KWDP

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 1

THE ORIGINS AND DEVELOPMENT OF THE KENYA WOODFUEL DEVELOPMENT PROGRAMME

Rutger Engelhard KWDP/The Beijer Institute

Nairobi, October 1984

P.O.Box 56212, Nairobi, tel.582004

Table of Contents

1. INTRODUCTION.

1.1. THE "OTHER ENERGY CRISIS" IN KENYA

Woodfuel(1), as both a non-commercial and commercial source of energy, accounts for three quarters of the total energy base of Kenya. The scope for employing other, locally-based energy sources is limited. And, although economic development normally encourages a move from woodfuel to more flexible and liquid fuels (like oil and coal) the high price of such fuels on the world market retards the rate of such a transition. As a consequence, woodfuel will continue to play a dominant role within the energy economy of Kenya during the decades to come.

Woodfuel consumption is currently already exceeding the yearly woodfuel yield (i.e. sustainable wood production). From a total woodfuel demand of 18.7 tonnes (in 1980), some 5.7 million tonnes (i.e. 30%) is supplied from wood stock. Total energy demand is projected to grow at an annual rate of 4.7 percent. Fuelwood and charcoal end-use consumption will grow at annual rates of 3.6 and 6.7 percent respectively, the latter reflecting an increasing trend towards urbanisation. As standing woodfuel stocks will increasingly be depleted to meet this growing demand, yields will further decrease and stock depletion will be accelerated, creating a vicious cycle. Standing woodfuel stocks are expected to decline by about 20 percent over the years to 2000. And, at the turn of the century, a shortfall of 30.6 million tonnes of woodfuel will occur (about 65 percent of the national woodfuel demand), if prevailing conditions and practices remain unaltered.

To meet this expected, dramatic woodfuel deficit in the year 2000, the Government of Kenya has formulated the Woodfuel Supply Strategy and the National Energy Conservation Strategy. The former is based upon a combination of options to meet the medium- and long-term supply requirements, comprising Agroforestry programmes, Peri-urban Woodfuel Energy Plantations, Industrial Woodfuel Energy Plantations and an active participation by the Ministry of Energy and Regional Development in ongoing Rural Afforestation and Soil Conservation Programmes.(2)

The Kenya Woodfuel Development Programme has been initiated to contribute to the implementation of this Woodfuel Supply Strategy.

1.2. SOME EVENTS LEADING TO THE KENYA WOODFUEL DEVELOPMENT PROGRAMME

Neither the Woodfuel Supply Strategy, nor the Kenya Woodfuel Development Programme have appeared out of the blue. On the contrary they are the result of a process of successful energy policy planning in Kenya, that began ~~stated~~ in the late seventies.

---

(1) Woodfuel= Fuelwood + Charcoal
(2) Republic of Kenya (1983) Development Plan 1984-1988, Government Printer, Nairobi, pp 135-136

In November 1978, the Government of Kenya approved of, and actively participated in the Kenya National Energy Symposium. This Symposium was organised by the Kenyan Academy of Sciences, the National Council for Science and Technology and the Beijer Institute(3). During this Symposium the major "actors" within the energy economy of Kenya were identified. The Symposium moreover initiated a forum for a continuous energy debate in Kenya.

The Kenya National Energy Symposium was followed up by an International Workshop of a more technical nature. This Workshop, held in May 1979 with a wide local and international attendance of experts, provided a data base for elucidating the future energy policy issues for Kenya.

As a result of the discussions in 1978 and 1979, the Government of Kenya decided that the role of woodfuel being the focal point in the present and future energy economy of Kenya should be further studied and explored.

During the same period the Ministry of Energy was created. It was this Ministry that invited the Beijer Institute to assist in carrying out a systems analysis, that would form the basis for a large rolling programme of energy provision in the decades to come.

This so-called Kenya Fuelwood Cycle Study took three years. The Study was comprehensive and covered the full spectrum of the Kenyan energy economy, including future supply and demand prognoses in the commercial and non-commercial energy sectors. The Study did not stop with the production of a policy analysis. Consideration was given to the costs and benefits of programmatic options. A series of intervention options was worked out in broad terms and their effects on the energy balance estimated.

In retrospect, many of the conclusions of the Kenya Fuelwood Cycle Study(4) which are applicable to other African countries as well, seem commonplace. These conclusions, however, mark a significant shift from the accepted wisdom of energy planning and suggest:

(a)- that if terms of trade between developed and developing countries continue to stagnate there will be little capital available to increase the proportion of commercial energy in the national energy budget.

---

(3) The Beijer Institute is the International Institute for Energy and Human Ecology of the Royal Swedish Academy of Sciences in Stockholm.

(4) Phil O'Keefe et. al. (1984), Energy and Development in Kenya. Opportunities and Constraints, Energy, Environment and Development in Africa, no.1, The Beijer Institute/The Scandinavian Institute of African Studies, Stockholm.

Consequently, (woody) biomass utilisation will increase in absolute terms, if not in relative terms as well;

(b)- that, since woodfuel is the most important source of energy, increasing pressure will be placed on its sources of supply by a fast growing population.

Consequently, there will be increased cuttings of standing wood stocks because annual yields are insufficient to support demand;

Is this real?

(c)- that, since rural energy consumption is largely based on fuelwood supplied by **trees outside the forests**, the more densely populated, high potential agricultural regions will experience greatest shortage.

Consequently, it will be necessary to evolve programmes that provide biomass energy from within farms;

(d)- that, given the accelerated urban demand for charcoal as a result of rapid urbanisation, accelerating wood removal in the less densely populated, arid- and semi arid lands will occur as charcoal making often causes the complete destruction of whole trees.

Consequently, to meet the growing charcoal demand and to limit the ecological damage caused by the destruction of vegetation in these fragile ecosystems, attention should be given to the provision of woodfuel energy plantations around urban centres;

(e)- that there appear to be many problems associated with the country wide diffusion of new stoves, and so there are structural constraints that inhibit woodfuel conservation.

Consequently, it will be necessary to concentrate upon stove improvement and diffusion efforts on the rural and urban markets;

(f)- that, given the scarcity of capital for technology (development) and the problems of technology transfer, conservation efforts in the commercial energy sector will have a slow impact.

Consequently, careful analysis of future energy technology combinations is necessary if national enterprises wish to remain viable.

The results and the conclusions of the Kenya Fuelwood Cycle Study constitute an important base of reference for policy development viz. the energy economy of Kenya.

1.3. THE NEED FOR FURTHER RESEARCH AND DEVELOPMENT

Having adopted the conclusions of the Kenya Fuelwood Cycle Study, the Ministry of Energy and Regional Development has embarked upon a number of studies and projects in order that the broad conclusions of the Study and

the indicated programmatic options can be specified and translated into actual intervention programmes.

It is within this perspective, that programmes focussed upon the development of renewable energy sources have been undertaken. Besides other activities of the Ministry of Energy and Regional Development in this field, such as the Kenya Renewable Energy Development Project, the Kenya Woodfuel Development Programme was initiated. The present knowledge of farmers of tree-growing has sofar been underplayed and underestimated. The potentials and constraints of substantially increasing woodfuel production have to be considered within the context of the producers, i.e. the rural household. The Kenya Woodfuel Development Programme has been assigned to look into these issues and,on the basis of its findings to develop pragmatic woodfuel supply strategies.

The Kenya Woodfuel Development Programme therefore forms part of the total package of Research and Development activities, which the Government of Kenya has undertaken to avert the "other energy crisis" in Kenya.

2. THE KENYA WOODFUEL DEVELOPMENT PROGRAMME

2.1. THE OUTSET

To contribute towards the implementation of the Woodfuel Supply Strategy, the Ministry of Energy and Regional Development initiated the Kenya Woodfuel Development Programme.

The objectives of this Programme are:

(a)- the design of a methodology through which locally feasible technical options and locally-tailored extension approaches and methods can be developed to ensure the effectiveness of **District Woodfuel Development Projects;**

(b)- the actual verification of the feasibility of technical options, and the effectiveness of extension approaches and methods through which rural households can be encouraged to step up their woodfuel production for auto-consumption and for the market and to economize on the conversion and end-use;

(c)- the development of a Kenyan manpower capacity (at both district and national levels) that can prepare, execute and monitor **District Woodfuel Development Projects;**

(d)- the development of a (woody) biomass assessment and monitoring methodology, that can be applied at national and district level.

On the basis of a grant from the Government of the Netherlands, the Kenya Woodfuel Development Programme started its operations in November 1983. The funds, allocated to the Programme under this grant, cover the costs of the following components (for the period November 1983-October 1986):

(a)- a pilot District Woodfuel Development Project in Kakamega District. Within this pilot project, methodologies that will lead to feasible technical options and effective extension approaches and methods ('tuned' to locally prevailing conditions) are to be developed, and the technical options and extension methods actually verified. Through training programmes, a manpower capacity within the district to implement the District Woodfuel Development Project at a district-wide scale is to be created;

(b)- the development of a Kenyan manpower capacity at the national level to prepare, support and monitor District Woodfuel Development Projects and to liaise with, and consequently to ensure a structural integration of the programme into the existing rural afforestation, soil conservation and other related programmes and projects;

(c)- the development of replicable (woody) biomass surveying and socio-economic monitoring techniques.

From the outset it was envisaged that the Kenya Woodfuel Development Programme would gradually extend its activities to other districts as well.

The agro-ecological, socio-economic and cultural conditions which determine the present ongoing agroforestry practices on the farms, and which limit the scope and potentials for increasing the woodfuel production vary greatly from district to district, and even within a single district. As a consequence different District Woodfuel Development Projects are required to "tune" planned intervention to these prevailing conditions. Moving to other districts is an incremental process: use will be made of the experiences gained in the pilot project area; and the methodology, that leads to locally-adapted technical options and effective extension approaches/methods will be refined.

