source: Socio-economic survey by author, 1998

The actual method in which the farmer got the present plot were; buying (49.3%), balloting (18.8%), allocation from FD (15.9%), and being given by a friend (13%) (see table 5.3b).

Table 5.3b: Method by which farmer got the current shamba (%)

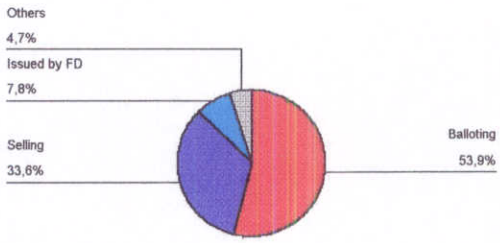
Method	Uplands	Kinale	Kamae	Kieni	All stations
Buying/selling	38,5	75	75,8	3,3	49.3
Balloting	23,1	8,3	12,1	33,3	18.8
Allocation from FD	17,9	5,6	6,1	36,7	15,9
Given by a friend	19,9	11,1	0	20	13.0
Others	0,6	0	6,0	6,7	2.9

Source: Socio-economic survey by author, 1998

Results from table 5.3a and 5.4b are illustrated in figures 5.1 and 5.2 .

Fig. 5.1: Usual shamba allocation method

Data for all stations

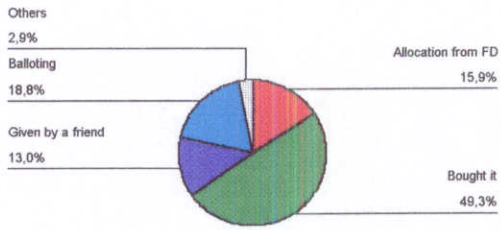


Data collected during socio-economic survey

1998

Fig. 5.2: How farmer got present shamba

Data for all stations



Data collected during socio-economic survey

1998

The results revealed a sharp contrast between the usual method used in allocation and what exactly happens on the ground. This is brought about by the perception of the farmer on how the allocation is supposed to be done and the actual reality on the ground. In Kinale 58,3% of the farmers indicated balloting as the usual method of allocation and 38,9% indicated selling/buying. However the methods in which the farmers got their shamba with were; 75,8% of the shambas were sold/bought and only 8.3% were got through balloting. The stations, which indicated high rates of selling of plots, were Kinale and Kamae. In Kieni forest station, the dominant method of allocation on the ground was allocation by FD (36.7%) followed by balloting (33.3%). The plots that were got through sale were only 3,3%.

Majorities of the farmers in the four stations were satisfied with allocation method (54%) while the remaining 46% were not satisfied. However this result was heavily influenced by the result from Kieni station. Tables 5.4 show that farmers in the other three stations are not satisfied with allocation method but 83.3% of the farmers in Kieni are satisfied. This observation can be related to the earlier results which showed that most of the plots in Kieni are allocated through balloting and others are issued by FD (see table 5.3b).

Table 5.4: Satisfaction of farmers with allocation method (%).

Station	Yes	No
Kamae n=34	42,6	57,6
Kinale n=36	44,4	55,6
Uplands n=40	47,5	50
Kieni n=30	**83,3**	10
Average	54	46

Source: Interviews with farmers, 1998

The demand of shambas brought about by high population in the neighbourhood and proximity of the station to the road had a relation with plot allocation method. The areas with high demand recorded high rates of plot selling. According to most farmers interviewed, balloting of the plots is done as a public shows piece to satisfy the public that balloting has been done. The plots got through balloting are few in relation to the total plots available. Most of the plots are given out using other methods prior to or after the balloting. This has made farmers lose confidence in the balloting system. They consider the exercise as a waste of time. Farmers who fail to get the plots during balloting results to buying to ensure they secure a plot to cultivate. The prices the plots are going for are beyond the means of a common farmer. This practice has taken root to an extent that some farmer feel that they are being helped by forest guards when they are selling them the plots.

From the evidence got the following can be concluded; FD is the main agent of informing the farmers of shamba availability. The current methods used in shamba allocation are not fair and so can affect the commitment of farmer in forestry.

5.3.1.2 Foresters view on shamba allocation

All the foresters interviewed reported that the main method used in allocation is balloting. The balloting committee involves the forester and the local administration. The DO is the chairman of the allocation committee. Some foresters reported that not all the plots are balloted for since some are sold out without forester knowledge while others are issued before balloting to interested parties.

The methods as reported by the foresters does not represent what happen on the ground. It is appreciated that some foresters did report that plots are sold in their stations. In a further discussion[8] with the Foresters, District Forest Officer and FD officers from the headquarters, they accepted that selling of the plots is going on thus validating the answer given by the farmers. The sale of plots is done through the forest guards with or without knowledge of the forester, local leaders who sell plots that are allocated to them by virtual of their position and farmers.

The harm done by unfair allocation and improvement on allocation is discussed in section 8.4.2.

5.3.2 Survival of seedlings planted in the shamba.

The foresters reported a high survival of seedlings planted under shamba system as shown in table 5.5. The high survival is attributed to reduced weed competition; trees benefiting from fertilisers applied to crops and reduced game damage.

Table 5.5: Survival of seedlings planted in the shamba plots

Station	Survival of seedlings (%)	Comments
Uplands	60-65	Survival at first is high but decrease with time due to interference by farmers
Kereita	Over 80	Not always due to some cases where farmers tamper With seedling to remain in shamba for longer time
Kinale	85	
Kamae	Over 80	Survival was 96% in 1995, 80% in 1996, and 92% in 1997.
Kieni	Over 80	Main damages occur after trees are established.
Ragia	80	Survival good if other conditions are favourable.

Source: Interviews with forest stations Officers, 1998

The high seedling survival achieved with shamba system is a benefit to plantation establishment and support evidence that shamba system is suitable for plantation establishment.

5.3.3 Game damage to trees and crops and ways of protection

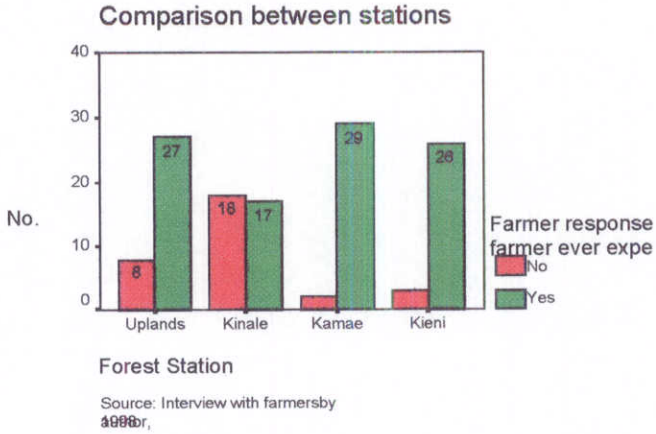
5.3.3.1 Farmers view

Losses incurred by the farmer through game damage are critical in determining the suitability of shamba system to plantation establishment. The loss is done to crops and trees. A farmer whose crops are frequently damaged by animals cannot be expected to continue cultivating in the same plot. The evidence about game damage was got through asking the farmer whether he/she has ever experienced game damage (Q36), main animals involved in damage (Q37), how farmer protect crops from game damage (Q38) and whether farmer feel FD has any role in protecting crops from game damage Q39).

Results showed that majority of farmers (71.2%) had crop damage by wildlife animals and 22,3% reported no past crop damage. The cases of reported damage was highest in Kamae (87.9%), followed by Kieni (86.7%), Uplands (67.5%) and Kinale (47.2%). In Kieni the first group of farmers had to abandon their shambas due to game damage. Cultivation was only possible when the farmers were allowed to put up temporary structures where they stay in order to scare away animals. This information is illustrated in Figure 5.3.

[8] Discussion done during presentation of part of my finding in KEFRI HQS, Muguga

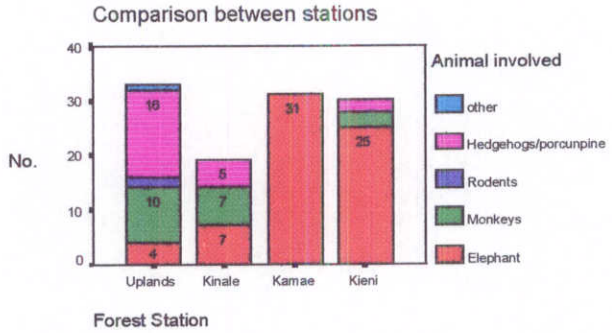
Fig. 5.3 :Have you ever experienced damage
of crops by wild animals



Source: Interview with farmersby author, 1998

Results suggest that elephants are the main animals causing game damage. The destruction by elephants reduces as one move from Kinale to Uplands. This is because these areas are more open unlike Kieni and Kamae, which are mainly forested. The main damage in Uplands and Kinale are the hedgehogs and monkeys though their level of damage is not like the one caused by elephants. Figure 5.4 show the main animals causing damage to crops in each of the four stations

Fig.5.4:Main animals causing damage to
crops



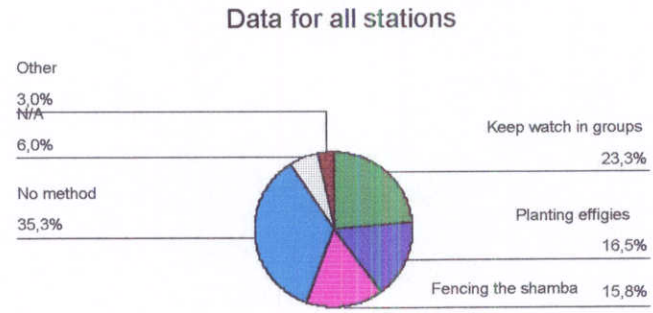
Source: Interview with farmersby author, 1998

Results showed that majority of farmers (34%) have no special method of protecting their crops from animals. The other methods identified for protection were keeping watch in groups (20%), fencing the shamba (18.9%) and planting effigies[1] (18%).

Figure 5.5 shows the methods used by farmers to protect their crops from destruction by wild-animals in all stations while figure 5.6 is specific per each forest station.

[1] Effigies are human like scarecrows or objects, which will scare away the animal by attraction or making noise.

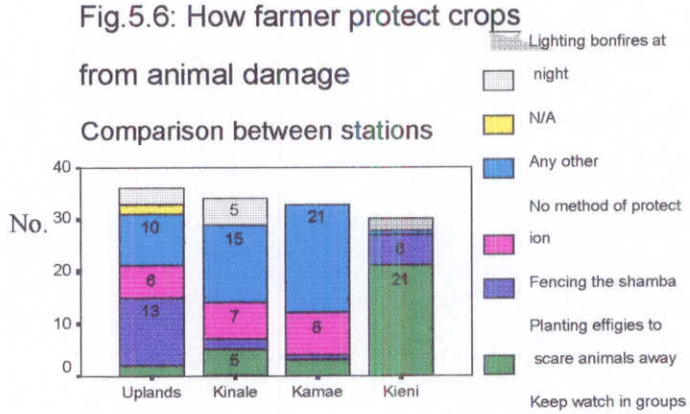
Fig. 5.5: How farmers protect crop from game damage



Source: Interviews with farmers

1998

Fig.5.6: How farmer protect crops from animal damage



Source: Interviews with farmers

1998

Following is an explanation of some the methods used in game protection,

- Fencing is meant to keep away small and medium wildlife animals and livestock. It is an effective way for such animals but cannot keep away elephants since it will break the fence easily (See photo 2).

- Planting of effigies is meant to scare small animals like antelopes, monkeys and rabbits. This is at times complemented by a device that makes noise as it is being moved by wind to scare away the animals.

Keeping watch on animals in-groups requires some joint effort by the farmers. This was evident in Kieni where the farmers have organised themselves in shifts to keep watch on their crops at night. Farmers beat drums to scare away the elephants. They also use burning firewood pieces, which they throw to the elephants to scare them

This is possible since most farmers are allowed to construct temporary structures within the forest area (See photo 3).

The evidence got from the interviews showed that majority of the farmers (66,2%) feel that FD has a role in protecting their crops from game damage as shown in table 5.6.

Table 5.6: Does farmer feel FD has any role in crop protection from game damage.

Station	Yes (%)	No (%)
Kieni	86,7	13,3
Kamae	75,8	21,2
Kinale	55,6	30,6
Uplands	52,5	35
All stations	66,2	25,9

Source: Interview with farmers, 1998

The response closely corresponds with the level of damage experienced by the farmers. In Kieni and Kamae, more farmers felt that FD has a role in crop protection. Farmers feel that FD can assist them in game protection through informing the game officers of animal attack and assisting in chasing away and poisoning some animals.

From the evidence got from the results, it can be concluded that farmers suffer big losses through game damage, are ill-equipped to protect their crops from game damage and so expect much assistance from FD in game protection. It follows that shamba system is not suitable in areas with high game damage unless methods are devised to protect crops and trees from game damage.
A further discussion on how to manage the problem of game damage is in section. 8.4.6.

5.3.3.2 Foresters view on game damage and methods of protection

The discussion with the forester revealed that game damage is a big constraint to shamba system. The main animals causing damage in each station and the method of protection is shown in table 5.7. The foresters confirmed that farmers are not compensated for the game damage to their crops. The damage is not only to the crops but also to the planted trees.

Table 5.7: Damage of crops by wild animals and methods used in protection

Station	Main animals causing damage	Main type of damage	Method of protection	Remarks
Uplands	Monkeys, buffaloes, and antelopes		Farmers form vigilant groups when crops mature.	KWS staff do not operate in this area
Kereita	Elephants, monkeys and wild pigs		Farmers lighting bonfires, making noise by hitting tins/drums to chase away animals, trapping animals	
Kinale	Elephants, monkeys, moles	Trampling, uprooting and eating	No major way of protection	Co-ordination between FD and KWS very poor
Kamae	Elephants, monkeys, and antelopes	Damage to crops and young Seedlings	Maintaining of game moat (1/4 maintained), scaring away animals in groups	Role of KWS staff in protection limited by low number and immobility. No compensation is done.
Kieni	Elephants, monkeys, antelopes and buffaloes	Rubbing on the trees by buffaloes and debarking by the elephants	Farmers scaring animals, KWS staff scare animals away, use of game moat to keep animals away	Forester acts as co-ordinator between KWS staff and farmers
Ragia	Elephants, monkeys, antelopes		Game moat, scaring away by rangers, farmers scaring away, use of scarecrows	No compensation or assessment of damage is done in forest areas.

Source: Interviews with forest station Officers, 1998

5.4 Administration of shamba system.

The administration of shamba system and the interaction of the farmer and FD are important aspects in deciding whether the system is suitable or not. A suitable system should be easy to administer without many constraints. The relationship of the partners should be cordial and they should get necessary assistance from each other. To assess the assistance got from FD, the farmer was asked whether he/she feels more contacts with FD can assist him/her in normal shamba operation (Q29), assistance which farmer expects through more contacts (Q30). The farmer was also asked if he/she had ever got any assistance from FD (Q32), the type of assistance FD extended to the farmer (Q34) and the type of assistance FD should give to the farmer in his/her normal shamba operation Q35). The foresters were asked about regulations in shamba system and ways of enforcing them.

5.4.1 Contacts and Assistance farmer gets from FD

Most farmers felt that more contacts with FD can help them in their normal shamba activities. 82 (60.7%) of respondents feel that more contacts with FD can assist in their shamba operation and 48 (35.6%) felt that it would not assist (see table 5.8a).

Table 5.8a: Does farmer need more contacts with FD staff?

Station	Yes (%)	No (%)	No answer
Kamae	67,7	32,3	
Uplands	66,7	25,6	7,7
Kieni	56,7	36,7	6,7
Kinale	51,4	48,6	
Average	60,7	35,6	

Source: Interviews with farmers, 1998

The type of assistance the farmer can benefit from more contacts varied from station to station, but the overall in all the stations is that farmer feels he/she can report game damage to FD staff (14,4%), followed by being advised on how to tend the planted trees (13,7%). The response per station is summarised below.

> In uplands, first benefit is being advised on how to tend the trees (20%), followed by advise on how to get another plot (15%) and reporting game damage (15%). The assistance required in Kinale is on replacing dead trees (11,1%) and advice on how to tend young trees (11,1%). In Kamae farmers need to be advised on how to tend trees (15,2%) and on regulations and corporation in shamba system (12,1%). In Kieni, advice needed is reporting game damage (23,3%) and getting another shamba (10%).