During the preparations of the Kenya Woodfuel Development Programme the very densely populated, high potential agricultural districts of Kisii (Nyanza Province) and Muranga (Central Province) were identified as first priority areas for the programme besides the Kakamega District. By the end of 1984 the Kenya Woodfuel Development Programme will have extended its activities into those districts. The initial phase of the District Project in Muranga have been made possible by a grant from the Swedish International Development Authority (SIDA).

Furthermore the Nakuru District (Rift Valley Province) has been identified as a priority area for the Kenya Woodfuel Development Programme. This district includes high potential and very densely populated areas, semi-arid lands, settlement schemes, and a major urban centre. Within one district, the area are to be found most aspects to be taken into account when planning woodfuel development on a regional level. Developing a District Woodfuel Development Project for Nakuru can therefore be considered as an effort with a regional perspective.

The implementation of the Kenya Woodfuel Development Programme has been delegated to the Beijer Institute, which have acquired the assistance of the Netherlands-based organisation ETC-Foundation. However, it is envisaged that the Kenya Woodfuel Development Programme will be fully Kenyanised, and given

Approach

a semi-autonomous status (under the auspices of the Ministry of Energy and Regional Development) as soon as feasible.

2.2. THE APPROACH

The Kenya Woodfuel Development Programme operates essentially at the level of the district (in line with the district focus for rural development of the Government of Kenya). The approach of the work is holistic and characterised by its step-wise, evolving nature.

In a first phase the district's natural and human resources are thoroughly studied. District-level information, derived from aerial photographs, is combined with documentary information on population, soils, rainfall, land ownership etc. The analysis of this information yields a detailed "map" of the district, on the basis of which intra-district differences can be determined, critical areas with respect to woodfuel deficit, and of related aspects such as soil conservation, can be delimited. The specified areas within the district can be described in detail on the basis of this information.

Specific household information is collected through field-based investigations to establish the existence of ongoing agroforestry practices, the utility and consumption of available woody biomass, and the socio-economic forces within the household which mediate domestic production and the utilisation of woodfuel.

It is on the basis of the combined results of the preparatory surveys carried out in phase 1 that technical options and extension strategies/methods are designed and tested in cooperation with selected farmers in Phase 2. In this phase the Kenya Woodfuel Development Programme actually intervenes in the ongoing agroforestry systems of the farmers. It is a difficult phase, as success can only be obtained if the programme can develop a relationship of mutual trust with the selected farmers. It is only on the basis of such a relationship that the programme can fully benefit from the knowledge and experience of the farmers. Their suggestions, the results of their experimentations with innovative technical options and their ultimate conclusions on the validity of new agroforestry practices ensure the development of technically, but also of socio-economically and culturally feasible options for increasing the supply of woodfuel within their farms.

In a following phase the actual intervention is substantially extended to determine the logistical and manpower requirements for a Woodfuel Development Project to be implemented on a district-wide scale. It is the phase in which the Kenya Woodfuel Development Programme will link itself to the programmes of other, related agencies in the district. The programme presents the overall woodfuel development strategy for the district, the verified technical options and the developed extension methods for further consideration and application. The extension staff of the other programmes will be involved in the implementation of this phase as much as is possible.

Interaction of KWDP with other related agencies

1) Do they exist?
2) Do they do it?
3) What arrangements are available for this to be done?

After this phase the District Woodfuel Development Project can be implemented, gradually including the whole of the District in the area of coverage of the Project. Ideally, it is not a project of the Kenya Woodfuel Development Programme anymore, but a joint effort of the government extension services and non-governmental institutions and agencies within the district. The Kenya Woodfuel Development Programme will maintain a presence in the district, providing training, technical and monitoring services.

2.3. THE METHODOLOGY

2.3.1. TARGET LEVEL.

An early priority for the Kenya Woodfuel Development Programme is the selection of its initial level of intervention: the "target-level" for its activities within the district.

The choice of levels is wide, ranging from the most general, with the district itself acting as the unit of focus, down through a hierarchy of division, location, sub-location, and village-unit to the most specific and concrete— that of the household and its individual members.

The definition of the principal "target-level" is important because it determines the scope of the activities and the problems with which the Kenya Woodfuel Development Programme has to contend. This is so because it is the potentials and constraints prevailing at that level that are the subject of study, intervention and assistance. If, for example, the Kenya Woodfuel Development Programme sets the district as its "target-level", the target group will consist of the District Commissioner, the members of the District Development Committee and the District staff; the problems to be tackled will be their problems, the solutions to be adopted by them. If, however, the Programme decides to take the individuals within each household within the district as its "target-level", the target group will be those very same individuals, and the problems to be addressed those of these individuals.

Since woodfuel development is a new, complementary and additional task for the District Development Committee, it would certainly be legitimate to determine the district as the initial target level. However, such a choice would assume that the Kenya Woodfuel Development Programme already has at its disposal concrete and transferable technologies for increasing woodfuel production on the farms, replicable extension and training programmes etc; and, that if applied by the District Development Committee they would result in the expected increase of woodfuel production on the farms and around the farm houses in the district.

However, although agroforestry is in the limelight of both the national and international attention, very little is actually known about the present woodfuel production and management systems of the rural population; about its regional and sub-regional differences; about its interlinkages with agriculture and husbandry; about the socio-economic and cultural forces that are of influence. Existing potentials for increased woodfuel production on the farms and prevailing constraints have sofar been underplayed and underestimated.
Advice to the District Development Committee that is not based on adequate

knowledge of this sort would be of little use and intervention projects embarked upon would be a waste of money and effort.

The same argument applies to the extension and training strategies and methods. Extension of new technologies has so far been largely confined to agriculture, husbandry, soil conservation, health and home economics. Comparatively little has so far been achieved in the field of agroforestry or rural woodfuel development projects. Although it is known that women are mainly responsible for the supply (collection) and the end-use of fuelwood, too little is known about ways to motivate them (and presumably their husbands) to change current practices. Too little is known about how woodfuel procurement activities interrelate with other types of work of the women.

It is for this reason that the Kenya Woodfuel Development Programme has adopted as the "target-level" for the first three phases of its programme development activities relating to the **individual households** within a district.In the first instance more knowledge of present woodfuel production, management, procurement and end-use systems of the household (and the role of the individual members in each of these aspects) has to be gathered. It is only then that technical options and extension methods can be designed and tested (verified) at this level. Once sufficient experience and results have been obtained, generalisations can be made so as to design an woodfuel development strategy that can be applied at the District level.It is at this moment that the Kenya Woodfuel Development Programme will shift its "target-level" from the individual household to of the governmental extension services and non-governmental organisations, that work in the district and that can best implement the District Woodfuel Development Strategy. The problems that these organisations will face in implementing the District Woodfuel Development Strategy have then to be addressed and solved. These problems may range from lack of experienced field staff to logistics. "Tuned" solutions are to be found, together with the organisations concerned to make a District Woodfuel Development Project a viable venture.

The decision to begin the work at the level of the individual household implies that the Kenya Woodfuel Development Programme has to restrict its area of coverage within a district. Limited manpower and financial resources do not allow it to deal with all households within a district. In any event, there is nothing to be gained by a total coverage, since the purpose of the initial phases of the programme activities within a district is to get to know more about the woodfuel production, management, procurement and end-use practices applied in the district and to develop and verify options for improvements. This can most efficiently be achieved through a representative sample of the households in the district.

2.3.2. STEPS TOWARDS SOLUTIONS

The approach of the Kenya Woodfuel Development Programme is characterised by its step-wise evolving nature. The anticipated activities within a District have been divided in five steps:

(1)- District Resource Analysis;

(2)- Formulation and testing of technical options and extension methods;

(3)- Formulation and testing of manpower, organisational and logistic requirements for a Woodfuel Development Project at a district-wide scale;

(4)- Training and manpower development within existing government and non-governmental organisations in the district;

(5)- Rendering technical advice; monitoring the effects of the Woodfuel District Development Project.

Although the Kenya Woodfuel Development Programme laid down these steps, it has purposefully not worked out each of them in detail. The exact content of each step will be determined after the evaluation of the preceding step. Thus the Kenya Woodfuel Development Programme builds upon what it has found existing within the district.

Of course, in the course of the extension of the Kenya Woodfuel Development Programme to another district, the experiences and instruments used in earlier districts will be used. For example, after having completed the District Resource Analysis of the Kakamega District, the developed methodology will be refined and applied for the District Resource Analyses of the Kisii and the Muranga Districts. Also, the technical options and extension methods, successfully developed in one district, will be evaluated as to their applicability in other districts. But, as the variety of potentials and constraint for woodfuel development between the districts is great, it is important to develope solutions that are "tailored" to the specific conditions and peculiarities of each district. One uniform recipe, or the off-hand replication of solutions developed in one district to others would deny the existing, wide differences and would underutilised the locally existing potentials for increasing the woodfuel supply from within the farms.

2.3.3. ROUND TABLE WORK

Within a district farmers will be asked to share their existing knowledge of tree growing developed over the years and to explain their traditional woodfuel procurement and end-use systems upon which they rely for the energy supply. Recent changes within their environment (population growth, increased land pressure, land adjudication, transition from subsistence to market economy etc.) may have made these practices insufficient. External expertise can be brought in to meet the felt need for other forms of woodfuel production and procurement. But these technologies are so to say "naked" and have to be "dressed" to be applicable for the farmers under their prevailing conditions.

The Kenya Woodfuel Development Programme will sit with the farmers "around the table" to discuss their problems as they are felt by them, the woodfuel supply situation of their households as perceived by them, and solutions for an increased woodfuel production on their farms as thought to be viable by them. In this way it is intended to elicit their active participation in the research and development activities and to maximise the benefits to be gained from their knowledge of existing potentials and constraints. Of course, possible solutions based on experiences gained elsewhere in Kenya or abroad will be proposed. By including such suggestions in the discussion with the farmers a first screening takes place, and opportunities to adapt the suggestions to the locally prevailing conditions are thus created.

2.4. COMPLEMENTARITY

It is certainly not the intention of the Kenya Woodfuel Development Programme to duplicate and/or to substitute presently ongoing agro-forestry, rural afforestation and soil conservation programmes (e.g. of the Ministry of Energy and Regional Development, the Ministry of Environment and Natural Resources, the Ministry of Agriculture and Livestock Development and of Non-Government Organisations).

With its initial emphasis on research and development, the Kenya Woodfuel Development Programme builds up a body of knowledge of locally available woodfuel production, management, procurement and end-use systems; of locally "tailored" technical options and extension methods that have proved to lead to increased woodfuel production from within the farms.

This knowledge will be shared with all parties involved in implementing the Woodfuel Supply Strategy.

With its latter emphasis on manpower development within the district, the Kenya Woodfuel Development Programme will structurally link itself with other related organisations actively involved in agro-forestry, soil conservation, energy conservation etc. programmes. By offering training and technical advice services, the results of the research and development work will be passed on for further application at a district-wide scale.

It is in this way that the Kenya Woodfuel Development Programme, with its emphasis on research and development and on training and manpower development is complementary to ongoing activities and programmes in the field of woodfuel supply development in Kenya.

3. CONCLUSION

In this paper the events that have led to the initiation of the Kenya Woodfuel Development Programme have been summarized. The objectives and approach of the Programmes have been outlined.

The Kenya Woodfuel Development Programme started its activities in the Kakamega District. For this district the resource analysis has been completed. Based upon the experiences gained in the course of this first phase of the work in the Kakamega District preparations are underway for district resource analyses of the Kisii and the Muranga Districts.

In three successive Working Papers (No.2,3,4) the results and conclusions of the District Resource Analysis of the Kakamega District are presented for further discussions with interested colleagues in Kenya. The Kenya Woodfuel Development Programme attaches much importance to the exchange of views with interested colleagues: their criticism can only improve the ultimate results of the work that is undertaken.

A last Working Paper (No.5) focusses upon first the ideas on technical options and extension approaches to be tested out in the ensuing phases of the work in the Kakamega District. The ideas have been derived from the findings and conclusions of the District Resource Analysis.

The above mentioned Working Papers also give an impression of how the step-wise, evolving nature of the approach of the Kenya Woodfuel Development Programme is being brought into practice.

KWDP

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 2

THE DISTRICT RESOURCE ANALYSIS AS APPLIED TO KAKAMEGA DISTRICT

Phil Bradley KWDP/The Beijer Institute

Nairobi, October 1984

P.O.Box 56212, Nairobi, tel.582004

THE DISTRICT RESOURCE ANALYSIS AS APPLIED TO KAKAMEGA DISTRICT

SUMMARY AND CONCLUSIONS

The following report describes the methods employed and the results achieved by the District Resource Analysis in its application to Kakamega District in Western Kenya. The data that is utilised is derived from low-level colour air photography on a sampled basis. With respect to woody biomass outside the forest the major conclusions are as follows:-

1 On-farm woody biomass adopted a number of different forms in the district, from individual planted trees, through planted stands of trees and shrubs, to remnant natural vegetation.

2 The ground cover occupied by this vegetation varies, but in general occupies a significant proportion of the total land area. In some subregions it is as high as 29 percent; in othes it is as low as 7 percent.

3 There is a clear relationship between the percent ground cover occupied by woody biomass and the density of population. Rather surprisingly the higher the population density, the greater is the amount of land devoted to woody biomass.

4 The various forms that this woody biomass adopts varies from subregion to subregion. Each area has its own characteristic combination of elements. As a general rule, where population density increases, then the proportion of "man-made" as against natural woody biomass also increases. In other words as the pressure on the land becomes more and more severe, we find much more tightly-managed, and more "controlled" systems of woody biomass utilisation. It is through an interpretation of these controlled systems that the KWDP is searching for an "open door" through which to implement its development initiatives.

5 As yet we do not know the production rates of these different woody biomass elements, although a biomass survey is underway. So far it seems that a crucial role for planted stands of trees is to provide cash income, largely through the sale of building poles and timber. Domestic woodfuel would seem to come from hedges and bush rather than from these woodlots. In some areas a type of intercropping is practiced, whereby Sesbania sesban is grown within the maize fields. These small trees are grown specifically for woodfuel.

6 As far as the maintenance, or reproduction of this woody biomass is concerned, natural vegetation such as bush and riparian woodland regenerates without direct assistance, although in areas of high population density, such natural vegetation is progressively being cleared. With respect to "man-made" woody biomass active planting is pursued, through a variety of methods which are discussed within the Agroforestry Survey report.

7 The woody biomass configuration within agricultural land are the product not of some random process, but of the same social, cultural and economic factors which determine the total rural economies of the district. Trees on farmland should be considered within this broader context.

8 Through combining both woody biomass data and other land-use/demographic/evironmental information the District Resource Analysis is able to stratify the district into a number of subregions. These subregions form the base for further investigations, and the loci for implementation.

THE DISTRICT RESOURCE ANALYSIS AS APPLIED TO KAKAMEGA DISTRICT

INTRODUCTION

The general purpose of the District Resource Analysis (DRA) is to assist the KWDP in establishing a data-base which covers the district under review. In this instance we are concerned with KAKAMEGA DISTRICT, although the method and approach can be equally easily applied to other districts. This working paper outlines the methods employed, and the results so far achieved for Kakamega.

The DRA is part of an integrated series of rapid research programmes which provide the information needed to put a development programme into action. Complementary investigations include the AGROFORESTRY SURVEY (AFS) and the CULTURAL/SOCIO-ECONOMIC SURVEY (CS). The DRA is the first of these three to be implemented and has the following specific aims:-

1 To continue the "down-scale" process of information-gathering, in which a sequence of nation - district - subregion - sublocation - household is envisaged. Through this sequence of scale changes, detailed knowledge of the household can be integrated with higher level information, and vice-versa, so that all information can be linked together. In this respect the DRA forms the bridge between a general district profile and individual household data.

2 Within the context of a district, the DRA provides an overview of the spatial pattern of a number of selected land-use and resource variables (cropping patterns, on-farm woody biomass, population density, farmsize, etc.). Maps are constructed which show these patterns, indicating changes in local economies and land-use.

3 By a synthesis of these different maps, a stratification of the district into a number of subregions is possible, accompanied by descriptions or "profiles".

4 Within these subregions, "typical" sublocations can then be selected, so as to provide a stratified sample base for household and other enquiries (see working papers on AFS and CS).

5 By focussing on the contrasts between the different subregions, the DRA assists in the identification of important elements in the woody biomass configurations of the district. It is through an examination of these elements that possible approaches to intervention can be considered.

METHODOLOGY

The DRA is founded on information gathered from low-level aerial photography. Interpretation of 35mm colour transparencies provides the data input to subsequent cartographic and computer analyses. The stages in data-gathering and analysis are as follows:-

PHOTOGRAPHY

1 Low-level aerial photography (at 150m flying height). Photographs are taken through a 35mm camera using an 18mm lens with high-speed Ectochrome film. Colour transparencies, or slides are produced.

2 Photographs are taken at 1.3km intervals along flight lines which themselves are 2.5km apart. The ground area covered by each photograph is approximately 4ha at a photo-scale of approximately 1:6700. The resulting sample density is 1.3 percent of total ground area. In the case of Kakamega District, some 900 photographs were taken.

INTERPRETATION

3 The slides are projected vertically onto a white table giving an interpretation scale of 1:670. Quantitative estimates of the ground cover of the various attributes and variables under review are obtained by the use of transparent stratified random dot sheets. These are positioned over the projected image, and every time a certain attribute (woodlots) is intercepted by a dot a count is made. If out of some 350 dots on the screen, 35 fall onto woodlots, then we would surmise that 10% of the area is covered by woodlot.

4 Because of the large scale of photography and interpretation, a very large number of detailed land-use and other categories can be interpreted. The LBDA data file, from which the Kakamega information was extracted, contained over 250 categories. For the KWDP, the number could be reduced to less than 50. Interpreted categories, or variables, can be usefully grouped into the following:-

(a) Physical resources[1] (climate, geology, soils, etc.)
(b) Agricultural landuse (crops, fallow, livestock, pasture, etc.)
(c) Infrastructure landuse (transport, buildings, etc.)
(d) Woody biomass (plantations, hedges, bush, trees, etc.)
(e) Socio-economic data[1] (demographic indices, etc.)

---

1 - Much of this information is derived from non-photographic sources (goverment statistics, various documents, reports, etc.). It can be added to the photographic data set so that all available sources of information can be easily integrated, and presented and analysed from a common standpoint.

ANALYSIS

5 The results of interpretation are stored as individually-referenced data sources. Thus individual records (for each photo-point) can be accessed and treated.

6 In the case of the DRA, the basic areal unit of analysis is a 5 km square, equivalent to the national grid. All photo points falling within a given 5km square are aggregated to give average values for the variables under consideration.

7 For any given variable, maps can be prepared to show its distribution pattern across all the 5km grid squares covering the district. Examination of these patterns, and in particular the search for similar patterns amongst different variables, yields the first clues towards an understanding of what is happening in the district.