Results suggest that FD give some form of assistance to the farmers. 71,2% of respondents had got some assistance from FD. The respondents were asked the type of assistance they got from FD staff. The average assistance in all stations was getting a shamba (38,8%) and being allowed to cultivate in the forestland (21,3%).

The farmer was asked the type of assistance he/she feels FD should assist him/her in their normal shamba activities. 21.6% of farmers in all stations feel that FD should assist them in protecting their crops against game and livestock damage and 20.1% feel that FD cannot give them any form of assistance. The other assistance identified by the farmer is free allocation of plots (15.2% of Kamae farmers) and allocations of extra plot (11.1% of Kinale farmers).

The type of assistance the foresters reported that they give to the farmers is given in table 5.8b

Table 5.8b: Type of assistance forester gives to the farmer

Type of assistance	Forest station where it is provided
Free fencing materials	Kereita, Kamae,
Reporting game damage to KWS	Kereita, Kieni,
Ensuring security for the crops	Kinale, Ragia
Improvement of infrastructure	Kamae

Source: Interviews with forest station Officers, 1998

5.4.2 Regulations in shamba system

The regulations of shamba system are contained in the contract between the farmer and FD. The terms and the conditions of the contract are as follows:

- Cultivator must walk to and from the cultivation areas every day.
- No structure will be allowed in the cultivation areas.
- Cultivation period shall not exceed three years. There will be no obligation for the FD to give another plot thereafter.
- Only annual crops will be allowed. No creeper or climbers will be allowed.
- Seedling survival must be over 90% during the first season. Any cultivator attaining less than that level will lose the right to cultivate and his plot will be given to the neighbouring cultivator.
- No allottee is allowed to lease out or hire out his/her plot under any circumstances.
- The allottee must take care of the seedlings during non-crop season, i.e. during period when awaiting next season, he/she must control weeds.

A copy of the contract is attached as appendix 4. There is need to review the contract agreement to consider both the needs of the farmer and FD. A good contract should be the one where both the FD and the farmers' rights are clearly spelt out to avoid exploitation on either side. Once such a contract is signed, there should be a way of ensuring that it is followed. Possible areas of review are given in section 8.4.5.

From the evidence got the administration of shamba system seems suitable but farmers do expect more assistance from FD staff. The regulations in all the stations are difficult to enforce without farmer participation. A possible way in which farmers can participate is discussed in chapter 8. The study inquired the rights the farmer has under the shamba system. The foresters were not clear as to what can be called farmers right. This is an area, which need to be clarified so that each party in the contract is clear on what is their right under the system.

5.5 Constraints faced by FD in managing the shamba system

The management problems identified by the foresters in shamba system can be grouped as follows;

- Lack of proper communication between farmer and FD. This is mainly because the FD does not know all the farmers. This leads to difficulties in controlling the farmers and some disagreement between them due to different interest of the partners.
- Damage of trees by farmers. This is caused through destruction of the rooting system either intentionally or during harvesting of the crops, cutting of tree tips especially along the paths used by farmers, illegal pruning, illegal grazing and application of chemicals with side effects to the trees.
- Illegal practices. These would include extending of shamba boundaries and selling of shamba.
- Lack of funds to purchase farm inputs
- Poor infrastructure
- Long distance of travelling from forest to the reserve.

The problem of damage of seedlings/trees by the farmers used to exist even before the ban of shamba system (World Bank 1988). The main aim for the damage is to retard growth or kill the tree. This is done to ensure that the farmer cultivate in the same plot for a longer time or reduce trees competition with trees. The FD staffs are supposed to do inspection to apprehend farmers involved with these malpractices. It is however difficult for FD to maintain regular patrols due to the few number of staff[10]. Farmers will in future be increasingly used in planting and doing some silvicultural operations like pruning. The interventions to be done to ensure proper care of trees by the farmers are discussed in chapter 8.

5.6 Alternative methods used in establishment and their success.

There is no suitable method of plantation establishment that was developed during the period of ban. Most of the methods used were having low survival or were too expensive to apply. The methods used for establishment and the success in each station is summarised in table 5.9.

[10] We noticed cases where farmers had overpruned the trees leading to stunted growth and at times death of the trees (See photo 8).

Table 5.9: Alternative methods used in plantation establishment and their success.

Station	Methods tried out
Uplands	Planting immediately after felling gives good survival in the beginning but this decrease later due to competition with weeds
Kereita	Strip ploughing (problem is to get a plough) and pitting though it is expensive. In both methods there is a serious problem of rat damage. No better alternative was found to shamba system.
Kinale	A sequence of clearing (slashing and burning), staking out, pitting, planting, tending, spot weeding (twice per year) was tried out in Gatare forest station where the forester was working. It was very successful with a survival of 89%. The main problem was labour shortage. Spot weeding alone was tried out but it was not successful
Kamae	Tried out pitting in Feb./March, planting in April and spot weeding twice per year. Main problem was rat damage, climbers competition and competition with high vegetation.
Kieni	Burning and pitting followed by slashing three times per year to reduce grass competition was tried out and it had 75% success. Line cleaning was tried out. The survival was 40% even after beating up. Main problem was competition with weeds. In both methods, there was serious problem of big rats damage
Ragia	Pitting and direct planting, strip cleaning and planting along the strips and total site cleaning and planting.

Source: Interview with Foresters in Kiambu District

This shows that shamba system remain the main feasible way of plantation establishment until a time when a better alternative will be developed.

5.7 Involvements of farmers in planting of trees and undertaking silvicultural operations like pruning

Farmers were involved in assisting FD in their normal activities. The involvement of farmers in forest activities is a benefit to FD since it will save on the costs, which it would have incurred. Farmers were involved in tree planting and pruning. Farmers have to be explained why they have to be used in forestry activities and also have to be taught how to carry out various activities. The extent of farmer involvement in various stations is given below,

- Uplands - Farmers are ready to participate in forestry issues since he/she feels that they get some benefits from FD. There is need for proper supervision, protection and education.
- Kereita - Farmers have been used in pruning successfully but they can overprune. FD gives pruning saws and informs farmers when to prune. Farmers have not been used in planting. (See photo 4 and 8).
- Kinale - Farmers feel they are not paid for the work. However farmers have to plant due to a ministerial declaration that they should assist in planting. While farmers may plant trees, FD should do the pruning.
- Kamae - Farmers have been involved in forest operations successfully. There is need to explain to farmers why they are being used in tree planting, otherwise they expect to be paid for their labour. Farmers are not experienced in forestry and this can lead to low survival.
- Kieni - Meetings are held where the farmers are informed of the date of planting. This has been done successfully. Prior to planting a demonstration is done to show farmers how to plant. Mixing FD staff and farmers to ensure proper planting follows this. Farmers have not been used in pruning since they do not have the

skills.

- Ragia - Farmers have been used in planting and in pruning mainly to open up for their crops.

A discussion on the merits and implication of using farmers in forest operations and the training required by farmers is given in section 8.4.8

Photo 1: Farmers cultivating in a two-year-old Cypress plantation in Uplands. Growth rate of the trees is quite high

Photo 2: Fencing to keep away small animals and livestock in Kamae. Note new areas recently clearfelled and ready for allocation in the background.

Photo 3: Temporary structure constructed by farmers in Kieni. Structure is built on the boundary between plantations and natural forest. Farmers stay in this structure in order to protect their crops from game damage.

Photo 4: Overpruned cypress trees in Kinale. Tree left with very small photosynthetic surface for it to survive. Leads to death of trees.

6. Suitability of shamba system to socio-economic welfare of participating farmers.

The suitability was evaluated in terms of benefits/losses farmer incurs, constraints/problems faced by the farmers and FD approach in shamba management with regard to socio-economic betterment of the farmer.

6.1 Benefits/losses incurred by the farmer.

This is evaluated through the time period farmer is allowed to cultivate crops before trees are planted, valuing of shamba by the farmer, main crops grown by the farmers, effect of crops yield with time and marketing systems used to sell extra harvest.

6.1.1 Period of cultivation before trees are planted

The farmer was asked the period taken before trees were planted in his/her shamba (Q24b). Time taken before trees are planted affects the benefits the farmer gets from the shamba. Farmer gets more benefit if he/she cultivate for a longer period before trees are planted.

Results suggest that over 50% of shambas were planted in less-than one year from the time of allocation, 39.5% were planted in less than 12 months from the time of allocation, 27.6% in 12 to 24 months and 17% immediately after allocation. Table 6.1 gives time taken before trees are planted in each station.

Table 6.1: Time taken before trees were planted in the shamba

Time period before planting	Kamae % farmers	Kinale % farmers	Kieni % farmers	Uplands % farmers
Immediately after allocation (Less than 3 months after allocation)	76,9	25	21	15
Less than 12 Months	15,4	58,3	15,8	15
12 – 24 Months	7,7	12,5	36,8	45
24 – 36 Months	0	4,2	15,8	5
Over 36 Months	0	0	10,5	10
Trees had been planted earlier	0	0		10

Source: Interview with farmers, 1998.

The reason for trees being planted soon after the allocation is in an effort to clear the backlogs in plantations establishment. Planting trees immediately reduces the benefit the farmer gets from the shamba. The time taken before trees are planted is a major difference between the current NRC system and the shamba system practised before the ban. Before the ban, farmers were allowed to cultivate for 18 months before trees were planted in their shamba. A further discussion on time taken before planting is given in the prognosis of future of shamba system in 8.4.3.

6.1.2 Valuing of shamba by the farmer.

The value the farmer attach to the shamba determines the economical benefits got from the shamba and the opportunity cost for the shamba. A plot is suitable if the total benefits got from it are high. The value farmer attaches to the shamba was evaluated through considering size of the shamba (Q9), cost of leasing an equivalent plot in the vicinity (Q10), cost of buying where they are sold and the value the farmer attaches to the plot with crops and without crops (Q16).

The main shamba size was 0.25 acre. 62.6% of interviewed farmers had this size. In all stations except Kieni, this was the majority size of the shamba. 67.5%, 91.7%, 51.5%, and 33.3% of the farmers in Uplands, Kinale, Kieni and Kamae recorded this size respectively. In Kieni the majority size was 0,25 - 0,5 acre which was recorded by 36.7% of the respondents.

The cost of leasing an equivalent plot in the locality outside the forest reserve can be considered as the opportunity cost of acquiring a plot in the forest area. The average cost of leasing a standard size shamba in all stations was Ksh. 2925 per ¼ acre per year. Costs of leasing in each station are summarised below;

> Cost of leasing differed from station to station. In Uplands it was Kshs. 1989, in Kinale Kshs. 2764, in Kamae Kshs. 1807 and in Kieni Kshs. 5053. In Kieni the cost is high since the neighbouring reserve area, located 10 km from the station are small scale farms which are mainly planted with tea as the main cash crop. The presence of a major cash crop reduces the space left for crop cultivation and so few farmers would be willing to rent out their land for cultivation.

The average cost for buying a ¼ acre plot in stations where they were sold was Kshs. 3255 per ¼ acre plot. The selling only include the user right for the plot up to the time when the tree canopy close in since the owner right is still with the FD.

Results showed that farmers attached different values to their plots depending on whether it had crops or not and its locality. The average value attached to a shamba without crops was Kshs. 4295 and the one with crops was valued at Kshs. 11,077. A cost of Kshs. 5835 was attached to the shamba without specifying whether it had crops or not. Table 6.2 below gives the values attached to the shamba in different stations.

Table 6.2: Value farmer attaches to the shamba per station

Station	Shamba without crops Kshs.	Unspecified shamba Kshs.	Shamba with crops Kshs.
Uplands	5000	6232	8667
Kinale	4530	5438	11000
Kieni	4143		17273
Kamae	3507		7367
Average	4295	5835	11,077

Source: Interviews with farmers, 1998.

The evidence got suggests that farmers attach a high value to their shamba and are ready to spend much money on the shamba. High value attached means that there is enough economic motivation for the farmer to participate in shamba and so the system is suitable in improving the economic welfare of the farmers. However this can lead to corruption of the system and so proper administration and management is necessary.

6.1.3 Main crops grown by the farmers

One way of assessing the benefits the farmer gets is knowing the range of crops grown by the farmer. The farmer was asked in different question to rank his/her, first main crop, second main crop, third main crop (Q13) and the most marketable crop (Q14). This results is given in the table 6.3 below-:

Table 6.3: Main crops grown by the farmers

Station	Crop No1.	Crop No. 2	Crop No. 3	Most marketable crop
Uplands	Potatoes	Kales	Cabbage	Potatoes
Kinale	Potatoes	Kales	Cabbage	Potatoes
Kamae	Potatoes	Cabbage	Carrots	Potatoes
Kieni	Potatoes	Cabbage	Kales	Potatoes

Source: Interviews with farmers, 1998.

Potato was the main crop in all the stations (See photo 5). This can be explained by the fact that potatoes are relatively more durable than the other crops. They can be kept for up to 4 months. This is important to the farmer since he can decide to store his/her crop during the period of overproduction when the prices are low in order to sell in off-peak season when prices improve. In Uplands and Kinale, kales is the second major crop. They are harvested after every two weeks for a period of 8 months. There exist a well-established market system for kales in these two stations. Middlemen buy kales from the farmer, which they sell to far markets, mainly in the coast town of Mombasa. The four

stations supply the neighbouring urban centres with food. Uplands, Kinale and parts of Kamae supply Nairobi while Kieni and some parts of Kamae supply Thika town. Other crops grown are carrots and cabbages (See photo 6).

6.1.4 Effect of crop yield with time.

In attempting to get the distribution of the benefits with time the farmers were asked to compare crop yields in first and second year of cultivation (Q23). Results showed that the first year of cultivation has high yields as shown in table 6.4.

Table 6.4: Was harvest in first year more than the second year?

Station	Yes (%)	No (%)	No response
Kinale	77,8	16,7,	5.5
Kieni	56,7	36,7	6.6
Uplands	52,5	42,5	5.0
Kamae	39,4	51,5	9.1
All stations	56,7	36,7	6.6

Source: Interviews with farmers, 1998.

This shows that the farmer benefit more from a new shamba and then the yields start dropping with time. To sustain the high yields, farmer has to put more fertiliser inputs.

6.1.5 Marketing system used by farmer to sell extra crop

The method of marketing affects the returns farmer gets from his/her crops. A suitable system is where the farmer gets the highest return from the sale of the crop. The evidence on marketing was got through asking the farmer how he/she sold the extra harvest (Q21) and the best method of sale that can give farmer the highest return (Q22a).

Results showed that majority of the farmers (58%) sold their extra produce to middlemen who buy from their plots. 19.8% had no surplus to sell and 13.7% sold their products directly to the far markets. The best option of sale, which could give the highest return, was selling to the middlemen (56.6%), followed by selling to the far market (35.2%). Table 6.5 shows the methods used in marketing of produce and the best option, which can give farmer, the highest returns in each station.

Table 6.5: Method used to market crop

Marketing method	Uplands	Kinale	Kamae	Kieni
Sold to middlemen	48,6	63,9	62,1	58,6
Sold to far markets	18,9	11,1	10,3	13,8
Sold locally	16,2	2,8	6,9	3,4
No surplus to sell	16,2	22,2	20,7	20,7
Best option for marketing which will give highest return				
Sold to middlemen	38,2	71,4	56	60,7
Sold to far market	52,9	25,7	28	32,1
Sold locally	5,9		12	3,6

Source: Interviews with farmers, 1998

Most of farmers sold their products to middlemen, even in cases where they knew that selling to the market would give them more returns. The main consideration was time spent in taking the product to the market. A number of farmers complained of exploitation by the middlemen. Cases were reported of middlemen frustrating efforts of farmers to sell their products to the market directly. Farmers who took their products to the market reported that they gain by selling the products. Further discussion on marketing and improvement can be found in section 8.3.9

6.2 Other problems faced by farmers in shamba system

The farmer was asked the extra problems he/she faces in the shamba (Q40). This question was supposed to exhaust the problems, which may not have been discussed with the farmer. A farmer who gives a response of no problem means that he/she does not have any extra problems except those discussed earlier. The problems identified were no additional problem (29,5%); game damage (10,8%) and theft of produce (10,1%).