8 A number of options can now be pursued, of which two are of immediate importance:-

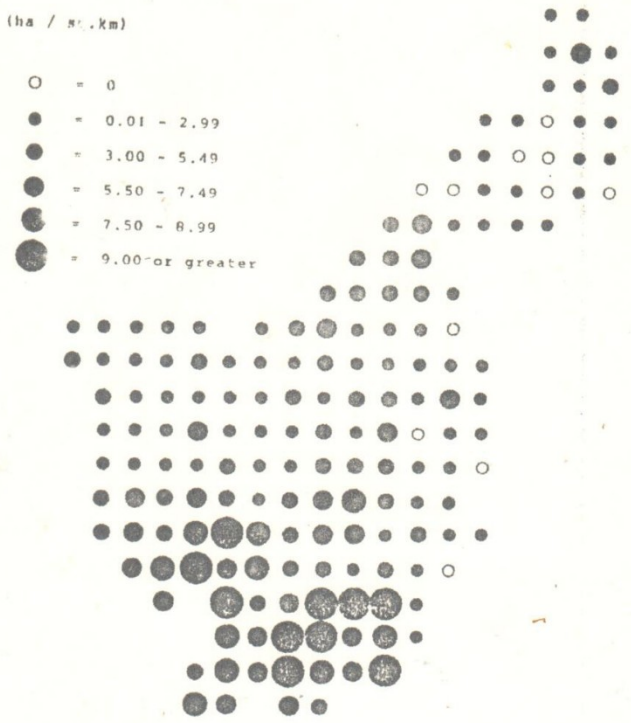
(a) By examining the maps of different variables (for example population density and the area of land under woodlots) it is possible to establish inter-variable relationships. Initial impressions can be confirmed by statistical analyses. It is from these initial impressions of the character of the district that the first ideas concerning implementation and "targets" emerge. With the results from the AFS and the CS, these are further modified and enlarged.

(b) By "overlaying" maps of the more important variables, it is possible to build up a multi-variate picture of the district. In other words by synthesising the different maps, we are in a position to divide the district into a number of strata or sub-regions; each defined by a combination of characteristics which makes it distinct from other strata. This stratification of the district provides the basis for a sampling framework for the ground-level AFS and CS, and for a selection of sub-locations within which to begin the test phase of the implementation programme.

RESULTS

The data for each variable is expressed in quantities relating to each of the 168 5km grid cells which cover the district. These data can be mapped in the form of density gradients across the district. An example, showing the quantity of planted stands of woody vegetation (woodlots + windrows + hedges) in hectares per square kilometer (= % cover) is shown overleaf (figure 1). The full numerical range of the variable has been split into 6 classes. For this variable there is a clear trend from high to low in a south-north direction, with a suggestion of a wedge driving up through the centre of the district. This pattern, which we can refer to as TYPE 1, mirrors reasonably closely the trend in population density across the district.

FIGURE 1 : GROUND AREA (HA PER SQ.KM) COVERED BY PLANTED STANDS OF WOODY BIOMASS IN KAKAMEGA DISTRICT. (WOODLOTS+WINDROWS+HEDGES)



A number of other variables can also be identified as showing a type 1 distribution:-

bananas
maize (as a food crop rather than as a commercial cash crop)
livestock
"natural" vegetation as a component of total woody biomass
planted woody vegetation (in absolute quantities)
farmsize

A different distribution pattern is shown by sugar, with an overwhelming concentration in Wanga, and a lesser quantity in a broad peripheral zone stretching away to the east. TYPE 2 distributions such as this are also shown by cassava (when expressed as a ratio of maize), and to a lesser extent, hedges. A third type (TYPE 3) is best viewed as a combination of types 1 and 2, and is demonstrated by pastureland, bush, food crops as a percentage of total cultivation, and agricultural saturation (the percentage of cultivable land actually under cultivation). Other variables display a pattern unique to themselves, which cannot be grouped into a general category. The ratio of modern to traditional roofs is a good example of such an idiosyncratic distribution. Still others, such as riparian woodland, reveal no pattern at all, but more an apparent random distribution (in this case in fact not random but linked to the irregular pattern of valleys).

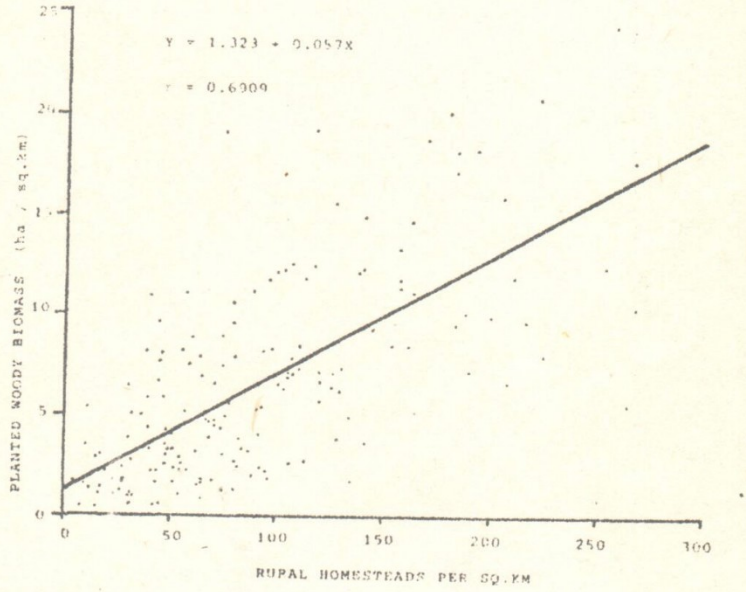
Of particular interest are the maps showing the quantitative distribution of the different woody biomass elements. These have been loosely grouped into three major categories (indigenous forest and plantations omitted):-

1	individual planted trees	:	trees around houses
		:	trees in agricultural land
		:	trees along paths and waysides
2	planted "stands" of woody vegetation	:	woodlots
		:	windrows
		:	hedges
3	"natural" vegetation	:	bush
		:	trees in bushland
		:	trees in open grassland
		:	riparian woodland

There is insufficient space here to illustrate all of these elements, though planted stands has already been presented (figure 1). The aggregate picture (when all three of the constituent elements are combined) clearly reflects population density, or at least the density of rural homesteads; but when disaggregated, three quite different patterns emerge. Thus for woodlots, there is a remarkable concentration in the extreme south east of the district (broadly South Maragoli). By contrast windrows, and to a limited extent hedges, are most dominant in a zone which includes Marama and Kisa. Finally we may note that hedges are most characteristic of the north centre of the district. What these patterns seem to suggest is the following:-

1 In general, as population density increases, then planted woody vegetation also increase (figure 2). This is particularly evident when planted stands are expressed as a proportion of total woody biomass.

FIGURE 2 : THE RELATIONSHIP BETWEEN POPULATION DENSITY AND THE GROUND AREA OF PLANTED WOODY BIOMASS IN KAKAMEGA DISTRICT



2 However, the particular form that these planted stands take varies from area to area. Thus in South Maragoli, woodlots are dominant, whereas in Marama/Kisa windrows and hedges together form the larger proportion of these planted stands. In Bunyore we find a more or less even mixture of the three elements.

These patterns are not the result of some random accident. They reflect deliberate management choices by the farmers in the areas. Thus we see that in South Maragoli the physical environment is characterised by a high density of deep valleys. These valleys typically have marshy bottom lands which are unsuitable for agriculture. In more northern areas where population density is less, riparian woodland dominates these bottom lands, but in South Maragoli, the pressure on land is such, and the need to generate a cash income so pervasive, that the natural riparian woodland has

been cleared, and replaced by Eucalyptus woodlots - which grow extremely quickly in permanently moist soils, and which provide a valuable source of income. It is by interpreting these patterns, and by attempting to understand the reasons which lie behind them, that the KWDP can best realise the aim of designing its intervention around (and complementary to) existing practices.

A detailed examination and a search for explanations of the distribution patterns of individual variables sheds light on current activities and pressures operating in the district. Nevertheless it is inevitable that by association; by correlations between different variables, there is an inescapable drift towards a "multivariate" consideration of the geography of the district. Such a progression is desirable for two reasons. Firstly it changes the emphasis from "intangible" variables to "concrete" places or areas; areas within which the KWDP has to base its operations. Secondly it provides a means of reducing a complex and extremely variable district of 3500 sq.km and 1.0 million people to a restricted number of "small" and manageable areas in which to begin the intervention programme.

An efficiently-produced, and objective multivariate synthesis is best achieved through the numerical analytical power of a large computer. This is presently underway with the help of the University of Nairobi Computing Centre. In the interim, it is possible to arrive at a somewhat cruder approximation by map overlays and compound statistics. It is via such an approximation that the KWDP has been able to stratify the district into 11 sub-regions, each identified by a combination of significant characteristics. A simplified model and a map of the stratification is illustrated in figures 3 and 4.