The response per station is summarised below,

- Uplands -No additional problem (27,5%), theft of produce from shamba (25%) and lack of market (17,5%).
- Kinale- No additional problem (50%), theft of produce (11,1%) and lack of markets (8,3%).
- Kamae- No additional problem (21,2%), game damage (18,2%), and lack of finances to buy inputs (12,1%).
- Kieni- Lack of finances (23,3%); no problem (16,7%) and game damage (16,7%).

The new problems identified were lack of market for the produce and lack of finances to buy farm inputs.

6.3 Suggestion to shamba improvement.

The farmer was asked the extra suggestion he/she had on shamba improvement (Q54). The main suggestion identified by the farmers were to increase the tree preplanting time (26.7%), followed by providing loan to farmers to buy inputs (12%) and improvement of roads (10.7%). This information is given in table 6.6.

Table 6.6: Farmer suggestion to shamba improvement

Suggestion	Farmers giving the suggestion (%)
Increase pre-tree planting time	26,7
Provide loan to farmers	12
Improve roads	10,7
Farmers benefit and so should be encouraged	5,3
Fair plot allocation	5,3
Issue bigger plots	5,3
Allow farmers to settle in the forest	5,3
Others[11]	29,3

Suggestions given by farmers in each station are summarised below:

- Uplands – No suggestion (40%), increase time taken before trees are planted (12,5%) and provide loan to the farmer to enable him/her to buy inputs (10%).
- Kinale – No suggestion (41,7%), increase time taken before trees are planted (25%), and give bigger plots (8,3%).
- Kamae – No suggestion (42,4%), farmer benefit and so system should be encouraged (6,1%), improve roads (6,1%) and improve wildlife protection (6,1%).
- Kieni – No suggestion (30%), increase time taken before trees are planted (16,7%), and provide loan to enable farmers to buy inputs (13,3%).
- All stations – No suggestion (42,4%), improve wildlife protection (6,1%), free shamba allocation (6,1%), improve roads (6,1%) and farmers benefit and so should be encouraged (6,1%).

The new suggestion is on road improvements and that farmers benefit from the shamba and so the system should be encouraged. The road condition in most stations is impassable during the rains. This makes marketing of the crop very difficult if not impossible. Crops rot in the shambas due to poor roads. Most of the crops grown by the farmers are perishable products and their high season is during the rainy season. The road condition is made worse by logging during the rainy season. Donkeys are mainly used in extracting produce in areas where roads are bad. However, some areas become totally impassable even with the donkey. Forest department has a role to maintain the roads in forest area since they use the same roads in their daily operations.

6.4 Role of forester in assisting farmer to improve yields

Most foresters felt that they do not have any role in assisting farmers to improve their yields. While it is noted that foresters are not trained in agriculture, they can be used as the link between the agriculture extension officers and the farmers. Foresters can be

[11] Other suggestion groups all suggestion, which were lessthan 5%.

inviting these officers to advise the farmer on methods for increasing the yields. Some foresters are only interested with survival of the trees without considering how the crops are doing. This attitude is wrong since a farmer who does not get good yields from his/her plot will not take good care of the trees.

The forester's views in each station is summarised below:

- Uplands. Forester feel that farmer is the one who should come to him to ask for assistance. Forester is only interested with trees that he has planted but not yields of farmers. Forester understanding of participation is the classical top down approach.
- Kereita. Forester feels FD has no role.
- Kinale. FD is not concerned. They are only interested with their trees. Agriculture officers can be involved.
- Kamae. Forester feel he can facilitate contact with agriculture extension staff, improve marketing system for the crops and also propose setting up of a processing industry to process farmers produce.
- Kieni. During meetings farmers are informed of crops which do well in that locality and hybrids which can be used. The divisional meetings can act as a forum where the forester can raise farmers' requests since officers from other departments also attend. Such officers can be invited to come to advise farmers.
- Ragia. Forester helps in protection of crops against destroyers and wild animals thus increasing the yields. Pruning of trees also lead to better crop performance.

6.5 Relationship of demand of shambas to population of neighbouring areas.

The demand of the shamba plot is related to the population of the surrounding area. This relationship affects the sustainability of the current shamba practice especially in fulfilling the demand of the shamba to the surrounding communities. The size of the plots has been decreasing with the increasing rise in population of the surrounding communities. Evidence from each station is given below;

- Uplands- Demand very high in Roromo block, which borders the reserve and lows in Nyamweru block which, is located in the interior. Size of plot is ½ acre but can go lower to ¼ acre.
- Kereita- Sizes of plot have been decreasing with increasing population. Small areas of cultivation lead to destruction of forest and stealing of produce from other farmers. Forester feel size of shamba should not be less than ¼ acre.
- Kinale- Size decreasing to satisfy the demand.
- Kamae- Size has decreased due to increasing population. Subletting of plots leads to further smaller plots some of, which are not economically feasible. The small plots leads to encroachment and bad practices like charcoal burning.
- Kieni- Demand of shambas was originally very high due to false hope given to farmers by a local politician that they will be allocated plots permanently. Demand has now reduced after farmers realised this was not true. Few new farmers are coming for shambas except those displaced from tribal clash areas.
- Ragia - Demand relates to land scarcity due to high population, accessibility and degree of game damage market availability and prevailing weather conditions.

The rising population will continue increasing the demand for the shamba. The main question is what is the smallest size of the plot, which can be cultivated economically by

one farmer. This size was found to be ¼ acre plot. The increasing demand affects the sustainability of the shamba system. The FD will continue being faced with the challenge on how to fairly allocate the shamba to the farmers.

6.6 Involvement of local communities in forestry issues.

The foresters were asked how they involve local communities in forestry issues. The extent on local community involvement shows how FD integrates forest management with the local communities. The response from each station is summarised below:

- Uplands- No involvement of local people.
- Kereita. -Forester has been close to the local communities in forestry issues. The incentives he use for community participation include free shamba allocation, allowing construction of temporary structure to keep off wild animals, and allowing a children nursery which was put up in forest land to operate. Regular meetings are held with communities to discuss forest issues. Forester has formed a committee to oversee shamba issues. The local communities have been used to protect forest and in demarcation of plots prior to allocation.
- Kinale - Farmers assist in fire fighting, and helping in tree planting. They are given shamba in return especially when they assist in planting.
- Kamae- the surrounding communities feel that they own the forests since the charges of forest produce they get from the forest are too low e.g. Kshs. 36 for a head-load of fuel-wood daily for one month. The forester has appointed chief and some specific people to assist in informing him of forest destruction. Local communities have been used in fire fighting and in tree planting. Meetings are held to educate the communities on importance of forestry especially the indirect benefits from the forests.
- Kieni- Forester informs local people about importance of forest issues through chiefs meetings. The surrounding communities have been complaining of forest exploitation that is being done by people from outside.
- Ragia- Local people promote forest hygiene through collection of fallen dead materials. Grazing in the forest reduce fire risk while shambas have assisted in establishment of the forests.

In the study little involvement of local people in forestry issues was discovered. The only station, which had little involvement, was in Kereita. In the other stations the local people are only used when the FD stands to gain like in fire fighting and planting. The attitudes of the FD staff towards the local community need to change if local people are to contribute to forest issues. The attitude is rooted on the past management practices which have considered forest as the domain of the forester and his staff and the local communities as the destroyers of this resource with no knowledge on how to manage the forest. Forest management in Kenya was introduced during the colonial period when the local communities were poorly regarded by their colonisers. While this changed after independence, the forest staffs have not been able to interact with the local communities and there still exists some mistrust between FD staff and local communities. This can be solved through the concept of community participation in shamba system, which is discussed in chapter 8.

6.7 Conflict resolutions in shamba system management

The suitability of the shamba system is dependent on the methods employed by FD in solving various conflicts, which arise between farmers. The foresters were asked how they solve various conflicts. Table 6.7 reports some conflicts faced by forester in shamba system and some ways of solving them.

Table 6.7: Conflict resolutions in shamba system

Station	Conflict and resolution method
Uplands	Farmers being interested with crops other than trees, theft of produce from farms. Forester brings parties in dispute to an agreement and arranges for compensation where applicable.
Kereita	Conflicts include extending of boundaries, cultivating in other farmers' shamba and theft of produce. Role of forester is to bring the parties in dispute together, discuss and ensure necessary compensation is done.
Kinale	Forest guards help in resolving conflicts
Kamae	Conflicts include mistaken identity where farmers' exchange plots to go to a better plot than the one issued and livestock damage. Livestock causing damage is arrested and taken to the forest station. Forester summons the owner and complainant for a discussion to determine compensation to be paid. Forester acts as mediator.
Kieni.	Grazing of shambas where once a complaint is received, a damage assessment is done and compensation done. In case of boundary disputes, alignment is done when both farmers are present. Other conflicts are on stealing of produce and stealing of employee's fertilisers by his workers. This happen for farmers who cultivate from far distances.
Ragia.	The conflict is that the farmer would like to cultivate forever, while FD would like to plant the trees as soon as possible. Also problem of farmers cultivating in restricted areas.

Source: Interviews with FD officers, 1998

The main role of the forester is to bring the parties in conflict to a consensus. A committee involving the farmers' representative can assist forester in resolving conflicts in shamba system.

Photo 5: Potatoes cultivation on a Cypress plantation. Potato is the main crop grown by the farmers

Photo 6: Cabbage cultivation on a Cypress plantation. On the background are more areas under shamba system.

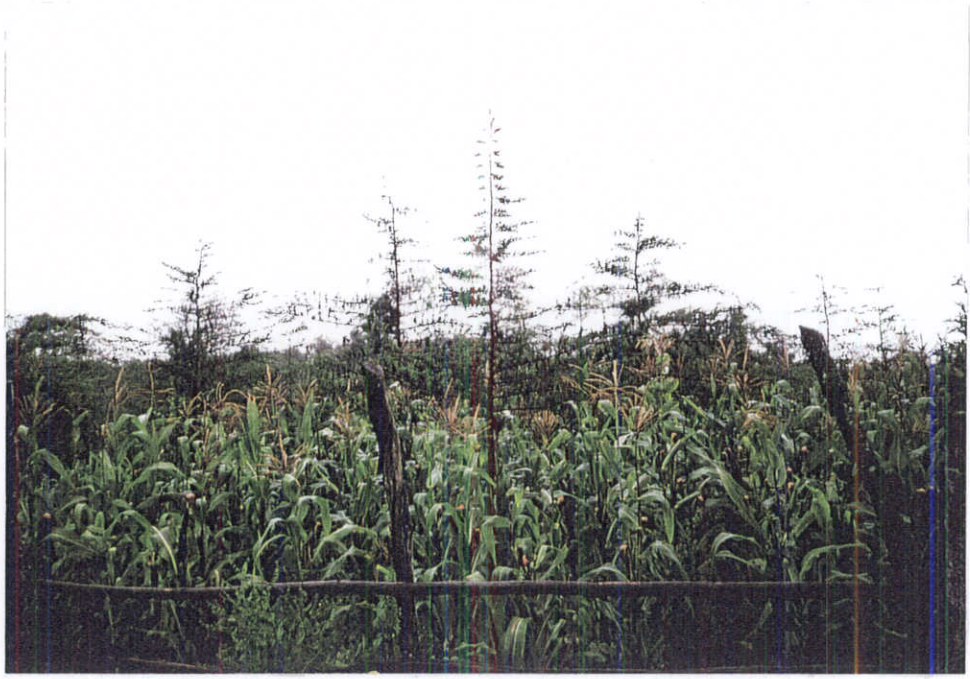


Photo 7: Maize planted on a Cypress plantation. Maize should be planted when the trees are big to withstand competition.

Photo 8: Established Pine plantations. Farmers can do proper pruning if trained. Crops yield reduce as the tree grows due to competition.

7. Financial analysis of Shamba system

In an effort to evaluate the suitability of the current method of plantation establishment, a financial analysis was carried out. The analysis focused on the cost saved by FD when they establish forest plantation using shamba system and financial benefit farmer gets from the system. The shamba system will only continue when the FD feels that it is saving cost in establishment and the farmer has a net benefit from his/her participation in the system. An estimation of the total benefit got by the farmers is computed to show the contribution of shamba system to the local community.

7.1 Results of Case studies to estimate farmer's benefits

Three case studies were conducted to determine the benefits farmers get from shamba cultivation. They were conducted in Kinale, Uplands and Kamae. Inputs and outputs required by the farmer for cultivation in one year were considered. Farm gate prices were used in considering costs and benefits.

The selection of the farmers was based on the earlier survey where farmers who showed more co-operations in giving out cost data were shorlisted. A further confidence build-up was necessary with the farmers to ensure that they give correct and reliable data. This was done through more contacts. Since only three farmers were studied, the results may not be considered representative of the area but they give an indication of the benefits the farmers get from the system and can be a starting point for further detailed financial analysis.

The labour cost was valued by getting the mandays (MD) required to perform each operation. Each manday costed Kshs. 100 in this area. The calculation of labour includes the family labour. This means some of the cost in labour actually goes to the family members and so is an addition benefit to the farmer.

7.1.1 Case study 1: Mama Guchu shamba in Kinale forest station

She is married and the family has one child. The size of her plot was ¼ acre. Her main fixed costs are the cost of buying the shamba (Kshs. 5000), buying a Napsac sprayer (Kshs. 6000), fencing the shamba (Kshs. 1000) and cost of buying working tools (Kshs. 600). The other costs are variable costs. The main crops she planted during the year were carrots, potatoes and cabbages. The output of carrots was 12 bags per plot with a sale price of Kshs. 500 to Kshs. 1500 per bag depending on the season. Potato output was 15 bags from a new shamba and 5 bags from an old shamba. The selling price per bag was Kshs. 500 to Kshs. 1400 depending on the season. Cabbage output was 6000 pieces with a sale price of Kshs. 0.5 to Kshs. 10 per piece depending on the season. The farmer sells 95% of the output and uses the remaining 5% for local consumption. A detailed yearly calendar, costs and revenue got by the farmer is given in annex 2.

Table 7.1: Annual costs and Revenue in case study 1

Inputs			Outputs		
Item	Unit Cost/item	Sum cost	Item	Sale price	Sum revenue
Fixed assets					
Materials					
Purchase of Napsac sprayer		6000			
Cost of shamba	5000	5000			
3 holes	200	600			
Labour costs					
Fencing		1000			
Initial land preparation		800			
Subtotal		**13400**			
Carrots cultivation					
Materials					
Seeds 250 grams		360			
Cost of chemical		360			
Labour costs					
Land preparation		600			
Planting		100			
Labour for spraying 2*	100	200			
Weeding 10 MD	100	1000			
Harvesting 10 MD	100	1000	Sale of 12 bags of carrots	1000	**12000**
Transport to washing point	80/bag	960			
Washing of carrots	30/bag	360			
Subtotal		**4940**			
Potatoes cultivation					
Materials					
Buying of seeds- 10 buckets	200	2000			
Fertilisers 15 Kg.	30	450			
1st spraying- chemical		370			
2nd spraying- chemical		370			
Chemical Spraying to protect from blight. Done 2 times	370	740			
Labour costs					
Land preparation		400			
Making planting trenches		200			
Planting		200			
Labour for spraying		200			
Weeding 2 MD		200			
Labour for spraying		200			
Harvesting 7 MD		700	Sale of 15 bags of potatoes	1000	**15000**
Transport to roadside	60/bag	900			
Subtotal		**6560**			
Cabbage cultivation					
Materials					
Buying seeds		380			
Fertilisers 20 Kg	30	600			
Chemicals for spraying 2*	470	940			
Labour costs					
Cost of watering young seedlings		1200			
Digging 4MD		400			
Making holes		200			
Planting		400			
Spraying labour 2*	200	400			
Weeding		400			
Harvesting		600	Sale of 6000 pcs cabbage	3	**18000**
Subtotal		5520			
Grand total		**30420**			**45000**

Source: Case study of farmer, 1998

The farmer spends Kshs. 30,220 and gets revenue of Kshs. 45,000. Farmers profit is Kshs. 14,580 per ¼ acre. This translates to Kshs. **142,244** per hectare. The prices of

outputs given are for an average season for the farmer. However prices fluctuates according to the season. An indication of this fluctuation is given below:

In case of a high season when the prices are low, the gross income of the farmer will be as follows,

12	bags	carrots	at	Kshs. 500/bag	= Kshs.	6000
15	bags	potatoes	at	Kshs. 500/bag	= Kshs.	7500
6000	pcs[12]	cabbage	at	Kshs 0.5/pcs	= Kshs	3000
Total					= Kshs.	16,500

Costs will remain the same and so farmer gets a loss of Kshs.13, 920. This is equivalent to a loss Kshs. **135,804** per Hectare.

In case of the low season when the prices are high, the gross income got by of farmer will be as follows:

12	bags	carrots	at	Kshs. 1500/bag	= Kshs.	18000
15	bags	potatoes	at	Kshs. 1400/bag	= Kshs.	21000
6000	pcs	cabbage	at	Ksh. 10/pcs	= Kshs.	60000
Total					= Kshs.	99000

Farmer gets a profit of Kshs. 68580/acre. This is equivalent to Kshs. **669,073** per Hectare

7.1.2 Case study 2: Mama Wanjahi shamba in Uplands forest station

She is married with 2 children. Her plot size was ¼ acre. Her main fixed cost are the cost of buying a Napsac sprayer (Kshs. 5000) and cost of buying working tools (Kshs. 1200). The main crop she grows in a year is potatoes, carrot cabbages and kales. Potato production was 10 - 11 bags for a new plot and 8 bags for an old plot. The sale price was Kshs. 450 to Kshs. 1000 per bag depending on the season. The output from carrots was 8 to 10 bags with a sale price of Kshs. 300 to Kshs. 500 per bag. Cabbage output was 4000 pieces with a sale price of Kshs. 0.5 to Kshs. 7 per piece. Kales output was 5 bags per every two weeks for 8 months. The sale price was Kshs. 20 to Kshs. 400 per bag. Detailed costs and yearly calendar is given in annex 3. Table 7.2 shows the annual cost and revenue.

[12] Pcs. Abbreviations for pieces which means one cabbage

Table 7.2: Annual cost and revenue in case study 2

Inputs			Outputs		
Item	Unit cost	Sum cost	Item	Sale cost	Sum revenue
Fixed assets					
Materials					
Napsac sprayer	5000	5000			
3 holes	200	600			
3 fork holes	200	600			
Subtotal		**6200**			
Potatoes cultivation					
Materials					
Seeds – 1 bag		1500			
Fertilisers- 6 Kg.	30	180			
Chemicals for spraying 2*	360	720			
Labour costs					
Preparation 9 MD	100	900			
Digging of trenches and planting		200			
Weeding 4 MD		400			
Spraying 2 times	100	200			
Earthing up 6MD	100	600			
Harvesting 8 MD	100	800	Sale of 10 bags of potatoes	750	**7500**
Subtotal		**5500**			
Carrots Cultivation					
Materials					
Seeds		350			
Foliar spray to accelerate growth		200			
Labour costs					
Herbicide chemicals		150			
Preparation 4MD		400			
Planting		300			
Spraying labour		200			
Loosening soil for aeration 5MD	100	500			
Harvesting 4 MD		400			
Transport to the roadside 10 bags	40/bag	400			
Washing of carrots 4 MD		400	10 bags carrot sale	500	**5000**
Subtotal		**3300**			
Cabbage cultivation					
Materials					
Seeds		400			
Ambush herbicide		280			
Labour costs					
Preparation (Digging and making holes)		700			
Raising of seeds		200			
Planting		400			
Weeding, done twice	300	600			
Harvesting 3 MD		300	4000 pcs cabbage	3,5	**14000**
Subtotal		**2880**			
Total for the year		**17880**	Total for the year		**26500**

Source: Case study with farmer, 1998.

The total cost by the farmer was Kshs. 17,580 against total revenue of Kshs. 26,500. Profit per year is Kshs. 8620. This is equivalent to Kshs. **84,097** per hectare. Benefits got in high and low season are summarised:

During high season when prices are low, the gross income got by farmer is as follows,

10	bags	Potatoes	at	Kshs.	450/bag	= Kshs.	4500
10	bags	Carrots -	at	Kshs.	300/bag	= Kshs	. 3000
4000	pcs	Cabbage -	at	Kshs.	1.00/pcs	= Kshs.	4000
Total						= Kshs.	11500.

Farmer gets a loss of Kshs. 6380. This is equivalent to Kshs.**62,244** per hectare.

During low season when prices are high the gross income got by the farmer is,

10	bags	Potatoes	at	Kshs.	1000/bag	= Kshs.	10000
10	bags	Carrots	at	Kshs	500/bag	= Kshs	5000
4000	pcs	Cabbage -	at	Kshs.	7/pcs	= Kshs.	28000
Total						= Kshs	43000

Profit per year is Kshs. 25120/acre. This is equivalent to Kshs. **24,5073** per hectare.

7.1.3 Case study 3: Murimi Mwega shamba in Kamae forest station

His plot size is ½ acre. His main fixed costs are cost of initial digging (Kshs. 3000), clearing cost (Kshs. 1500), and harrowing (Kshs. 1000). His main crops are potatoes, cabbages, and carrots. Potato output was 15 bags with a sale price of Ksh. 600. Cabbage output was 4000 pieces with a sale price of Kshs. 4. Carrot output was 50 bags with a sale price of Kshs. 600. A detailed cost and revenue information is given in Annex 4 and tables 7.3 gives the annual cost and revenue for the farmer.

Table 7.3: Annual cost and revenue in case study 3

Inputs			Outputs		
Item	Unit cost	Sum cost	Item	Unit cost	sum revenue
Fixed costs					
Shamba rent		150			
Labour costs					
Clearing the shamba		1500			
First digging		3000			
Harrowing		1000			
Subtotal		**5650**			
Potato cultivation					
Materials					
Seeds 1.5 bags	1000	1500			
Spraying. chemicals 3 times	400	1200			
Fertilisers DAP one bag		1300			
Labour costs					
Planting 4 MD	100	400			
Weeding 6 MD	100	600			
Labour for sprayer. 3 times	100	300	15 bags sold at 600	600	**9000**
Harvesting 6 MD	100	600			
Subtotal		**5900**			
Cabbage cultivation					
Materias					
Cost of seeds		1000			
Fertilisers DAP 75 Kg		2050			
Chemicals for spraying		425			
Labour costs					
Digging		600			
Making holes		300			
Planting		500			
1st weeding		500			
2nd Weeding		500			
Labour for spraying		300			
Harvesting		500	4000 pcs of cabbage sold	4	**16000**
Subtotal		**6675**			
Carrots cultivation					
Materials					
Seeds 300 gm.		630			
Chemicals bought for spraying		1198			
Labour costs					
Digging- contract		1000			
Harrowing- contract		500			
Making lines – contract		500			
Planting		100			
Labour for spraying		300			
Weeding 6 MD		600			
Harvesting		2000	50 bags of carrots	600	**30000**
Subtotal		**6828**			
Total for the year		**25053**	Total for the year		**55000**

Source: Case study with farmer, 1998

The farmer incurs a cost of Kshs. 25,053 against revenue of Kshs. 55,000. This gives a profit of Kshs. 29,947 per ½ acre plot. This is equivalent to Kshs. **146,083** per hectare.

7.1.4 Average profit per farmer

The average profit for the farmer during an average crop season can be estimated by getting the average profit in Kinale (142,244), Uplands (84,097) and Kamae (146,083). The average is Kshs. **124,141** per hectare per year. In addition, most of the labour cost which was entered as a cost to the shamba system is done by the farmer and so this means he/she gets more benefits than the one reported above.

The evidence got from the three case studies suggests that the system have financial benefit to the participating farmer. However the farmer can at times incurs loss due to the fluctuation of the market prices of the commodities in different seasons.

7.1.5 Contribution of shamba system to social economic welfare of the community

The contribution of the shamba system to the economy of the farmers cultivating in the forest, in Kiambu district, can be estimated roughly by using the profit of farmer per hectare per year (Kshs. 124,141). This can be multiplied with the area under shamba system in each station. This result is given in the following table 7.4.

Table 7.4: Earnings from shamba system in Kiambu District.

Station	Area under Shamba system (ha.)	Farm cash surplus (Kshs)
Uplands	375	46,552,875
Kereita	754	93,602,314
Kinale	400	49,656,400
Kamae	217	26,938,597
Kieni	368	45,683,888
Ragia	180	22,345,380
District total	2294	284,779,454

The contribution of the shamba system to the farmers is in the tune of **Kshs. 284,779,454** per year. This is equivalent to **8,899,358 DM** or **$4,746,324** per year. This assumes that cultivation is being done in the areas that are said to be under shamba system. The total contribution is much higher if the added benefits by the middlemen, transporters, other people employed by this sector and family labour is considered.

The results show that shamba system is suitable to improving the socio-economic well being of the communities' surrounding the forest station and ensuring food security. These benefits are in addition to the contribution the shamba has in ensuring that trees are successfully established. This forms another financial benefit to the FD at the end of the rotation. Shamba system has economical advantage to the FD and to the farmer. This forms an important part of the benefit which need to be improved through proper marketing of the products, efficient management of the shamba and joint efforts in solving constraints faced by the FD and farmer in management and administration of shamba system. There is a need to look into the sustainability of the shamba system to ensure that the benefits can be provided on a sustainable base for a long time. The question of sustainability of the system is discussed in chapter 8.

7.2 Cost of plantation establishment in absence of shamba system (Cost per Ha.)

The FD would incur the following costs in plantation establishment per hectare in absence of shamba system (the costs are calculated using the task rate provided in Annex 1).

Table 7.5: Plantation establishment costs per ha (Kshs)

Operation	MD/ha	Unit cost/MD	Sum
Site cleaning	50	100	5000
weeding (first three years)	50MD/year	100	45000
Total	500		50000

Forest Department is saving Kshs. **50,000** per ha in establishment cost if shamba system is used. FD also gets additional revenue from the rent paid by the farmer, which is Kshs. 200 per hectare per year. This totals to Kshs. 600 in three years. The total cash benefit FD gets by using shamba system is Kshs. **50,600** per hectare in three years time. This is in addition to the revenue they get during harvesting and thinning.

The results suggest that shamba system is suitable for plantation establishment. It saves on cost of plantation establishment, which is the most expensive operation in forest plantation establishment.

8. Prognosis of future shamba establishment methods

8.1 Shamba system in relation to Forest Policy

Shamba system has been used for establishment of forest plantations with a good degree of success since the start of the forest plantation programme in 1910. In the period between 1975 to 1994, policy changes, which have taken place, have affected its adaptability and implementation. Some of the changes have been done without studying their implication to the plantation development and the socio-economic conditions of the communities benefiting from the shamba system. Due to the long history of the shamba association with the plantation establishment, FD has grown to be dependent on shamba system as method for plantation establishment. The main argument for using the system is that it is low in cost and easy to apply. In addition the FD has not been able to develop a suitable alternative to shamba system. The methods which have been tried have largely been a failure or too expensive for the FD to implement. This means that shamba system still remains the most suitable method for plantation establishment.

No system can be said to be perfect in totality. There are always problems brought about by both external and internal frame conditions under which the system is operating. It becomes the task of the forest manager to optimise on the benefits of the system while still taking care of its detrimental effects to be able to have the biggest benefit to all for a long time. The aim of having biggest benefit for all is supported in the current Kenya Forest Policy. The policy state that, "the primary goal of the policy is to ensure that the forest resources of the country serve the present and future generations of its people through the traditional principle, of using the forest resources for the greatest good of the greatest number on a sustainable basis" (Kenya Forest Master Plan 1994). A number of conditions have changed in time and have consequently had an impact on shamba system.

The first change is the steady increase in the population of the country during the last twenty years. This has meant more pressure being exerted on the government forests by the surrounding communities. This is compounded by the fact that most of the forests are located in high and medium potential areas. These areas only cover 20% of the country's total area, but 80% of the country population reside there. The second frame condition which has changed is the abolition of forest villages and resident cultivation. This affected the distance farmers have to travel to go to the shamba and the effectiveness of methods they can use to protect crops from game damage. The third condition that has changed is the reduction of the forest department staff through the retrenchment[13] programme, resulting to forest stations only having skeleton staff who cannot manage the activities required in the stations. Retrenchment programme started in 1994 with an aim of reducing the government expenditures. The staff changes and the current situation are given in Figure 8.1. The socio-economic conditions of the farmers have changed which has affected their livelihood strategy. Shamba system needs to be

[13] Retrenchment is the staff reduction through early retirement.

viewed as a dynamic system, which should change to adapt to the changing frame conditions under which it is operating on.

FD remains committed in fulfilling its mandate to the Kenyan people on forestry issues. This is stated in the new Kenya Forest Policy. Four objectives stated in the new forest policy, which relate to this study, are to;

- Increase the forest and tree cover of the country in order to ensure an increasing supply of forest products and services for meeting the basic needs of the present and future generations and enhancing the role of forestry in socio-economic development.
- Support the government policy of alleviating poverty and promoting rural development, by income based on forest and tree resources, by providing employment and by promoting equity and participation by local communities.
- Manage the forest resource assigned for productive use efficiently for the maximum sustainable benefit, taking into account all direct and indirect economic and environmental inputs; also review ways in which forests and trees are valued in order to facilitate management decisions.
- Promote Partnership- Broad strategy of the master plan in dealing with large numbers of people who live near or inside the forest, some of whose activities (Legal and illegal alike) endanger the existence of the very forest they depend on, is to involve these local people in conservation and management of the forest

The Forest plantation section is expected to be revenue earning so that it can contribute to supporting essential non-profit forest activities such as forest conservation (Kenya Forest Master Plan, 1994).

From the above policy statements the following can be deduced,

- The government interest is to have a sustainable production of forest products in the country. One prerequisite for sustainability in plantation is that the area harvested should be replanted in time in order to have all age classes at any one year.
- Forest plantations should be revenue earning, this means the cost of the establishment should be kept at a minimum.
- FD has a role in supporting government policy of alleviating poverty and promoting rural development. Poverty, as well as being a social evil, is one of the main underlying agent of environmental degradation.
- In order for FD to succeed in the their objectives, they have to involve the local communities in forest activities.

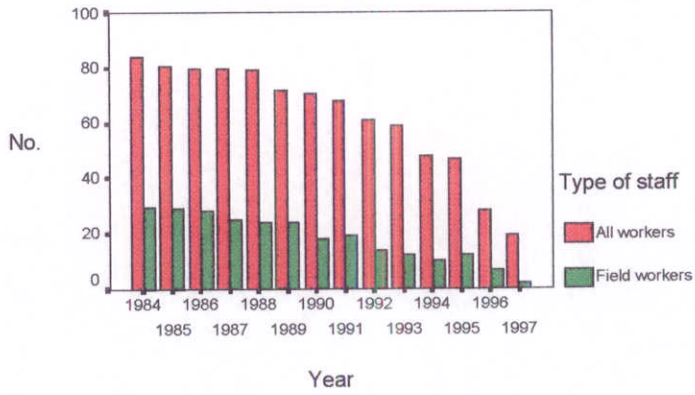
Shamba system provides solutions to some of the above objectives. The government is able to plant the areas as soon as they are harvested and thus eliminating backlogs. The cost of establishment is low for the FD. In addition the socio-economic welfare of the communities surrounding forest is improved through earnings from the shamba. The communities are to a certain degree involved in forestry activities and thus providing a form of participation. However the level of participation is still very low. There exist mistrust between farmers and FD officers, which make participation difficult. People's

participation is now thought by many to be a prerequisite for sustainable development (FAO, 1995). This needs to be supported and enhanced in the shamba system.

8.2 Review of forest plantation trends

The forest plantation trend is affected by the labour available to FD, area harvested and the area planted with trees. The labour status in the forest stations has reduced gradually during the last ten years leaving stations with only skeleton staff. This has affected the field workers greatly. The labour status is shown in Figure 8.1.