FIGURE 3 : SIMPLIFIED MODEL ILLUSTRATING THE FUNCTIONAL RELATIONSHIPS OF 11 SUBREGIONS OF KAKAMEGA DISTRICT

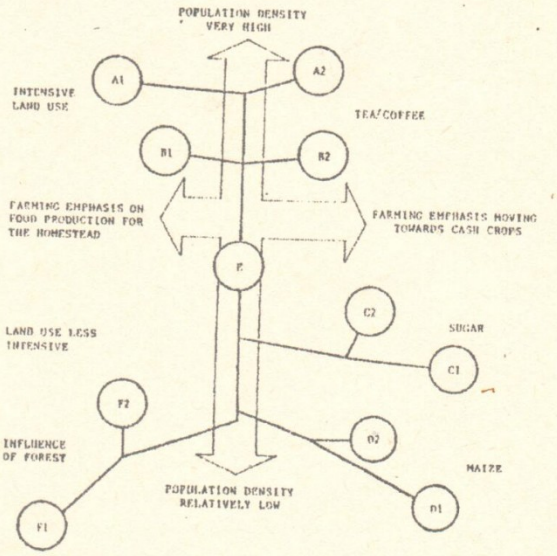
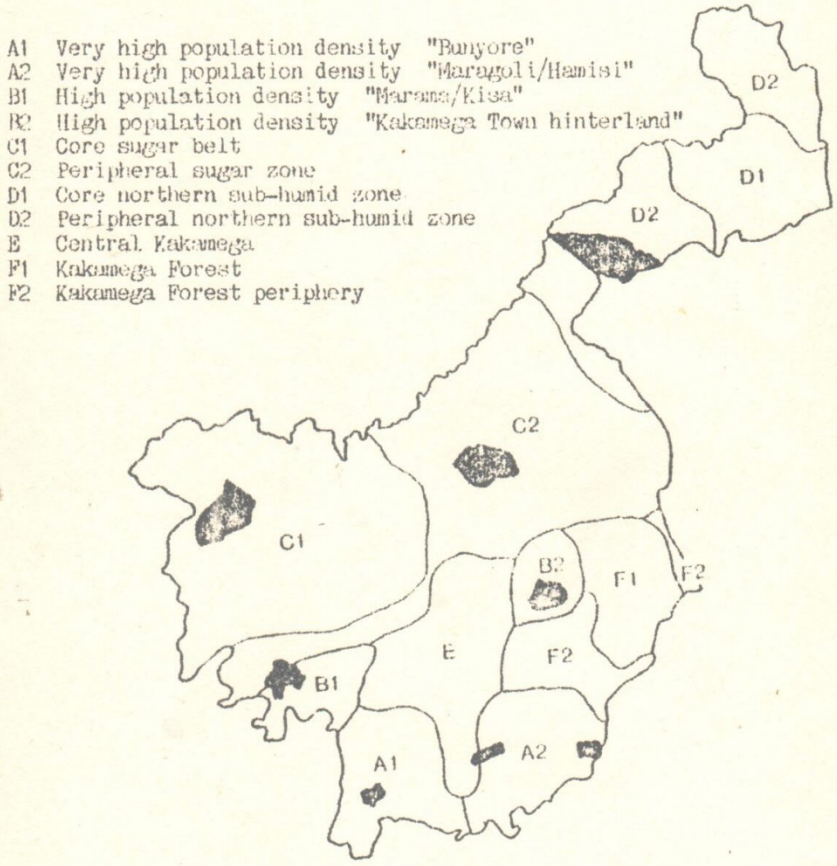


FIGURE 4 : THE 11 SUBREGIONS OF KAKAMEGA DISTRICT ACCORDING TO THE DISTRICT RESOURCE ANALYSIS



(black areas denote sublocations selected by the KWDP for intensive consideration)

Table I reveals some of the more interesting woody biomass configurations of these different strata.

TABLE I : SELECTED LAND-USE ELEMENTS OF 11 SUB-REGIONS OF KAKAMEGA

SUB-REGION	NO. RURAL HOMES (KM^2)	FARM SIZE (HA)	HA. MAIZE (KM^2)	HA. SUGAR (KM^2)	HA. PLANTED WOODY BIOMASS (KM^2)	HA. BUSH (KM^2)	HA. TOTAL WOODY BIOMASS (KM^2)	TOTAL WOODY BIOMASS PER RH. (SQ.M)	"X"	TOTAL PLANTED WOODY BIOMASS PER RH. (SQ.M)
A2	195	0.49	21	1	15.4	6.5	23.8	1220	525	790
A1	185	0.53	27	<1	11.7	6.2	21.2	1150	670	630
B1	176	0.56	13	5	16.3	11.7	29.0	1650	931	930
B2	160	0.57	10	<1	12.5	3.8	20.5	1281	1024	781
E	112	0.87	14	1	9.7	6.9	20.6	1839	1158	844
C2	80	1.16	10	5	5.6	7.0	15.4	1925	1467	700
C1	78	1.22	3	33	5.2	4.8	12.0	1540	978	660
F2	74	1.12	14	1	4.5	12.5	23.8	3216	2624	608
D2	54	1.70	31	0	3.4	6.1	13.7	2530	1950	640
F1	22	2.39	7	0	2.5	2.1	11.2	5091	3957	1136
D1	16	3.33	26	0	1.4	3.3	7.4	4590	3263	850

"X" = HEDGE + BUSH + RIPARIAN WOODLAND (SQ.M PER RURAL HOMESTEAD)
(the major woody biomass elements contributing to woodfuel supply)

SUB-REGIONS:-

- A1 Very high population density - "Bunyore"
- A2 Very high population density - "Maragoli/Hamisi"
- B1 High population density - "Marama/Kisa"
- B2 High population density - "Kakamega Town hinterland"
- C1 Core sugar belt
- C2 Peripheral sugar zone
- D1 Core northern sub-humid zone
- D2 Peripheral northern sub-humid zone
- E Central Kakamega
- F1 Kakamega Forest
- F2 Kakamega Forest periphery

The division of the district into these sub-regions is based on the following domains:-

1. population density
2. agroclimatological considerations
3. the relative importance of commercial and "subsistence" agriculture
4. indices of an agricultural economy undergoing a rapid transformation
5. resultant woody biomass characteristics

Put together these variable complexes indicate the dynamics and constraints which underlie current resource management on the farms. If the KWDP is to achieve its goal of finding harmonious technical inputs which can improve the fuelwood supply situation: inputs which are readily accepted by farmers, and which can be integrated into their current activities without serious disruption, then an understanding of these underlying forces is essential. The DRA, and its ability to stratify a district, is part of the process of discovering these fundamental constraints. As an example of the benefits of this approach, we may consider the essential characteristics of sub-region A1 (of which the sublocation EBUSIKHALE is a part)[2].

SUBREGION A1 : Very high population density - "BUNYORE"

This area is amongst the most densely-populated parts of Kenya, with some sublocations supporting more than 1000 people per sq.km. Rural homestead densities are extremely high at 185 per sq.km, with correspondingly small farms (average of 0.53 ha). Not surprisingly land is used very intensively, with an overwhelming concentration on directly-consumable, rather than commercial, crops (maize, beans and bananas). Despite this intensive pressure on the land, a significant proportion is devoted to woody biomass (21.2%). The mix of elements which comprise this figure is very diverse. In fact, this subregion cannot be defined in terms of a single type of tree management system. All of the various forms of tree and shrub configurations are present. The distinctive feature is the dominance of planted material - some 55% of all woody biomass. As the pressure on the land has increased, the natural vegetation has been removed, but in this instance it has been deliberately replaced by more "controlled" vegetation: hedges, woodlots, windrows, and individual trees. As a proportion of total land area, the woody biomass ground cover is much greater than in situations where population pressure is less, and natural vegetation more important. 21.2% is a large figure, and confounds the general view that as population density increases so tree cover decreases. In fact the reverse is the case. Not just in this subregion, but also throughout Kakamega, the greater the number of people on the land, then the greater the proportion of land devoted to trees and shrubs. The conclusion is clear: the interdigitation of trees and agricultural crops is a **normal** phenomenon in Kakamega. Agroforestry is a concept already well-established amongst the smallholders of the district. Of particular interest in this subregion is Ebusikhale: a sublocation in which an indigenous tree (Sesbania sesban) is freely grown amidst the maize fields. It is an important source of fuelwood, and the local farmers are well aware of its properties. It grows extremely quickly, casts a light shade, is nitrogen-fixing, regenerates freely, and can be grown relatively densely in the maize fields. It is a good example of the extent to which

---

2 - In a following working paper the implications of this information (along with the results from other surveys and observations) are examined. In particular we shall see the way in which a traditional agricultural economy is undergoing a fundamental change, particularly with respect to social attitudes and responsibilities within the household. It is through a recognition of these changes that the KWDP perceives an "open door" through which to introduce sensible inputs which have a *reasonable chance of succeeding.*

traditional agricultural practices are already well-attuned to the ideas of agroforestry.

CONCLUSION

This working paper on the District Resource Analysis serves two functions. Firstly it briefly outlines the techniques that have been employed, and the way in which data collection and analysis are brought together. Secondly it presents a sample of some of the results which are of relevance to the KWDP, and in so doing illustrates the positive contribution that such information can make to a development programme of this nature. What we have learnt through the DRA is the following:-

1. An overview of the current landuse situation in Kakamega, giving us the opportunity of splitting the district into a small number of subregions within which we can develop "tuned" intervention.

2. By attempting to interpret and explain these landuse patterns we approach an understanding of the forces which limit and guide the management decisions of the rural population.

3. Through a scaled approach to data collection we are able to go beyond the broad categories which emerge from the DRA, and progress, via more detailed and local surveys (AFS and CS), to a fuller understanding of to which the existing management strategies of individual farmers are adapted.

4. In gaining a first approximation to these constraints, we can short-circuit the normal experimental and "shot-in-the-dark" approach to development.

KWDP

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 3

THE AGROFORESTRY SURVEY IN KAKAMEGA DISTRICT

Berry van Gelder KWDP/ETC Foundation
Paul Kerkhof KWDP/ETC Foundation

Nairobi, October 1984

P.O.Box 56212, Nairobi, tel.582004

Table of contents

1. SUMMARY AND CONCLUSIONS

Little consideration has been given to the large numbers of trees to be found on the farms in the Kakamega District. The quantity and the diversity is considerable, and the purpose of the agroforestry survey was to find out the percentage level of involvement of farmers in tree growing activities.

In particular the south of the Kakamega District is densely populated, with an average land holding smaller than one hectare. To a great extent existing land use patterns within this area will determine any possible required intervention. Frequently tree planting on small farms is not considered a viable solution alongside the cultivation of agricultural crops. Nevertheless, trees are found in this area, and the objective of the survey was to find out to what extent people were using land to grow trees.

The survey focusses on the frequency of the existing woody biomass configurations. More quantitative information has been collected on woody biomass reproduction by farmers; such as the number of nurseries and seedlings produced. The socio-economic context concentrates on the size of the landholding and the agricultural aspects, while the use of woodfuel has been expressed in household use and market share.

The survey has been conducted in seven sub-locations, representative of the District. At least 60 farmers from each sub-location, and in total 528 farmers, have been interviewed. Young school leavers from the sub-locations were recruited and trained as enumerators in order to obtain reliable data.