Fig. 8.1.: Labour Status in Kiambu District forest stations 1984 to 1997

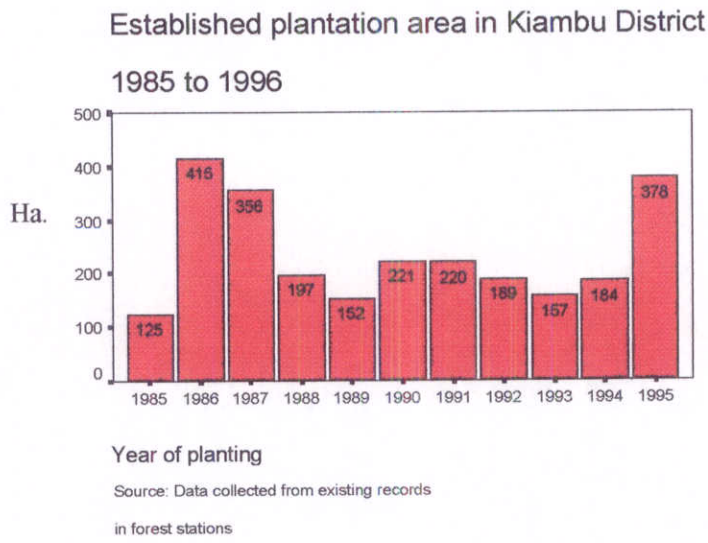


Source: Records from forest stations

The reduction of staff number means that FD will be more dependent on the local communities in plantation establishment, tending and protection of the forest.

The impact of the ban of shamba system on plantation establishment is shown in figure 8.2. The area established dropped after the ban in 1987 and then remained at the low figure up to 1995 when the ban was lifted. As reported earlier, the areas established during the ban had low seedlings survival and this means that they are even less than the ones reported to have been planted. The small area planted in 1985 can be attributed to severe drought that was experienced in 1984/85.

Figure 8.2



Area harvested during the same period of 1984 to 1995 is shown in figure 8.3. It shows that the harvesting area was maintained at almost at a constant figure between 1985 to 1992. This figure can be assumed to be the sustainable production. This trend was changed in 1993 when more areas were harvested reaching a peak in 1994. This was overexploitation of the resources.

Figure 8.3

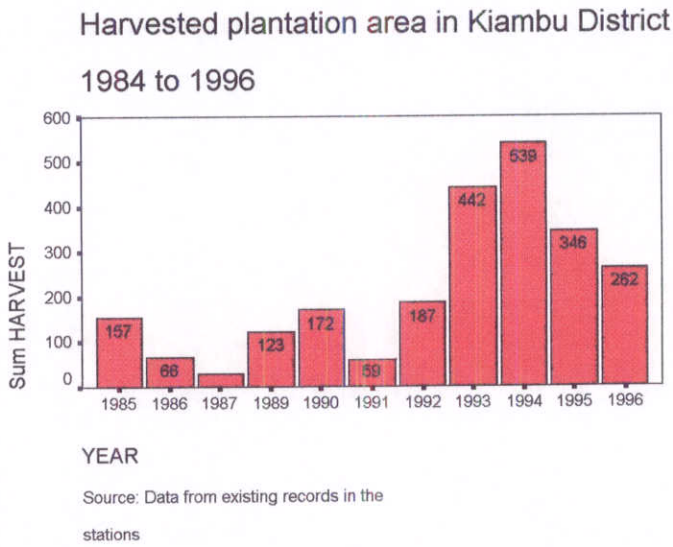
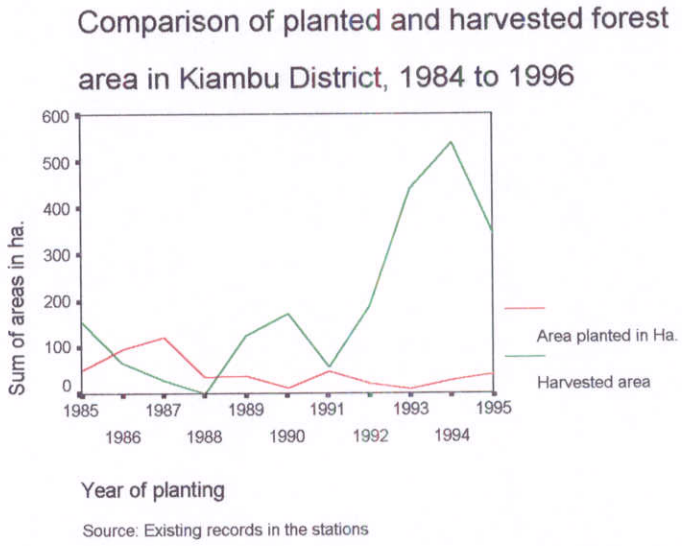


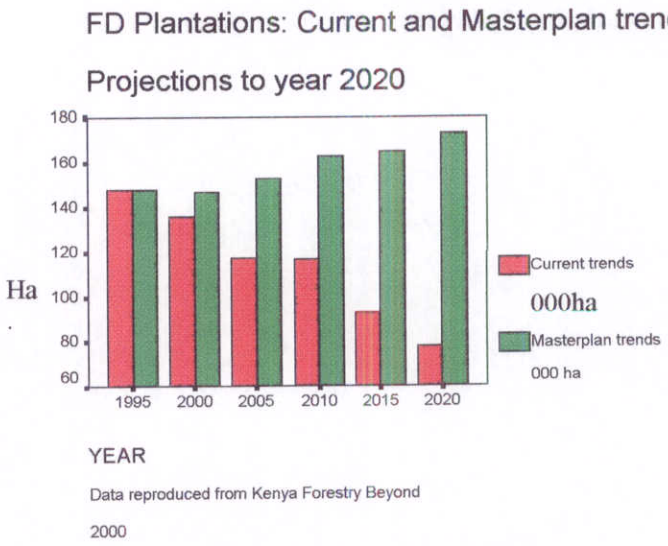
Figure 8.4 compares the area established and the harvested area. Harvesting of more areas than the established one leads to more backlogs in plantation establishment thus aggravating the problem which was originally created by the ban of shamba system.

Figure 8.4



The Kenya Forestry Development Project (KFDP) has given projections of the plantation areas in the whole country from 1995 to 2020. The first trend assumes the current situation continues without any intervention (Figure 8.5). The area under plantation will reduce drastically under this scenario. The master plan trend assumes that various interventions will be in place to reduce the downward trend in plantation.

Figure 8.5



The above time series in plantation establishment suggest that the area under plantations will decline more in the future unless interventions are done to counter the downward trend. Shamba system role is to ensure timely replanting of felled areas and high survival of the planted seedlings. The other interest of future trends is whether the plantations will be managed sustainably in the future.

8.3 Sustainability of shamba system

One objective of the study was to know the sustainability of the shamba system and consequently the sustainability of the forest plantations in Kiambu district. Sustainability as mentioned earlier is major goal in Kenya Forest Policy. The area under plantation area in the district was compiled. Considering a rotation age of 25 years for most of the plantation species grown (mainly *Cuppressus lusitanica* and *Pinus patula*), the annual cut can be computed. The total area under plantation was 6386 hectares in 1997. For a 25 years rotation, the annual cut per year should be 6386/25, which comes to 255 hectares per year. This amounts to 4% of the plantation area. Assuming that a farmer is given one year to cultivate before planting and then 3 more years before canopy closure, the area under shamba system at any one time would be 4 times the annual cut which is equivalent to 16% of the plantation area. Table 8.1 gives the current situation in the forest stations and this is compared to the expected situation under sustainable production.

Table 8.1: Comparison of current area occupied by shamba and the expected areas under sustainable production (area in ha.)

	Current	Situation		Expected sustainable	situation if
Station	Total area under plantations	Area under shamba System	Area under shamba not planted with trees	Expected annual cut per year	Expected area under shamba system (4 times the annual cut)
Uplands	870	375	280	35	140
Kereita	1054	754	200	42	168
Kinale	1003	400	187	40	160
Kamae	1200	217	55	48	192
Kieni	1553	360	290	62	248
Ragia	706	180	150	28	112
District Total	6386	2286	1162	255	1020

Shamba system will only operate successfully if the area opened up every year is equivalent to the annual cut per year. This means there is a limit to the expansion of the shamba system. The total area held by the farmers would be four times the annual cut, with equal areas with no trees, one-year trees, two-year trees and three-year trees. This

area can be increased to six times the annual cut if tree spacing is increased to allow more time for cultivation before the canopy closes. The current areas opened for cultivation are more than those allowable under sustained production. This was mainly brought about by the backlogs that accumulated when the shamba system was abolished in 1987.

There were few plantations that were established between 1987 to 1994 when shamba system was banned. The implication of this is that sustainability will be disrupted for a similar time period. This will happen from 2013 to 2020. In this period, there will be no mature plantation to harvest and to meet the demand; the FD may result to harvesting young plantations. The Issue of sustainability in plantation is still questionable even at present. The FD have overexploited the resources in the district to an extent that stations like Uplands, Kinale and Kereita have no plantations which can be harvested. This means that there are no new areas being opened through harvesting and consequently no new shamba are available to the farmers. The FD plantation programme cannot support the current number of farmers in the forest stations. Educating the farmers on these limits will help to prepare the farmers who are dependant on forestry that at one time, the forest estate will not be able to support all of them and so has to look for alternative means of raising income.

8.4 Review of Suitability of current system: Benefits, constraints and prognosis for future.

8.4.1 Farmers skills in forestry.

An average of 21.6% of the farmers with a range of 16.7% in Kinale to 30% in Uplands had no knowledge on tree planting. In addition 50.4% of all the respondents were new farmers who were not involved in shamba system prior to the ban in 1987. This is contrary to the assumption commonly held that farmers know how to take care of the trees. Farmers need to be educated on how to plant and tend trees if they are expected to take proper care of the trees. This can be done through public barazas[14] and having more contacts with the FD staff in the field. 95,7% of the farmers accepted that farmers' education on shamba system could improve their understanding of their roles as partners to FD (see annex 5). This will make the farmer know the role he/she is expected to play in the success of the system.

8.4.2 Allocation methods.

This is the most controversial issue in shamba system and the success of the system is to a large extent dependent on how the allocation will be done in the future. The allocation method determines who is excluded or included in the system. As shown in the results, the methods used in allocation are different from what the FD and the farmer regards as the commonly used method. Allocation method used can be considered as the bridge

[14] Public meeting called mainly by local administration to inform/educate the public on various issues

between the FD and the community especially in regards to how they regard forestry. Forest shamba can be considered as one benefit the local people can get from the forest.

Selling of the shamba has negative impact to the farmer as well as FD. The FD staff or their agents involved in the sale of the shamba ensure that any free area in the forest is allocated to shamba system without considering the annual plantation establishment programme. This leads to large areas being opened up more than the one expected under sustainable production. On the other hand, a farmer who buys a shamba feels that since he/she has paid for it then he/she has to maximise production to get the return of the investment. This maximisation may be at the detriment of the planted trees. Such a farmer will not feel that shamba is a benefit he/she is getting from the forest since he/she paid for it. The selling also denies access to shamba to the poor farmers in community who cannot afford the prices for the shamba.

The solution proposed here is to establish a Forest Village Committee, which will work together with the forester in allocation of the shamba. These type of committees have been shown to operate as an important way of Joint Forest Management in India (Poffensberger and McGean, 1996), in Usambara forest Tanzania (Johanson, 1998) and in Mgori forest Tanzania (Wily 1996). The concepts of Joint forest management and how it can be applied in shamba system will be discussed later.

8.4.3 Period of cultivation before trees are planted

The time taken before trees are planted has direct impacts on the benefit the farmer gets from the plot. This was noted as one of the main differences between the former shamba system and the current NRC. The interest of the farmer is to cultivate for a longer time before trees are planted while the interest of the FD is to establish forest as soon as possible especially if there are backlogs in establishment. During the period prior to the ban, a farmer would cultivate the plot for 18 months before the trees are planted. At present more than half of the plots are planted with trees in less than one year after allocation.

This time period is related to the time the farmer will cultivate his/her crops before the canopy closes. The crop yields decrease with time due to competition with trees and decreasing soil fertility. This time period before canopy closure depends on the species planted and the spacing used. One way of increasing the time the farmer can stay in a plot is to increase the tree spacing. In the survey study, 82% of the farmers felt that tree spacing should be increased to give more time to crops before canopy closure (see annex 5). The current spacing is 2.5 m * 2.5 m giving a density of 1600 stems per hectare. This number is finally reduced through subsequent thinning to 390 stems per hectare. The spacing can be increased without affecting the final yield to allow a farmer to cultivate for about 5 years instead of the current 3 years. This period can further be increased to a maximum of 8 years. The local experience from North Eastern Tanzania indicates that 8 years of cultivation is the maximum period foodcrops can be grown in

the same plot without severe drops in outputs, excessive risk of erosion and danger of permanent settlement in the forest (Silloh 1978). One argument against wide spacing is that the trees will develop large branches and so reduce the quality of the tree and that weed competition will be high. This can be solved through regular pruning with participation of the farmers. The weed competition will not be an issue since the farmer will keep the plot clean of weeds. This call for a revision of technical orders on main tree species to come up with a new spacing, pruning schedule and thinning schedule.
There is need for proper selection of tree species in shamba system. Farmers generally favour the trees, which do not offer fast competition with crops. This has led to situations where farmers have to abandon their plots even before the three years are over. In one case in Uplands KEFRI trials, the farmers had to abandon the plot within one year in plots planted with Eucalyptus.

8.4.4 Competition between trees and crops: Timing of planting for tree and crop

The crops grown by the farmer are the annual crops. The recommended type should vary with the timing of the tree planting season and the age of the tree seedling planted. In the period before trees are planted, a range of crops can be planted since there is no competition with the trees. The limitation of what to plant should start once the area has been identified for tree planting in the following season. The farmer should be informed of plans to plant trees in his/her plot in advance so that proper planning can be done. He/she should then avoid planting tall growing crops like maize, which will cover the trees and affects their growth. He can also avoid planting crop, which cover the entire area like carrots since they will be destroyed during tree planting. As much as possible, FD should try to plant trees at the beginning of the season to reduce the damage done to farmers' crops during staking out and planting. In the first year of seedling growth, the farmer should avoid planting tuber crops like potatoes since they will affect the tree root system during harvesting. High growing crops like maize should only be planted in the third year of cultivation (See photo 8).

In all cases, a minimum distance of 30 centimetres should be left between the crop and the tree seedling. This will ensure fewer disturbances to the trees when cultivating the crop and so the tree growth will not be affected. The choice of the crops grown at a specific stage of shamba system will contribute to the success or failure of the system. This could be the reason why an FAO (1967) report claimed that growing trees under taungya reduces their growth. The report gave an example in Kenya where trees in bare soil grew 15% better than those in maize taungya and 8 % better than those in bean taungya (FAO, 1967b). Later study by Konuche and Kimondo (1990), showed that the tree growth in shamba system was higher than in unattended plantations. The tree under shamba benefits from the fertilisers the farmers apply to the crops and also benefits from reduction in weed competition. The fertiliser application is however dependent on the ability of the farmer to purchase it and so may not be uniform for all the shambas. If the above guidelines on timing of planting various crops are followed, we should expect higher growth in shamba than in unattended plantation.

8.4.5 Contract between FD and farmer and maintenance of shamba register

The existing contract between FD and farmer seems to be more in the favour of FD than the farmer. There is need to review the contract to accommodate both parties. The obligations and rights of each party need to be clearly spelt out. A well-formulated contract can act as the basis for enforcement of the regulations in the shamba system. Some of the issues in the contract need to be reviewed to represent the reality of the time. One such issue is putting up of temporary structures in the cultivation areas. It has been shown that it is very difficult if not impossible to cultivate in areas with high game damage without putting up some form of temporary structures. Such structures are already in place in stations like Kieni. It is important to recognise this in the contract since the present situation is that the farmers are told to put up the structures in areas where they cannot be seen from the roadside. This is done to avoid the forester being accused of going against the terms of NRC by allowing structures in the forest area. Recognition of these structures in the contract will help the forester and the farmer since they do not have to hide them from road users.

A number of foresters said they had problems in communicating with the farmers since it is difficult to know all the farmers operating within the station. Maintaining a proper register of the farmers can solve this problem. A proper register showing the farmers in each block of the forest is important as a way of control. The regulations require such a register to be maintained and updated, but in the study this was only done in two stations. The updating of the register becomes complicated when the shambas change hands through sale or any other method. It is important that the forester or the forest guard knows the farmers cultivating in the forest or has records about them. This is helpful in cases where a farmer contravenes the agreed regulations. It also helps in ensuring that the rent payable to FD is paid by all the farmers.