The results show a very high degree of woody biomass awareness on the farms of the Kakamega District. Nearly every farm has trees around the house, in the shamba or in hedgerows. Woodlots and bushes are to be found on 65% and 47% of the farms respectively. The total area covered, and/or production figures, are part of the KWDP Resource Analysis, but the differences in species to be found in the different configurations are of particular interest. Exotic species ~~are~~ predominate in woodlots, while local species are abundant around the house. Fruit trees were mostly found in the agricultural land.

About 78% of all households planted trees or directly seeded tree species seed on their land. The number of farm nurseries is particularly astonishing. An estimated 89,000, or 38% of all households appeared to have a small farm nursery. The number of trees varied from a few up to a few thousand, totalling an estimated 50 million.
Survival rate within the nurseries and later on after outplanting is unknown, but even if it is only a few percent, the number of planted trees is considerable when compared to the seedlings produced by the government nurseries.

Tree species distribution among the tree reproduction activities on the farms shows clearly the dominant role of exotics (mainly eucalyptus) in the farm nurseries. Fruit trees are mostly collected, and direct seeding is mainly undertaken with local species (e.g. Sesbania sesban).

The species composition as found within the tree configurations on the farms differs from the tree species distribution of the tree reproduction activities. One explanation could be that the natural regeneration, within which the collection of wildlings forms part, is playing an important role in the woody biomass reproduction on the farms.

The existance of intervention nurseries which supply tree seedlings to farmers plays sometimes a minor, sometimes a major role in their surroundings.

Due to the high out-migration of men on small farms often only the women remain present. The proportion of female respondents in the agroforestry survey is much higher on small farms than on bigger farms. The index of women participating in agroforestry is on small farms higher than on large farms (44% as against 14%).

A comparison between two sub-locations, Kegoye and Ebusikhale, shows a high degree of difference in woody biomass composition. Despite similarity in average land size and percentage of female respondents, women are more involved in direct seeding (Sesbania sesban) in Ebusikhale than in Kegoye. Of trees planted on the farm, 62% of the households in Ebusikhale prefer to plant in hedges while in Kegoye only 25% of the households planted trees in the hedges.

Apparently a large combination of factors determine the woody biomass composition. Local habits and knowledge play an important role in the woody biomass management. A system dominant in one area may not even exist a few kilometers further on.

The agroforestry survey clearly revealed the existence of agroforestry activities in the District. Based on the activities, an intervention has to be developed in order to increase the woodfuel production (estimated to be insufficient to supply the demand in the future). The intervention as such should be homogeneous in general, but flexible enough to adjust to the specific conditions encountered within the different areas.

The focal point of the invention should be the mobilisation of existing skills, knowledge and resources of the farmers.

2. AGROFORESTRY CONFIGURATION

The agroforestry configuration on the farm has been classified by dividing woody biomass on the farm into five, specific-located components:

(1)- Trees around the house, including fruit trees and shrubs

(2)- Hedgerows, up to double rows of trees and shrubs

(3)- Trees in agricultural land (cropland, shamba) in the sense of intercropping of trees/shrubs

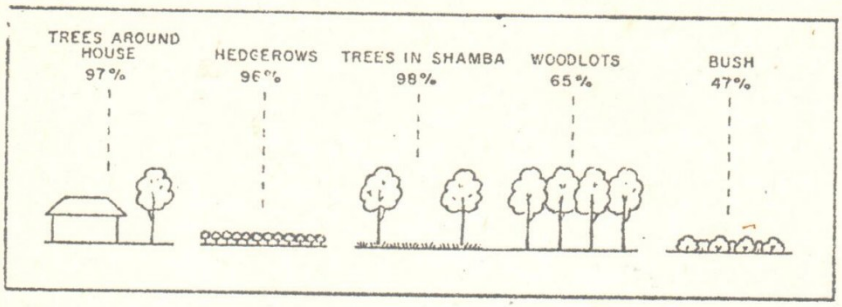
(4)- Woodlots, a group of trees of at least 20 in number

(5)- Bush, generally the remaining natural woody biomass

The survey recorded the frequency of the different components on the farm and the different species to be found in each component. The land area covered by the woody biomass, and the potential production figures, are part of the Resource Analysis and therefore not taken into consideration within this survey.

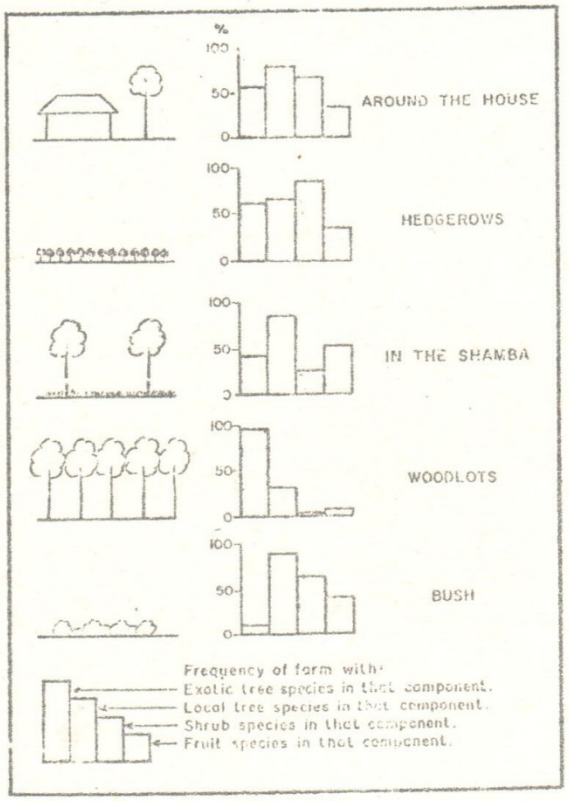
The percentage of farms having their own woody biomass components is presented in fig. 1. Trees around the house, hedgerows and trees in agricultural land are to be found on virtually all farms; woodlots and bushes to a lesser extent. About 65% of all farms independant of farm size have a woodlot, while 47% of all farms (particularly the larger land holdings) have a bush component.

FIGURE 1: SPATIAL DISTRIBUTION OF TREES ON THE FARM
(District averages)



The distribution of tree species, classified in four main group (exotics, local, shrubs and fruit trees) is presented in fig. 2. Exotic trees species, particularly eucalyptus, is dominant in woodlots; fruit trees in agricultural land; while local species are mostly found around the house.

FIGURE 2: SPECIES DISTRIBUTION IN THE VARIOUS AGROFORESTRY COMPONENTS ON THE FARM (District averages)



3. AGROFORESTRY ACTIVITIES

The different agroforestry components are to a great extent determined by the farmers themselves. About 78% of all households planted trees and/or directly seeded tree species seed on their land during 1983. The number of small farm nurseries found in the District is enormous. About 38% of all

households had a farm nursery. These estimated 89,000 nurseries produced a crudely estimated figure of 50 million seedlings. Survival rate within the nurseries and after outplanting is not known, but even a low percentage leads to a considerable production figure.

Future vegetation is not only determined by actively raising or planting trees but also by the process of natural regeneration. Collecting wildlings(undertaken by 45% of the households) is probably a reflection of this potential. A total overview of all different tree establishing activities is presented in the table below.

TABLE 1: PERCENTAGE OF FARMERS ENGAGED IN TREE ESTABLISHING ACTIVITIES ON THE FARM (Expressed in percentages).

Raising seedlings	38*
Buying seedlings	43
Getting seedlings for free	23
Collecting wildlings	45
Direct seeding	26
Planting seedlings	72
Planting and/or direct seeding	76

* or about 89,000 farm nurseries

A number of these activities take place simultaneously on the farm and figure 3. gives an overview, whereby, for example, farmers are engaged in seedling activities, a combination of raising and buying seedlings, and obtaining seedlings for free.

The exotic tree species, particularly eucalyptus, is the most common tree within the nurseries; local species are more particular for direct seeding and outplanting wildlings, while fruit trees are mostly collected as wildlings. An overview is presented in figure 4.

The tree species distribution within the agroforestry components are not directly comparable with the tree species as presently used in the different tree establishing activities on the farm. The active farm-based reproduction, like raising seedlings, etc., and the natural regeneration process are the main direct factors which determine the woodscape. The actual use and management of the woody biomass are the most indirect factors.

4. SOCIO-ECONOMIC ASPECTS

The socio-economic aspects concentrate on the male or female respondents, land holding size, cropping patterns and the number of animals at the farm.

The District is characterized by its high population density in the south (over 1.000 inhabitants per square kilometer) and the low density in the north (100 inhabitants per square kilometer). In the densely populated areas, out-migration of men from small farms is high; often only the women remain present. The proportion of female respondents in the survey is much higher on small farms than on bigger ones.

FIGURE 3: TREE SEEDLING ACTIVITIES IN THE KAKAMEGA DISTRICT (1983). PERCENTAGE OF THE FARMERS ENGAGED IN ONE OF THE THREE SEEDLING ACTIVITIES, OR COMBINATION THEREOF.