8.4.6 Game Damage to trees and crops.

The damage caused by animals is of very high economical value to the farmer as well as FD. Most of the damage is done to crops when they are mature to harvest. This means that the farmer has already incurred a lot of expenses on the crops. The damage in most cases is total especially that one done by the elephants. The issue of protection from game damage is critical in success of shamba system and hence successes of forest plantations in some areas like Kieni. The locality of some forest stations make them more prone to game damage.

The role of game rangers in crop protection is very limited by personnel and equipment. Some solutions to game damage would include;

- Proper maintenance of the game moat[15]. In the past lack of funds have resulted to neglect in maintenance. Considering the benefits got if maintained more funds

[15] Game moat is a deep trench, which was dug around the areas with plantations to keep away elephants.

should be allocated for this purpose.

- Electric fencing to keep animals away. This is an expensive venture and is not foreseen in the near future.
- Protection by farmer. Farmers protect by scaring away the animals through joint efforts. This is only possible if farmers are organised. The temporary structures have been instrumental in scaring away game. Farmers can be organised through a Joint Forest Management approach for them to effectively protect their crops.
- KWS need to provide more staff to scare away animals and come up with a compensation scheme for the damage done.
- In areas with high incidents of game damage, it is better to shift the landuse from plantations to other uses like natural forest. This suggestion had earlier been proposed by KIFCON project (KIFCON, 1994).

8.4.7 Damage of seedlings by the farmer and theft of produce from the farms

Damage of seedlings by the farmers is a problem, which was reported to exist even before the ban of shamba system (World Bank, 1988). The main aim for the damage is retard the tree growth or to kill the tree. This is done to ensure that the farmers cultivate in the same plot for a longer time or to reduce competition of trees with crops. 82 % of the farmers agreed that they should be held responsible for seedlings/trees that die due to their own neglect. This response showed that farmers have a commitment on caring of the trees. Farmers should be made responsible for the trees planted and should come up with recommendations on measures to take against farmers who damage the trees.

Farmers face problem of theft of the produce from their plots. This is mainly done by the middlemen or by the other farmers. This problem can be solved if farmers who know each other are located in one area since they will be able to organise themselves for protection of crops. This is possible if Forest Village committees are started

8.4.8 Involvement of farmers in forest operations

Farmers have been involved in tree planting and pruning in some stations. Their involvement is expected to increase more in future due to the reducing number of FD employees. There is a ministerial declaration that says that farmers should assist in these duties. While it is not the aim of this thesis to argue for or against the declaration, some facts have to be considered for such an activity to be successful.

Tree planting in forestry is considered as an emergency operation. It is done when there is enough build up of soil moisture. Precautions have to be done against seedlings drying up by planting without delay (Technical Order No. 18, 1995). Seedlings need to be handled with care. It has been shown that many recent failures in establishment were not caused by unsuitable soil moisture conditions but by poor planting which allowed seedling root to dry between lifting and planting. The farmers have no skills in tree planting and so have to be trained in planting before using them for the exercise. It is

also a problem to get farmers to come to plant within a short notice since they have their own programmes and most of them do not stay near.

In addition to the lack of skills, the farmer is bound to feel exploited when he/she is expected to do the planting. This amounts to the question of sharing the benefits from the forest. As for now the farmer has no benefit he/she gets from the established plantation. The argument that shamba system exploits the farmer by using his/her labour without payment has been a major criticism of shamba and taungya systems. The forest division financial position is sometimes so difficult such that most of the area may not be planted if it has to pay for land preparation and weeding. According to Hofstad (1978) in his study of evaluation of taungya system in Tanzania, the "exploitation" may be seen as a form of taxation of "peasants" consumption for reallocation to investment in wood production for the benefit of the Tanzanian society as a whole.

It is important to discuss with the farmers about their acceptance in planting because their failure to co-operate can lead to low survival. As the FD continues to use farmers to do forest operations, FD needs to consider how the eventual benefit from established plantation can be shared out.

Pruning need to be done with skills to minimise the wound inflicted on the tree. It has to be done using a pruning saw or a very sharp object. Farmers have no skills to do pruning; neither do they have the equipments. If they are expected to do pruning, they have to be trained on how to do it and the amount of portion to prune. During the study, the author saw cases where the farmers had overpruned the trees leading to stunted growth and final death of the tree. It is noted that the farmer is very interested with pruning of the tree since it will reduce the competition with the crops. This is the reason why a farmer can go ahead to prune to reduce this competition. Timely pruning of the trees should be done.

8.4.9 Marketing system

Results showed that farmers have not developed method of marketing their farm products. They mostly rely on middlemen to buy their produce. Most farmers feel that the middlemen exploit them. In addition farmers experience price fluctuations of the products in the market. The prices are high during off-peak period and then they decrease during the peak of the harvesting season. This is mainly due to over-production and poor marketing channels. Most of the crops planted by the farmers are perishable and so cannot be stored for long. The other problems experienced by the farmers in marketing include lack of enough information and lack of funds to enable them market their products outside.

During the study, no co-operative to help in the process of marketing was observed. No storage facility was also observed. No loans were extended to the farmers.

In order to develop better marketing situation for the farmers, there is need for initiation of marketing co-operatives, provision of credits to the farmers, improvement of infrastructure, provision of good marketing information and organisation of farmers associations need to be started.

8.5 Suggested improvements to shamba system.

A number of suggestions on the improvements of shamba system were read out to the farmers (Q42 - 53). The farmers were expected to say whether they were true, false or they did not know. The results are given in annex 5.

Farmers can benefit through technical advice from agriculture extension staff on how to improve the yields and the best seed hybrid to use in an area. The agriculture extension officers do offer the services to the farmers in the reserve areas, but not in the forest area. The forester has a role of inviting these officers to give advice to the farmers.

Another way of increasing the yields of some farmers is to introduce a credit scheme, which will help farmers to buy the necessary inputs. 94.2% of farmers said that they would benefit from a credit facility to buy farm inputs (Q45). This will especially assist the poor farmer who suffers from a diabolic cycle of poverty. Such a farmer has no funds to prepare plot adequately for planting, to buy the seeds and the fertilisers. He uses low quality seeds, is also unable to buy herbicides and fungicides to protect the crop from attack by pest, unable to purchase fertilisers to improve growth and prevent diseases, and is unable to do proper weeding. In the end his/her crops have low yields, are the ones which are seriously attacked by diseases and so the farmer becomes poorer. Such a farmer will not be able to take care of the planted trees in the plot. This cycle of poverty can only be broken through an external intervention. Credits can be given through an arrangements that will ensure that though the funds are allocated to a specific farmer, the whole group of farmers in a forest village association are held as guarantors for the loan. This will ensure the loan is paid back and finally used as a revolving fund. This will generally be possible in shamba system since most of the crops grown are annual crops and so the revolving time is short.

The FD has also a role to introduce motivation packages for the farmers participating in shamba system. Such motivation can be in form of rewards to farmers who ensure the highest growth and survival of the planted trees in his/her plot for example allocating an extra shamba to this farmer. Other motivation would be to allow farmer to collect firewood from forest area for use at home free.

Most farmers felt that education on shamba system will improve their understanding of the system. This means that the forester should make arrangements to have meetings with the farmers to discuss shamba system issues. The author attended such a meeting with the farmers in Kereita station and it came out clearly that farmers have a lot of questions about shamba system but at the same time, answers are easily found from the

same farmers. This calls for more participation of farmers in shamba system.

8.6 Building case of Joint Forest Management in Shamba system.

Shamba system can be considered as a loose form of joint forest management. The concept of Joint Forest Management (J.F.M) was borne in India out of the need for the departmental staff to redefine their relationship with the communities and regain the trust and allegiance of the villagers. It recognises that it is difficult for FD staff to take care of the vast forests without participation of the local people (Poffenberger and McGean, 1996). It has been used very successfully in West Bengal and is increasingly being used in other parts of India in protection and conservation of forests, which are endangered by high population in the surrounding. In East Africa, the JFM has been tried out in Usambara forest (Johanson, 1998) and Mgori area (Wily, 1998) both Tanzania and Button Buvuma Forest Reserve in Uganda. The case of Mgori forest, which involves Collaborative Forest management of forest using Villagers and Government, is a success story of JFM in East Africa.

Some lessons learnt that can be a base for starting JFM in shamba system are,

- High forest dependence may be the single most important factor in determining the user groups motivation to organise, protect and manage the forests.
- JFM policies should reflect flexibility in encouraging the diversity of institutional strategies that communities use to organise rather than providing prescriptive models or blueprint which must be followed.
- The principle function of a community institution in JFM is to provide an organisation structure that can articulate and represent the interest of all user subgroups of a forest area with partnership with FD.
- JFM programmes should not be viewed as a subsidy or a give away scheme to rural communities, but rather as a long-term agreement between the rural people and government, which secure rights to the forest products in exchange for serious responsibilities.
- Local community management can only succeed with strong legal and institutional basis for administration and management that recognise their tenure to forest resources.
- JFM is only possible if the roles and aspirations of the partners are defined and understood especially where the authority and legal mandate of the forest service is accommodated and concrete benefits exist.

JFM is run through establishment of Forest Village Committee that is composed of elected members from the community who manages forestry issues jointly with FD staff. They also start Village forest guards who protect the forest from destruction. Forest user rules and offences are agreed upon which guide the community in management. The rules also define fines for those who go against the rules. These rules have to be supported by the necessary legal framework and be consistent with the

existing forest rules.

The case of shamba system can be solved through establishment of Forest Village Committee who will work closely with the forester in identifying the needy cases in the society, in allocation, protection of crops and trees, and in solving the problems farmer face in shamba system. The problems faced by the farmer range from some which can be solved in the forest station by the forester, to some which can be solved by the District Forest Officer to the ones, which involve policy, which need to be referred to the FD headquarters. The FD staff must change their attitude towards the farmers to gain confidence and trust so that the partnership can be realised. The government and FD in particular need to redefine the benefits the local communities can get in the forest and their expectations from them. This has to be understood by both parties and articulated through formation of various committees which must be representative of the local communities.

A JFM approach will make the management of shamba system easy and in addition contribute to change of attitude of the communities to forestry and lead to better sustainable production and conservation of the forests.

9.0 Synthesis of Results, Conclusions and Recommendations

9.1 Synthesis of Results and Conclusions

The changes in shamba system in the past have affected its success in plantation establishment and the benefits the local people get from it. The analyses in chapter 3 show the impacts of every major policy change. The most evident impact was the backlogs in plantation establishment, which resulted when shamba system was banned. The farmers also lost the benefits they were getting from the practice. The conclusion from the historical review, is that it is important to monitor the implication of any policy change before it is implemented in order to be prepared for the impacts it will have and develop methods to counter the negative impacts .

Shamba system is suitable to plantation establishment in ensuring higher seedlings survival and low costs in forest plantation establishment. The forest department saves Ksh 50,000 per hectare when shamba system is used in establishment. The evidence from table 5.1 shows that farmers participating in the system have enough knowledge to make them better partners in plantation establishment. The above evidence supports that the system is suitable. However the system was found not suitable on the methods used in shamba allocation, damage of crops by wild animals and constraints faced in shamba management. The methods used in shamba allocation as shown in table 5.3b are unfair and this can affect the commitment of farmer to forestry. Most farmers reported game damage to crops (figure 5.3) and this affects the willingness of the farmer to take up shamba in areas with high game damage. Most farmers felt that FD has a role in protecting crops and trees from game damage. The farmers are ill equipped in protecting their crops from game (figure 5.5). The foresters mentioned several constraints in management, which include damage of seedlings by the farmers. The conclusion from above evidence is that, though shamba system is suitable in plantation establishment, it has shortcomings in the way it is managed and the conditions in which the farmers are operating on. These need to be improved to ensure more benefits to farmers, which will be translated to more benefits to forest department since the farmers will take better care of the planted trees.

Shamba system is suitable in improving the socio-economic well being of the communities surrounding the forest areas. A direct financial benefit in the range of Kshs. 124,141 per ha (Ksh. 12,141 per ¼ acre) is achievable per annum. The farmers attach a high value to their shamba as shown in table 6.2. This means that the farmer has enough economic motivation to own a shamba. The system can be used to raise income levels of the local communities (table 7.4). These benefits can be enhanced and improved if farmer has access to agricultural extension staff, provision of credit facilities to buy input and proper marketing channels for the produce. The period a farmer cultivate crops before trees are planted have reduced from the earlier 18 months to less than a year and even several cases where trees are planted immediately after allocation is done (table.6.1). This is not economically suitable to the farmer because it reduces the benefits from the shamba. In addition the farmer face serious problem of

game damage and impassable roads during wet season, both of which reduces his/her benefits. The above evidences suggest that shamba system is generally suitable in improving the socio-economic conditions of the farmers and in turn of the local communities. However there exist constraints, which hinders optimal benefits to the farmer and which need to be solved to improve its suitability.

The future of plantation establishment depends on the way shamba system is optimised for the continued benefits of FD and the farmer. The system should be managed in a sustainable way. The current area opened for shamba system is bigger than the expected under sustainable plantation development (table.8.1). This does not assure continued benefits for the farmer in the future. These areas need to be gradually reduced to only the area, which can work sustainably. The future outlook for shamba system is to involve farmers in decisions regarding administration and management of the system. Shamba system should be considered as one form of community participation in forest management and one that can be a solution of the persistent problem of pressure on forestland. As noted in the KFDP Midterm Review (1996), shamba system can be a compromise solution to the pressures by the surrounding communities to excise forestland. The landuse pressures in areas where plantations are situated have to be understood as a fact of life with increasing rural population and more demand for food. One way forward would be to adopt a Joint Forest Management approach in shamba system. This will ensure that the communities benefiting from the shamba play a role in protection and management of the forest. The FD will be expected to recognise the important role of these communities and gradually increase the benefits they get from the forest. This approach needs change of attitude by both forest department staff and the local communities. This should be followed by confidence build-up to eliminate mistrust between the two. The efforts need to be backed by the necessary legal, policy and institutional changes.

The study showed that though shamba system is suitable in plantation establishment and improving the welfare of farmers, it has major constraints, which hinder its optimal utilisation. The methods to be used to solve these constraints will determine the future success of the system. The FD need to learn from the past mistakes to ensure proper administration and management of shamba system. This will be more enhanced if forest village committees are established to ensure that local communities are involved. The reducing budget allocations which has led to reduction of FD staff means that FD has to involve communities in forest management. The results from the study form a base for further research on ways to improve shamba system.

9.2 Recommendations

1. Form a managerial team that will be monitoring the dynamics of shamba system practices, to ensure proper checks are in place to avoid abuse of the system.

2. Review the distribution of benefits from forest enterprise between the forest department on one side and the farmer and surrounding communities on the other hand.

3. Involve farmers in shamba practice decisions through Joint forest management approach.

4. Review administration and management practices that hinder optimal benefits to the forest department and to the farmer.

5. Conduct further studies on economic analysis of shamba system to determine its contribution in improving the welfare of the local communities.

6. Conduct further research on community participation in forest management.

Literature Cited

Blanford, H.R. 1958. Highlights of one hundred years of forestry in Burma. Empire Forestry Review 37(1): 33-42.

Czaja, R. and Blair, J. 1996. Designing Surveys. A Guide to Decisions and Procedures. Pine Forge Press.Thousand Oaks Califonia. London. New Delhi

Evans, J. 1992. Plantation Forestry in the Tropics. Second Edition. Clarendon Press, Oxford. London.

FAO, 1967b. Taungya in Kenya: The Shamba system. Proceedings of the World symposium on man-made Forest and their Industrial Importance, FAO Rome.

FAO, 1995. Forest Trees and People. Working Paper, Phase II. Participatory Approaches to Planning for Community Forestry. Results and Lessons from case studies conducted in Asia, Africa and Latin America. A synthesis report by Oltheten, Theo M.P. FAO Publication.

Fink, A. 1995. How to Report on Surveys. The Survey Kit, TSK 9. Sage Publications, London.

Gittinger, J. P. 1995. Economic Analysis of Agriculture Projects. Second Edition. EDI Series in Economic Development.The Johns Hopkins University Press. London

Gregersen, H., Draper, S., Elz, D. 1994. People and Trees. The Role of social Forestry in Sustainable Development. Economic Development Institute of the World Bank. EMI Seminar series. Washington DC.

Hammersley, M. 1992. Whats Wrong with Ethnography: Methodological Explorations, London, Routledge.

Hofstad, Ole. 1978. Preliminary Evaluation of Taungya For Combined Wood and Food Production in North Eastern Tanzania. Record No. 2 , Division of Forestry, Faculty of Agriculture, Forestry and Vertinary Science. University of Dar es Salaam.

K.F.D.P, Midterm Review. 1996. Kenya Forestry Development Project Midterm Review. Nairobi.

Kenya Forestry Beyond 2000. 1994. An Overview of Kenya Forestry Master Plan. Ministry of Environment and Natural Resources, Nairobi.

Kenya Forestry Master Plan. 1994. Kenya Forestry Master Plan, 1995 – 2020. Ministry of Environment and Natural Resources, Nairobi.

Kiambu District Development Plan. 1997 - 2001. Office of the Vice President and Ministry of Planning and National Development. Goverment Printer, Nairobi.

KIFCON. 1994. Management Guidelines For Natural Forests. Kenya Indigenous Forest Consevation Programme. KIFCON, Karura Forest Station, Nairobi.1996.

Kiriiya, C. K. 1994: The Rise and Fall of Taungya: Lessons from Kenya. Agroforestry Today, July - September 1994.

Kirks, J. and Miller, M. 1986. Reliability and Validity in Qualitative Research. Qualitative Research Methods Series, No. 1, London: Sage.

Konuche, P.K.A. and Kimondo, J. M. 1990. Prospects of replanting clearfelled forest plantations without a shamba system. Technical note No. 8, Nairobi, KEFRI.

Logie, J.P.W. and Dyson, W.G. 1962. Forestry in Kenya. A Historical account of the development of forest management in the colony. Goverment Printers, Nairobi.

Lundgren, B., (ed.). 1975. Land use in Kenya and Tanzania. The physical background and present situation and an analysis of the needs for its rational planning. Royal College of Forestry, Stockholm.

Mitchell, R.C. and Richard T. Carsson. 1989. Using Surveys to Value Public Goods. The Contingent Valuation Method. Resources for the Future, Washington DC.

Nair, P.K. 1993. An Introduction to Agroforestry . Kluwer Academic Publishers, Netherlands.

Nao, T.V. 1978. Agrisilviculture: Joint product of food and wood: Proceedings of the 8th World Congress, Jakarta, Vol. 3, pp 513-400 in Evans 1992.

National Development Plan, 1997 - 2001. Republic of Kenya, Goverment Printer, Nairobi.

Ochieng, E.A., Amahwa, Z.K., Sang, F.K., 1980. Review of squatter status in goverment reserves; Classification and practical solution. Internal Forest Department Report.

Poffensberger, Mark and Betsy, McGean. 1996. Village Voices, Forest Choices. Joint Forest Management in India. Oxford University Press.

Pudden, H.H.C. 1953. The advantages of shamba system and disadvantages of the grass-infected systems. Technical Note No. 11, Nairobi, Kenya Forest Department.

Raintree, J.B. 1985. Agroforestry. Tropical Landuse and Tenure. Background Paper for International Consultative Workshop on Tenure Issues in Agroforestry, May 27-31, 1985, Nairobi, 52pp

Ruthenberg, H. 1980. Farm Systems in the Tropics. Clarendon Press, Oxford.

Silloh, 1978. Personal communication to Hofstad, 1978

Silvermann, David. 1993. Interpreting Qualitative Data. Methods for Analysing Talk, Text and Interaction.

Stig, Johansson. 1998. Joint Forest Management in the Usambara Forests. Forest Action News No. 9

Sumitro, A. and Sudiono, Y. 1978. The significance of forestry as a source of employment in rural areas. Proceedings of the 8th World Forestry Congress, Jakarta, FEP/12-5.

Technical Order No. 18, 1995. Ministry of Environment and Natural Resources, Forest Department. Nairobi.

Wanyeki, F.H.M. 1980. Agroforestry practices in high potential areas in Kenya. In Buck Led, proceedings of Kenya National Seminar on agroforestry, Nairobi ICRAF

Wanyiri, J.M. 1995. Report on Planting and Silvicultural Backlogs. Supplementary Report 3(a). Kenya Forest Development Project, Ministry of Environment and Natural Resources, Forest Deparment.

Wily, Liz. 1996. Collaborative Forest Management, Villagers and Government. The case of Mgori Forest, Tanzania.

World Bank. 1969. Kenya: First Forestry Project, Loan 691-KE, Washington DC.

World Bank. 1975. Kenya: Second Forestry Plantation Project, Loan 1132-KE and Credit 565-KE, Washington DC.

World Bank. 1984. Impact Evaluation Report, Kenya: First and Second Forestry Projects (Loans 641-KE, 1132-KE and Credit 565-KE), Washington, DC.

World Bank. 1988. Kenya Forestry Subsector Review. Annexes I - III, February 1988, Agriculture Operations Division, Eastern Africa Department. Report No. 9005 - KE.

World Bank. 1990: Staff Appraisal Report. Kenya Forestry Development Project (KFDP), November 1990. Agriculture operations. Eastern Africa Deparment.

World Bank. Supervision Reports 1996. Kenya Forestry Development Project Midterm Review.

Yin, Robert K. 1988. Case Study Research , Design and Methods. New Delhi India.

ANNEX 1:

Current task rates for the current silvicultural schedule

Operation	Manday/ha.	Comments
Seedling production	13	
site preparation	0	50 for non NRC
Planting(including staking)	10	
Cleaning	0	50 for non NRC
Pre-commercial thinning	8	
1st pruning	8	
2nd pruning	15	
3rd pruning	15	
4th pruning	21	
Total	90	190 for non NRC

Source: KFDP World Bank Supervision reports, Midterm review, 1996.

The above table shows that the cost of establishment without shamba system would be 190 mandays per hectare. Taking a wage of Kshs. 80/workman/day and a current task rates the direct cost of plantation establishment compounded at 15% (estimated current inflation rate) to the end of a 30 year rotation is approximately;

- Kshs. 277,000/ha. for NRC areas and
- Kshs. 753,000/ha. for non-NRC areas.

This shows that shamba system is critical in economical establishment of the forest plantations.

ANNEX: 2

Case study 1. Mama Guchu from Kinale forest station

1 0 **Yearly calendar of the farmer**

1.1 **Alternative 1**. The farmer plants one crop in the whole plot.

- March. Preparation and planting of potatoes. Potatoes take 4 months to mature. They need two weeding and 4 fungicide applications.
- August. Harvesting of potatoes followed by planting of kales. Kales take 2 months before harvesting begins.
- October. Start harvesting of kales. Harvesting is done after every two weeks for a period of six months, that is until March.

1.2 **Alternative 2**. The farmer subdivides the plot into two equal sections.

1.2.1 Plot 1

- January. Preparation and planting of carrots. Carrots take 4 months to mature.
- May. Harvesting of carrots followed by planting of cabbages.
- September. Harvesting of cabbages. Land preparation done and then spinach is planted. Spinach can take up to 8 months. They are harvested after every two weeks.

1.2.2 Plot 2

- January. Preparation and planting of potatoes.
- April. Harvesting of potatoes.
- May. Planting of carrots.
- September. Harvesting of carrots followed by planting of potatoes.
- December. Harvesting of potatoes

2.0 **Inputs and output costs per crop**

2.1 **Fixed costs for all crops**

- Cost of buying shamba Kshs. 5000
- 3 hoes at 200 each. Kshs. 600
- Fencing. Kshs. 1000
- Cost of buying a Napsac sprayer. Kshs. 6000
- Initial land preparation. Kshs. 800.

2.2 **Carrots**

2.2.1 **Variable costs.**

- Land preparation-Kshs.600
- Planting- Kshs.100
- Seeds. 250 grams at Kshs.360
- 1st spraying. Cost of chemical Kshs.180 + labour cost Kshs.100 =Kshs. 280
- 2nd spraying -Kshs. 280
- Weeding. 10 mandays at Kshs.100 each = Kshs.1000
- Harvesting. 10 MD at Kshs.100 each = Kshs.1000
- Transport to washing point. Kshs. 80 per bag =Kshs.960
- Washing. Kshs. 30 per bag. For 12 bags is Khs. 360
- Total cost is Kshs**. 4940**

2.2.2 **Outputs**

12 bags of carrots harvested. The pricing of this carrot can range between Kshs. 500 to Kshs. 1500 depending on the season and the demand/supply status at a specific period, place and time. This translates into an income of Kshs. 6000 if the carrots are sold at 500, Kshs. 12000 if carrots are sold at 1000 per bag and Kshs. 18000 if carrots are sold at 1500 per bag.

2.3 **Potatoes**

2.3.1 **Variable costs**

- Buying of seeds. 10 debes at 200 each = Kshs. 2000
- Preparing land (digging) = Kshs. 400
- Making of planting trenches =Kshs. 200
- Fertilisers. 15 kg at 30/Kg= Kshs. 450
- Planting Kshs. 200
- Spraying. Foliar fertiliser (120) and Ridomil (250) plus labour (200). Total = Kshs. 570
- Weeding Kshs. 200
- Spraying to protect from blight 370 two times = Kshs. 740
- Labour for spraying Kshs. 200
- Harvesting. 7 MD at 100 =Kshs. 700
- Transport to road 60/bag. For 15 bags = Kshs. 900
- Total cost = Kshs. 6360

2.3.2 **Outputs**. Harvest from a new shamba can be 15 bags while an old shamba would produce 5 bags. Price range between 500 in bad season to 1400 during good season.

2.4**Cabbage**

2.4.1 **Variable costs**

- Buying seeds. 250 grams at Kshs. 380. Seeds planted in a nursery where they require to be watered. Cost of watering is Kshs. 1200.
- Preparation. Digging (400), digging of holes for planting (200). Total =Kshs. 600
- Fertilisers Kshs. 600
- Planting Kshs . 400
- Spraying of ambush chemical (350) and foliar fertiliser (120) and 2MD. Total cost = Khs. 670

- Weeding = Kshs. 400
- 2nd spraying =Kshs. 670
- Harvesting Kshs. 600
- Total cost Kshs. 5520

2.4.2 **Output**

Harvest done in 3 stages. First harvest give 3000 pieces and second harvest give 1000 pieces. Still about ½ is left which is harvested later. Total harvest can yield 6000 pieces. The price per piece range between 0.5 shillings to 10 shillings.

2.4.3 **Ways of marketing**

The cabbages may be sold directly to buyers with pickups who sell to Nairobi or other nearby markets. Alternatively they are packed in small bags and transported to the roadside from where they are sold. The third method is the one where they are packed in large bags, transported to the roadside and sold to traders who sell them in Mombasa. Farmers get information about the fluctuation of the market prices of food commodities through a daily broadcast through radio on the prices of commodities. This is helpful to the farmer cultivating in the reserve. For those farmers cultivating in forest shamba plots, middlemen dictate the prices. If a farmer refuse to sell to them at those prices, they come back to the shamba to steal the produce. 95% of the produce is sold out and 5% is used for local consumption.

ANNEX: 3:

Case study two: Mama Wanjahi Shamba in Uplands forest station

1. **Yearly calendar.** Has 3 seasons, January to April, April to August and August to December.
    - January. Plant potatoes. Take 3 months to mature.
    - April. Potatoes harvested and then carrots are planted.
    - August. Carrots harvested and then cabbages are planted.

2.0 **Inputs and output cost per crop**

2.1 **Fixed cost for all crops**

- Napsac sprayer costing Kshs. 5000
- 3 hoes costing 200 each = Kshs. 600
- 3 fork holes costing 200 each = Kshs. 600
- Total fixed assets = Kshs. 6200

2.2 **Potato cost- Planted in Jan.**

2.2.1 **Variable cost**

- Preparation 9 MD =Kshs. 900
- Digging of trenches and planting -Kshs. 200
- Seeds. One bag =Kshs. 1500
- Fertilisers. 6 kg at 30 = Kshs. 180
- weeding 4 MD = Kshs. 400
- Spraying 460 twice = Kshs. 920
- Earthing up of soil 6 MD =Kshs. 600
- Harvesting 8 MD =Kshs. 800
- Total cost = Kshs. 5500

2.2.2 **Outputs**

8 bags. First harvest can be 10 to 11 bags.

Prices range between Kshs. 450 to Kshs. 1000 per bag

2.3 **Carrots- planted in April**

2.3.1 **Variable costs**

- Seeds - Kshs. 350
- Preparation - Kshs. 400
- Planting Kshs. 300
- Spraying herbicides (herbicides 150 and labour 100) = Kshs. 250
- Weeding for soil aeration 5 MD =Kshs. 500
- Foliar spray to accelerate growth Kshs. 300
- Harvesting - Kshs. 400
- Transport by donkey to the washing point and later to the roadside Kshs. 40 per bag.
- Washing Kshs. 400
-

2.3.2 **Outputs -** 8 to 10 bags. Price range between 300 to 500 per bag.

2.4**Cabbage**

2.4.1 **Variable cost**

- Preparation and digging Kshs. 400
- Making planting spots Kshs. 300
- Seeds. Farmer has to buy one tin of seeds at Kshs. 400 and then raise the seedlings in the nursery.
- Raising seedlings Kshs. 200
- Planting Kshs. 400
- Spraying to prevent insect attack. Ambush used bought at Kshs. 180 for every plot. Has to employ 1 MD. Cost is Kshs. 280
- Weeding, done twice each time with 3 MD. Kshs. 600
- Harvesting. Kshs. 300

2.4.2 **Outputs.** 4000 pieces which are sold at Kshs. 0.5 to 7.00

2.5 **Kales**

2.5.1 **Variable costs**

- Preparation cost same as for the cabbage up to planting time.
- Seeds Kshs. 200 per plot
- Weeding- same as cabbage but has to continue weeding for the total period of harvest, which can be up to 8 months. Harvesting starts from one to one and half months after planting and can continue up to one year. Harvest is done after every two weeks.

2.5.2 **Outputs**. Every harvest produces 5 bags. Price range from Kshs. 20 to 400 per bag.

ANNEX 4:

Case study three: Shamba belonging to Murimi Mwega in Kamae station

1.0 Yearly seasons

- January to April
- May to August
- October to December

2.0 **Inputs and outputs per crop**

2.1 **Fixed costs for all crops.**

- Annual rent- Kshs. 150

- Clearing- Kshs. 1500
- Initial digging- Kshs. 3000
- Harrowing- Kshs. 1000

2.2 **Potatoes cultivation** – Planted in January and harvested in April.

2.2.1 **Variable cost**

- 1.5 bags of potatoes- Kshs. 1500
- Fertiliser- DAP 50 kg = Kshs. 1300
- Planting labour- Kshs. 400
- Weeding 6 MD- Kshs. 600
- Spraying three times each time costing 400 = Kshs. 1200
- Labour for spraying- three times =Kshs. 300
- Harvesting cost 6 MD = Kshs. 600

2.2.2 **Output.** Harvest. 15 bags each selling at Kshs. 600 =Kshs. 9000

2.3 **Cabbage cultivation** – Planted in May and harvested in August

2.3.1 **Variable costs**

- Digging- Kshs. 1000
- Seed cost = Kshs. 600
- Making planting holes- Kshs. 300
- Planting 5 MD =Kshs. 500
- DAP fertiliser, 75 kg = Kshs. 2050
- Weeding, 5MD = Kshs. 500
- Spraying three times, dimezued 100 ml costing Kshs. 150 and mixing with farmfliska costing 175/kg and Murphy. Sprayer uses a combination of 30ml of dimezuel, 300 grams. of farmfhaska and 150 grams of Murphy. Cost for chemical = 425
- Labour cost for spraying = Kshs. 300
- Second weeding 5MD = Kshs. 500
- Harvesting cost 5MD = Kshs. 500

2.3.2 **Output**. 4000 pieces of cabbages harvested. Each sold at Kshs.4.00 so total sale =Kshs. 16000

2.4 **Carrots cultivation** – Planted in October and harvested in December.