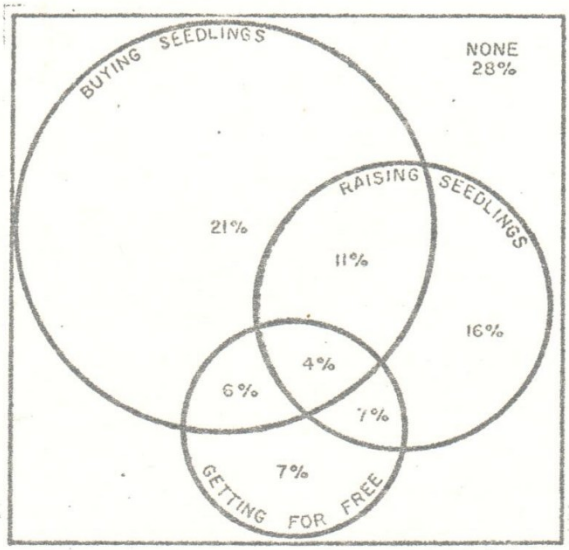
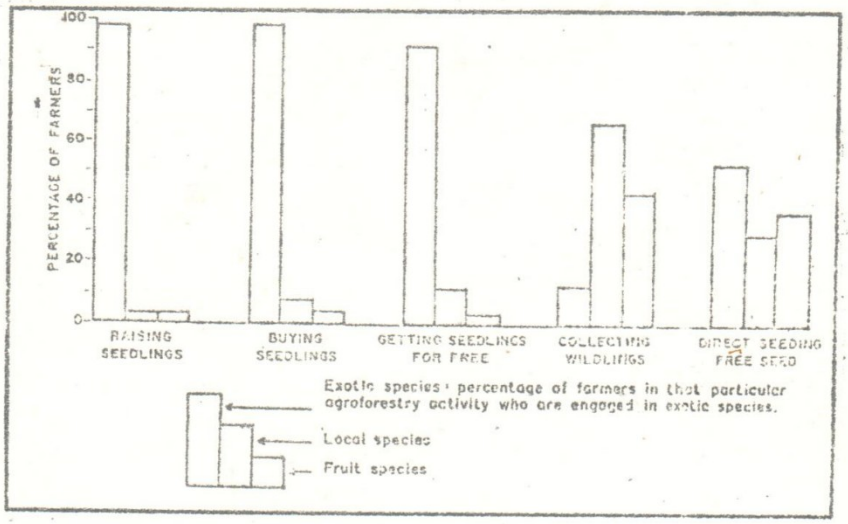


FIGURE 4: SPECIES DISTRIBUTION IN THE VARIOUS AGROFORESTRY ACTIVITIES ON THE FARM (District averages).



In the household the men are responsible for the reproduction of trees and the sale of wood. The task of the women is to collect and obtain fuelwood. In an attempt to reflect the women's participation in agroforestry activities on the farm, an index of female participation in the activities has been developed. The involvement of women raising seedlings, buying seedlings, getting seedlings free of charge, collecting wildlings, direct seeding, collecting seeds for the nursery and planting tree seedlings has been ranked for the sublocations. The index in presented in table 2 for the seven sub-locations under study and clearly shows the higher level of women's involvement in the agroforestry activities on the smaller farms in Ebusikhale and Kegoye.

TABLE 2: INDEX OF WOMEN'S PARTICIPATION IN AGROFORESTRY ACTIVITIES.

RANKING OF PARTICIPATION OF WOMEN IN EACH OF THE FOLLOWING ACTIVITIES:

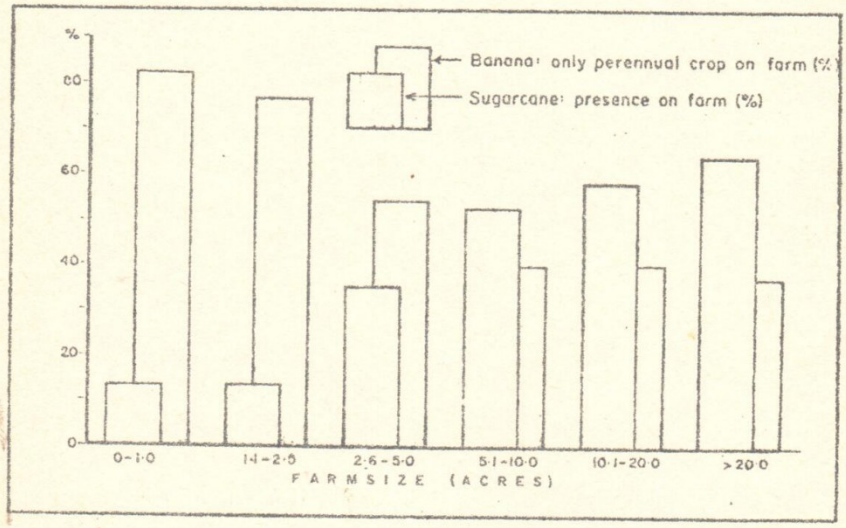
- COLLECTING OF SEEDS FOR NURSERY
- RAISING SEEDLINGS
- BUYING SEEDLINGS
- GETTING SEEDLINGS FREE OF CHARGE
- COLLECTING WILDLINGS
- DIRECT SEEDING
- PLANTING TREES

THE FOLLOWING ORDER IS THUS OBTAINED: AN "INDEX" OF FEMALE PARTICIPATION.

EBUSIKHALE	45
KEGOYE	44·5
CHEKALINI	26
LUKUME	26
ESHIANDA	23·5
MURHANDA	16·5
MAYONI	14·5

The cropping pattern within the District depends on the size of the land holding. Small farms have more often bananas on their land, while sugar is more normally found on the larger ones. A summary is presented in figure 5.

FIGURE 5: PRESENCE OF SUGARCANE AND BANANAS IN RELATION TO FARM SIZE



5. COMPARISON BETWEEN SUB-LOCATIONS

A more specific comparison between two sub-locations, both characterized by small size land holdings (average 0.7 ha) reveals more details in how far for example land size as such would determine the situation.

Table 3 is an overview of a few characteristics as found for the sub-locations Kegoye and Ebusikhale (also figures for the sub-locations Chekalini, Lukume, Eshianda, Murhanda and Mayoni are presented).

Average farm size for Ebusikhale and Kegoye is the same, as the percentage of female respondents (67 and 72 respectively). The women's participation index is the same at 44. The difference in woodscapes between the two sub-locations is the difference in tree species occurrence.

In Ebusikhale, Sesbania sesban and Markhaemia platycalex dominate in the agricultural land. In Kegoye both species are virtually absent while fruit trees are grown instead. An overview is presented in figure 6.

As to why specific systems and practices predominate in one area and not in the other with the same indicators is a question which cannot easily be

answered. It is obvious, however, that the agroforestry configuration on the farm is complex; that it can differ greatly even over relatively short distances, and under apparently similar circumstances.

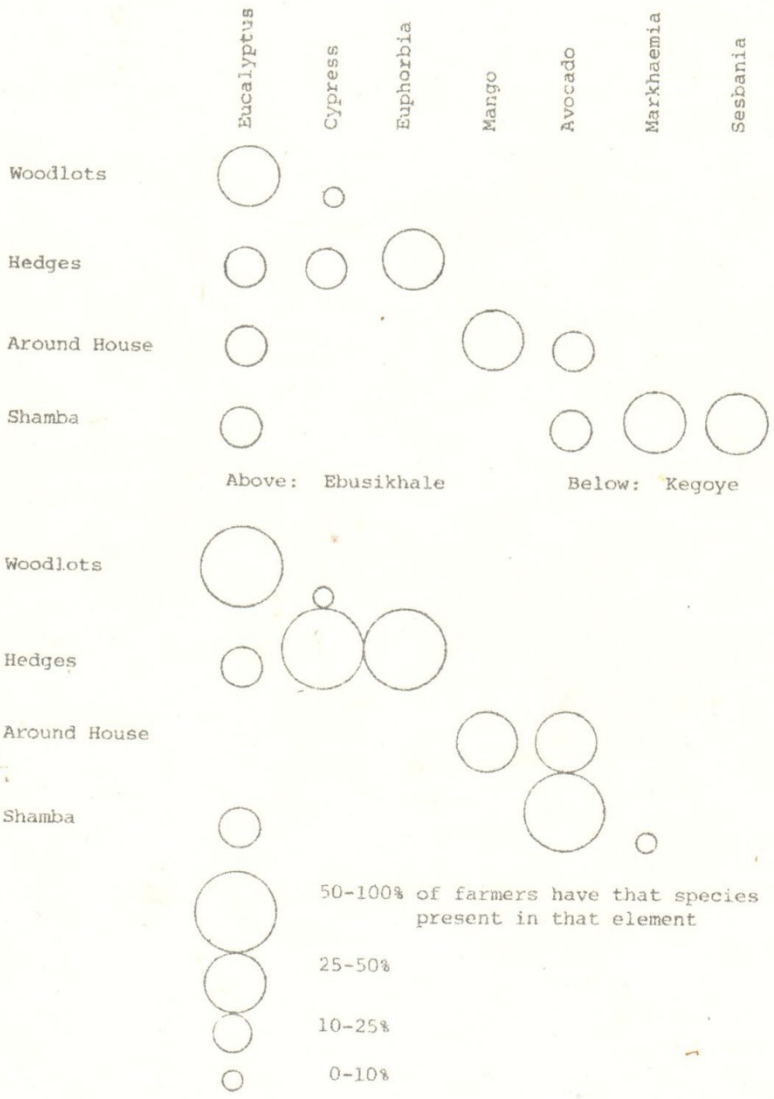
TABLE 3: VARIATION IN SOME SOCIO-ECONOMIC AND AGROFORESTRY CHARACTERISTICS IN THE KAKAMEGA DISTRICT.

	KEGOYE	EBUSIKHALE	ESHIANDA	MURHANDA	LUKUME	MAYONI	CHEKALINI
Average farmsize (ha)	0·7	0·7	1·3	1·3	3·9	5·2	6·8
Female respondants (%)	73	67	39	53	52	28	39
Participation index	44·5	45	23·5	16·5	26	14·5	26
Buying seedlings (%)	37	48	36	37	33	52	65
Direct sowing (%) (Sesbania)	-	15	11	2	-	2	-
Female participation sowing Sesbania (%)	-	85	-	-	-	-	-
Wildlings Croton (%)	5	2	-	38	3	-	8

6. FUEL SCAPE

The percentage of farmers buying fuelwood and charcoal increases if the size of the farm holding decreases. Not the existence of woodlots, but the availability of land covered with bush appears to be one of the explaining factors. Besides this general and overall explanation also regional differences show up which cannot be explained by farm size. An example is the sub-location Murhanda, neighbouring to the Kakamega Forest, were many women are involved in collecting and marketing fuelwood from the Forest.