2.4.1 **Variable costs**

- Seeds, 300 grams. Kshs. 630
- Digging- done on contract basis at a cost of Kshs. 1000
- Harrowing- done on contract basis at a cost of Kshs. 500
- Making ridges- done on contract basis at a cost of Kshs. 500
- Seeds- 300gms bought at a cost of Kshs. 630
- Planting cost 1 MD = Kshs. 100
- Chemicals sprayed
  - Faminon 50gm - Kshs. 770
  - Bylolian 1 kg - Kshs. 250
  - Boaster 1kg - Kshs. 178
  - Each spray requires 150 grams faminon, 300 grams byllolian and 300 grams of boaster. Total cost for chemicals is Kshs. 1198
- Labour cost for spraying 3MD = 300
- Weeding 6 MD = Kshs. 600
- Harvesting cost = Kshs. 2000

2.4.2 **Outputs**. 50 bags harvested. Each bag sold at Kshs. 600 so total sale is Kshs. 30000

ANNEX 5:

Response to suggested improvements to shamba system.

In an effort to seek approval of some proposals on improvements, farmers were asked questions 42 to 53. The suggestions were read out to the farmers and then he/she was expected to say whether the statement was true, false or does not know.

- 97.8% of the farmers said that production in their shamba can be increased if they had access to agriculture extension staff (Q43)
- 92.8% of farmers agreed that use of high yielding crop varieties can increase productivity in their plots (Q44).
- 94.2% of farmers said that they would benefit from a credit facility to buy farm inputs (Q45).
- 82% of the farmers agreed that spacing of trees should be increased for them to cultivate for a longer time before canopy closure (46).
- 95% of the farmers agreed with the proposal that there should be a reward package for the best farmer who has the highest tree survival in his/her plot (Q47).
- 82% of the farmers agreed that a farmer should be held responsible for the trees that die due to his/her neglect (Q48).
- 57.6% of the farmers agreed that the type of tree species planted affected the yields from the plot and 36% did not agree with this (Q49).
- 89.2% of the farmers agreed that farmers participating in shamba system should be allowed to collect firewood and other subsistence use products from the forest free of charge (Q50).
- 52.5% of farmers agreed that farmers should be allowed to prune trees and 34.5% did not agree (Q51).
- 95.7% of the farmers accepted that farmers education on shamba system can improve his/her understanding on the system (Q51).
- 55.4% of the farmers accepted that allocation of shambas should be given to the farmers neighbouring the forest and 41.7% did not agree with this proposal (Q53).

Appendix 1
Questionnaire to the farmers

Shamba system practises:
Practises and Improvements.

Dear **respondent**,.
This interview is part of the research work being carried out by Kenya Forestry Research Institute (KEFRI) in-order to get **the current practises, constraints, values and opinions** of the public in relation to Shamba system practises in Government forests. Based on the results of this survey, we hope to develop a socially acceptable form of shamba system which can be used for long term establishment of forest plantations.

Most of the answers are about your **opinion** and your **experiences**. This is what we are interested with. Different people think in different ways and so there are no right or wrong answers and so all your answers are very relevant and appropriate. Because we are asking only a few people to answer these questions, your completion of the survey is **extremely important**. Some of the questions involve the production factors in your shamba. We would like to state that all the answers will be kept **completely confidential** and your name will never be associated with them.

Joram K. Kagombe
Project Leader.

Section A : Attitude towards forestry in general
Q1 On the whole, how do you consider the importance of forestry to you? (Tick one answer)

1	Very important	
2	fairly important	
3	Indifferent	
4	fairy unimportant	
5	unimportant	
6	No comment	

Q2 Where did you **first** learn about forestry?

1. School
2. Other means apart from school
3. Both

Q3 How do you plant trees and make sure that they survive.

.....

.....

Section B. Shamba system Practices

Shamba system has been used for establishing forest plantations in government forest since 1910. This is the system where the forest department gives the farmer plots in the forest area for crops growing. In return the farmer take care of the planted trees. The system was banned in 1987 and later introduced in 1994.

Q4 Were you involved in shamba system prior to the ban in 1987?

1 Yes 2 No (Go to question no.7)	

Q5 Were you at that time living in the forest area?

1 Yes
2. No
3. N/A

Q6 Is there a difference between the present system and the former system?

1. Yes
2. No

Q6(b)Explain the reason for your answer.

.....

Q7 How long have you had the current shamba in the forest.?

.....Years

Q8 When shambas are available, how do people get to know about their availability?

.....

Q8b How is the allocation usually done?

.....

Q8c. How did you get your present shamba?

1	Allocation from forest dep.
2	Bought the shamba.
3	Given by a friend
4	Got through local leaders
5	Got through balloting
6	Spoilt option(Two marked)

Q9a What is the size of your Shamba?

.....

Q9b Is your Shamba the standard size ?

1. Yes
2. No

If no what is the standard size.....

Q10 How much does it cost to lease the standard size of a shamba in this area per year?. Ksh.

.....

Q11a Are you generally satisfied with the ways the shambas are allocated?

1. Yes
2. No

Q11b If no,what improvement would you propose. _

.....

.....

Q12 How much value do you attach to your shamba? In case you were to give it to someone else, how much would you ask as compensation?

.....

Q13 Give the four main crops grown in your shamba in the order of importance.

13a	First crop
13b	Second crop
13c	Third crop

Q14 Among the crops mentioned in the above question, priorities the first three main marketable crops.

14	Most marketable crop

Section C. Production and production costs

The following section examines the production factors in your shamba. This includes the **inputs and output**. The question are based on **one unit shamba**. I would like to reaasure you that this information will be treated as confidential and will **only** be used for the purpose of this research.

Q15 Kindly indicate the cost you incurred in preparing the shamba(Clearing and digging). You can either give the cost in terms of man-days or total cost used to prepare the shamba. (Total cost indicated. One manday = Ksh. 100

.....

Q16 Kindly indicate the cost you underwent in planting and tending of the two major crops grown in you Shamba.

Operation	Crop1	crop2
Making planting spots		
seeds/seedlings		
Manure		
Planting		
Fertalizers		
Weeding		
Pesticides		
Protection		
Harvesting		
Total cost.Ksh.	**16(a)**	**16(b)**

.....

Q17 How much output did you get from your first 2 crops.

- Crop1 .....
- Quantity (bags) .....

Q18 Crop 2 .....

Quantity .....

Q19 What proportion of the harvest did you use for

		crop 1	**crop 2**
1	Local consumption	19(a)	19(C)
2	Sold out	19(b)	19(d)
3.	Surplus for investments		

Q20 How did you sell your extra harvest?

1	Sold locally
2	Sold to middlemen
3	Sold at the far market
4	Did not sell any surplus
5	Indifferent/does not know

Q21 Considering the above options of selling your products, and keeping the transport into consideration, which is the best option which will yield you the highest return?

1. Selling locally
2. middlemen
3. Markets
4. N/A

Q22 How much does your first two products fetch on the market? (speciy which market)

	Product 1	**Product 2**
market		
Unit		
cost. Ksh.	22a	22b

Q23 Was the harvest in the first season more than in the second season?.

1. Yes
2. No
3. No answer
4. No difference

Q24 Have trees been planted in your shamba?

1 Yes
2 No
3 N/A

Q25 After how long, were the trees planted in your shamba?

_____ Years

Q26 With time the trees grew while you continued to grow your crops. What is your opinion of the trees

Q27 One way of ensuring higher survival of the planted seedlings is where each farmer is held responsible for the seedlings in his/her shamba. In case the seedling die, the farmer is expected to inform the forest department. Would you support this type of arrangement?

1 Yes
2 No.
3 No answer

If no give reasons

Section D: Interaction between farmer and FD.

The following section looks into the help the farmers are given by the Forest Department and the relationship of the farmer and the forest department.

Q28 How many times per 3 months do you come into contact with the forest department staff or Kefri staff?

.....

Q29 Do you think more contact with the forest department staff would assist your operation in your shamba?

1 Yes
2 No
3 No answer

Q30 Do explain your answer to question No. 29 by mentioning which areas you will benefit through more contacts.

.....

Q31 How would you rate your relationship with the FD?

1 Excellent
2 Good
3 Fair
4 poor
5.Very poor
6 No comment

Q32 Has FD extended any form of assistance to you?

1 Yes(Go to question 34)
2 No (Go to the next question)
3 N/A

Q33 Have you had any need in which you felt that FD would have assisted you?

1 Yes
2 No
3 N/A

If yes specify .....

Q34 What type of assistance did the FD provide you with?

.....

Q35 What type of assistance do you feel that the FD should assist you with in your normal shamba operations?

.....

36 Have you ever experienced crops damage by wild animals

1 NO (Go to question No. 39)
2 Yes
3 N/A

Q36(b) How often do you experience damage of your crops by the animal? (Indicate how many times in three months.)

.....

Q37 Which were the main wild animals involved in the damage

1 Elephants 2 Monkeys 3 Rodents 4 Hedgehogs 5 others (Name) 6 N/A	

Q38 How do you protect your crops from damage by the wild animals?

1	By organising ourself as a group to keep watch over the animals	
2	By planting effigies to scare away the animals	
3	Fencing the shamba	
4	I have no method of protection	
5	Any other	
6	N/A	

Q39 Do you think FD has any role to play in protecting your crops from wildlife damage

1 Yes
2 No
3 Do not know
4 N/A

Q39(b) If yes how?

.....

Q40. What are the other problems you face while tending your shamba?

.....

Q41. Do you feel that your participation in the shamba system has improved your attitudes towards forest conservation.

.....

.....

Section E: Improvements to the Shamba system

The following statements suggest improvements which can be done on the shamba system. Read through the statements and indicate whether you agree with each of the statements by answering true (t), false (f), or don`t know (d).

42	The size of the plot in relation to it`s productivity determines tree growth and survival.	
43	My production in the plot can be increased if I have access to Agriculture extension staff.	
44	Use of high yielding crop varieties can increase the productivity in my plot.	
45	I would benefit from a credit facility to buy necessary commercial inputs for the plot	
46	The spacing of the trees should be increased to give more time for crops before canopy closure.	
47	There should be a reward package to the farmer for the surviving trees in his/her plot	
48	The farmer should be held responsible for the trees which die due to his neglect.	
49	The type of species affected the yields from the shamba	
50	Farmers participating in the system should be allowed to collect firewood and other subsistence use products from forest free.	
51	Farmer should be allowed to do pruning for some species like Eucalyptus	
52	Farmers education on the shamba system practices will improve his/her understanding of the system	
53	The plots should be given to the farmers who are in the neighbourhood of the forest.	

Q54.Any other suggestion on improvement of the shamba system

.....

.....

Q55 How far is the distance of the shamba to where you stay?

..... KM

Q56 How much land do you own in the place where you stay?(acreas)

.....

Section F: Personal information

I would like to assure you that this information is **strictly confidential**. I would also like to stress that the following questions form an important part of the research.

Q57 What is your age category?

1	under 20
2	20-29
3	30-39
4	40-49
5	50-59
6	60-69
7	70 or over

Q58 Your sex?

1	Male
2	Female

Q59 What is the size of your immediate family?

.....

Q60 Can you indicate your highest level of formal education attained

1	No formal education
2	Primary school and less
3	Secondary school and less
4	College
5	Diploma
6	Degree
7	Postgraduate

Q61 Can you indicate which is your band of income before taxation.(The amount is in Kshs.)

	Per month	Per year
1	up to 833	up to 10,000
2	834 to 1,700	10,001 to 20,000
3	1,701 to 2,500	20,001 to 30,000
4	2,501 to 3,333	30,001 to 40,000
5	3,334 to 5,000	40,001 to 60,000
6	5,001 to 6,667	60,001 to 80,000
7	6,668 to 8,333	80,001 to 100,000
8	8,334 to 12,500	100,001 to 150,000
9	12,500 to 16,667	150,001 to 200,000
10	16,668 to 25,000	200,001 to 300,000
11	Over 25,000	Over 300,000

Q62 -67 Please indicate whether you agree with the following statements by answering true(t), false(f), or don't know(d).

62	I found the interview interesting	
63	The interview took too long	
64	I feel shamba system has success potential	
65	I felt I did not have enough information	
66	I felt I did not have enough time to consider all the questions	
67	Decision making generally comes easy to me	

Thank you for completing this survey.

Interviewer comments

Q69 Understanding

Complete	1
Great deal	2
Somewhat	3
Little	4
Not very much	5
Not at all	6

Q70 Consideration

Prolonged	1
Careful	2
Some	3
Very little	4

Q68 For what length of time did the interview approximately last? ____Minutes
Q72 Site of the interview.....
Q73 Place where the farmer has a shamba .....
Q69 Approximate distance from reserve boundary ..... Km.
Q70 Date of the Interview.....
Q75 Questionnaire Number.....

I certify that I conducted the above interview, and to the best of my ability I have correctly recorded the answers given by the respondent.

Signed ..... Date .....

Supervisor ..... Date .....

Appendix 2

Checklist questionnaire for Forest department staff.

The following information will be got through interview and discussions with the Forest officers incharge of the forest stations and the District forest officers incharge of the forest districts.

1 Forest station information:

- Total forest area,
- Area under established plantations.
- Annual cut per year,
- Annual Afforestation
- Number of staff and breakdown,

Total No. of staff

Officers

Forest guards

Patrol men

Office workers

Nursery workers

Watchmen

Field workers

Others

2. Shamba system practises:

- Area under shamba system,
- Area planted with trees
- Area not yet planted with trees
- Ways of issuing the land,
- Rights of the farmer,
- Regulations and ways of enforcing,
- Contract between the farmer and FD,
- Survival of the seedlings planted in these shambas.
- Assistance the FD extends to the farmer.

3 **Constraints faced and ways of solving them,**

- Management constraints
- Damage of seedlings by farmers
- Damage of crops by wildlife and methods used in protecting the crops from wildlife

  Main animals causing damage

  Frequency of damage

  Types of damage

  Ways of protection

  Linkage between the FD and KWS in crop protection and compensation
- Lack of proper tending by the farmers

4. Opinion of Forester on the applicability of the shamba system.

5. Cost of plantation establishment in case where shamba system is not in use per Hectares.
   - Site preparation cost
   - Planting cost
   - Tending cost up to 3 years

6. Alternative method used in plantation establishment and the success of these methods.

7 Opinion of forester on improvement to shamba system with an aim of developing a socially acceptable shamba system.

8 Effect of infrastructure on the choice of shamba by the farmer.

9 Involvement of local administration and local politicians in issuing of shambas

10. Involvement of the local communities in forestry issues.

11. Relationship of the demand of the shambas to the population of the neighbouring forest villages.

12. Conflicts resolutions in shamba system management

13. Impact of private sector in forest establishment

14 Involvement of the farmers in planting of the trees and undertaking silvicultural operations like pruning.

15. Role of FD staff in assisting the farmer in increasing his/her yields

APPENDIX 3

MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES

Kieni Forest Station

P.O.Box 66

MATATHIA

Receipt No.

Date.....Plot No. .....

Name.....

Address.....

RE: NON-RESIDENT CULTIVATION IN SELECTED FOREST STATIONS:Reference is made to Permanent Secretary letter Ref. No. FOR 41/9/195 of 20th Nov. 1993

Terms and conditions for the non-resident cultivation (NRC) systems which has to be followed strictly by any citizen issued with a shamba in the gazetted forest.

1. Cultivator must walk to and from the cultivation areas every day.
2. No structure will be allowed in the cultivation areas.
3. Cultivation period shall not exceed three years. There will be no obligation for the FD to give another plot thereafter.
4. Only annual crops will be allowed. No creeper or climbers will be allowed.
5. Seedling survival must be over 90% during the first season. Any cultivator attaining less than that level will lose the right to cultivate and his plot will be given to the neighbouring cultivator.
6. No allottee is allowed to lease out or hire out his/her plot under any circumstances.
7. The allottee must take care of the seedlings during non-crop season. I.e. during period when awaiting next season he/she must control weeds.

SIGNATURE.....

NAME OF CULTIVATOR.....

ID CARD NO. .....

CHAIRMAN/DO.....SIGNATURE.....

Forester.....Signature.....

Local Chief.....Signature.....

DECLARATION

I Joram K. Kagombe do declare that the thesis entitled **"The Suitability of the Shamba System to Forest Plantation Establishment in Kiambu District, Kenya: An Evaluation of Socio-economic Issues"** that I submitted today is my original work. It has been prepared by myself using data collected in the field and literature cited in the thesis. The work has not been published in any other place.

Tharandt, Germany

September 08, 1998

Joram K. Kagombe