FIG. 6. Variation in agroforestry configuration. Similarities and differences in agroforestry components between Ebusikhale and Kegoye sub-location.



KWDP

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 4

CULTURAL ASPECTS OF FUELWOOD PROCUREMENT IN KAKAMEGA DISTRICT

Noel Chavangi KWDP/The Beijer Institute

Nairobi, October 1984

P.O.Box 56212, Nairobi, tel.582004

Table of Contents

Summary and Conclusions

Within KWDP the cultural survey was carried out in an attempt to:

- understand the cultural aspects of the Kakamega people with regard to woody biomass production and utilization.
- involve the people right from the beginning
- define the fuelwood problem
- identify the functional target group.

The basic assumptions at the start of the survey, based mainly on the preliminary results of the agroforestry survey were:

- fuelwood procurement had no direct link to tree planting activities
- fuelwood is in short supply regardless of the size of the farm holding and the extent of tree planting activities
- tree planting is a male dominant activity
- women have very little control or access to the production resources available to the households.

The main findings from the survey are:

The general understanding in Kakamega is that the man (husband), as the head of the household, has the overall control of the household resources and in that capacity, everything in the household is viewed as belonging to him.

Current tree planting activities are dominated by the men and the concept of tree ownership (male dominated) has been effectively sustained through well manipulated cultural practices (taboos) resulting in almost a total lack of direct participation of women in tree planting activities.

The general situation displayed is that trees are planted for multipurpose uses with a major emphasis for poles and frames for construction purposes and wood for sale.

There is almost no direct reference to tree planting in relation to the supply of fuelwood and the only point of reference is in the form of a by-product, and/or split wood that is purchased as fuelwood on the market.

Without exception charcoal is purchased from the local market. Fuelwood is mostly collected and in some areas purchased from the market. Most of the cultural aspects on woodfuel concentrate

in the survey on fuelwood as charcoal use is low and mostly obtained from the market.

On the whole fuelwood procurement is predominantly a woman's specific task, and fuelwood collection outside the individual's farm is no longer possible. Women are therefore finding it necessary to engage in practices that will enable them to procure fuelwood either on their own farms or from the market.

An example of fuelwood production is found in Ebusikhale, where women have adopted the agroforestry system of trees in the agricultural land, based on Sesbania sesban (tsikhule or tsisabasabi) to supplement the collection from own farm and purchases from the market. The Sesbania sesban is viewed more in the context of fuelwood rather than "a tree."

Possible line of approach is:

In efforts towards the establishment of a complete chain of events in the fuelwood procurement cycle it is considered necessary that the fuelwood production concept be initiated. A possible point of activity may be through the launching of a major awareness programme.

The awareness programme should aim at making "tree planting for fuelwood" an acceptable proposition to the community ~~at large~~ in general and the households in particular.

1. Introduction

1.1. Background

In a project where the overall objectives have been initially defined in terms of technical and economic performance, cultural and social aspects may tend to be ignored. They may however manifest themselves during implementation stages as constraints on implementation.

With this in mind, it was considered necessary within the Kenya Woodfuel Development Programme (KWDP) to carry out a fairly quick cultural survey based on discussions with groups of men and women as a follow up to the agroforestry survey. After the cultural survey, a more detailed household level socio-economic survey would then be undertaken. The cultural survey was therefore carried out in an attempt to:

1.1.1. - understand the cultural aspects of the Kakamega people as they are seen to influence tree planting activities and woodfuel procurement and utilization patterns with the aim of effectively accommodating the same in the programme's activities. This would ensure that the programme's activities will not be disruptive to such cultural practices and traditional beliefs as may be found to exist.

A corolary to this was the need where desirable to stimulate the populace in questioning certain traditional practices as may be seen to have negative influence to envisaged development trends.

- involve the people in the initial and subsequent identification and analysis of their own problems related to tree planting activities in general and woodfuel procurement in particular.

This was seen as an attempt towards the involvement of the people at the earliest opportunity in efforts towards the assessment of possible programme activities that may be seen by them as best suited to their local conditions and most effective in solving the identified woodfuel problems as perceived by them.

- Define the fuelwood problem.

- Identify the functional target group.

1.2. Basic Assumptions

Certain basic assumptions were made at the start of the cultural survey, based mainly on the preliminary

results of the agroforestry survey.

1.1.2. - It appeared that fuelwood procurement had no direct link to tree planting activities.

1.1.3. - Fuelwood appeared to be in short supply regardless of the size of the farm holding and the extent of tree planting activities.

1.1.4. - Tree planting was seen as a male dominated activity.

1.1.5. - Women appear to have very little control or access to the production resources available to the households; could there be any differentiation on the lines of widows and women whose husbands do not reside permanently on the farm?

1.3. Major Areas of Interest

The major areas of interest for the purpose of the programme's activities included:

1.3.1. - Access and control of resources within households.

1.3.2. - Tree planting activities inclusive of ownership, nursery establishment, species preference, definition of a tree, etc.

1.3.3. - Purpose for which wood is produced.

1.3.4. - Sources of woodfuel

1.3.5. - Agroforestry concept.

1.3.6. - Household farm histories in relation to tree planting and woodfuel procurement.

1.3.7. - Utilization of woodfuel, inclusive of types of woodfuel, storage, stoves, etc.

1.3.8. - Women Groups and woodfuel related activities.

2. The District Focus: Kakamega

A generalization of the cultural aspects in the district is given in the form of summarized sub-locational depictions.

2.1. Access and Control of Resources

The general understanding in Kakamega is that the man (husband), as the head of the household, has the overall control of the household resources, and in that capacity, everything in the household is viewed as belonging to him. The wife therefore is expected to seek the opinion

of the husband and ultimately his consent before going ahead with any plans that may bring about any changes in the allocation of the household's resources. In theory however joint ownership between man and wife is implied, but this concept is seen to reflect more in as far as the wife is seen to belong to the husband alongside all the "other" household resources or "assets".

There is displayed a gradual realisation of the "disadvantaged" position by the women and systems of trying to create some degree of influence, while still maintaining the necessary respect as expected of them by the community, are being initiated. Such efforts are mainly reflected in the attempt by women to undertake certain activities that may result in raising some petty cash either on individual or group basis. Major influencing factors towards this trend may be summarised as follows:

2.1.1. - The established husband and wife relationship at the household level. Some men are more willing to allow a certain degree of "individualism" to the wife than others -- the role of religion to this end cannot be under-estimated as it is seen to have a rather neutralising effect to the traditional male supremacy stance.

2.1.2. - The degree of literacy of the woman -- a young wife who has been exposed to a reasonable length of formal education tends to be more willing to try out things which an older lady would not even like to attempt.

2.1.3. - Whether or not the husband resides permanently on the farm. Women whose husbands are employed away from the farm are seen to display a certain degree of access and control of the household resources and decision making.

2.1.4. - Widows seem to be in a general peculiar position. Generally their actions are greatly dictated by the expectations of the society at large and the immediate male relatives of her late husband. Older widows however tend to display a high degree of control of the household resources than young ones.

2.1.5. - The general situation displayed is such that men are seen to dominate the scene at the household level, and their support is seen as essential for the success of any envisaged programme activities.

2.2. Tree Planting Activities Inclusive of Ownership, Nursery Establishment, Species Preference, Definition of a Tree, etc.

Current tree planting activities are dominated by the men and the concept of tree ownership (male dominated) has been effectively sustained through well manipulated cultural practices (taboos) resulting in almost a total lack of direct participation of women in tree activities.

Apparently trees are viewed as permanent features in relation to land and indeed customarily, before the advent of land title deeds, land ownership where in dispute could be resolved in favour of the party which had claim over ownership of trees on the land, especially so if the trees were planted or were growing at the site of a grave belonging to the ancestors.

It is therefore seen that just as ownership of land is by custom denied to women, so by the above inference, ownership of trees is also denied to women. To ensure that this vital customary requirement is sustained, certain reasons are advanced as to why women are not allowed by custom to plant trees. Most of the reasons are seen to serve the purpose of scaring the women from active participation in tree planting activities in order to preserve male dominance other than any other purpose. The reasons advanced are summarised below:

2.2.1. - If a woman plants a tree, she would become barren. Child bearing according to custom was the only guarantee to stability in marriage, and because of the high value placed on marriage in any society, no woman would ever dare plant a tree lest she becomes barren and hence a social misfit.

2.2.2. - If a woman plants a tree, her husband would die, and since the life of a widow was a very miserable one, no woman would dare take action that may result in the possible threat to her husband's life.

2.2.3. - If a woman plants a tree, the action is viewed as a direct challenge to the husband's supremacy in the household (she is seen as seeking to claim equality to the husband) and such an action could result in a divorce.

2.2.4. - During the construction of a house, wood from a tree planted by a woman could not be used. It follows therefore that since one of the major uses of trees is for construction purposes, then women were prohibited from planting trees so as to rule out the possibility of wood from such trees being used for the construction of a house. Male ego!

2.2.5. - Certain trees were considered special for holding specific customary rituals, e.g., sacrifices for ancestors, religious ceremonies or funeral rituals. Such functions were performed exclusively by the men and the trees were exclusively planted at a specific point within the homestead compound. To sustain the male only requirement, women were totally excluded from any tree planting activities.

2.2.6. - Generally trees were never planted in the past and tree planting was restricted to specific customary functions, normally performed by men. Tree planting enmass is therefore a very recent practice.

2.3. Purpose for Which Wood is Produced

The general situation displayed is that trees are planted for multipurpose uses with a major emphasis for poles and frames for construction purposes and wood for sale. There is therefore a general preference for multipurpose exotic species, predominantly eucalyptus with a few cypress and pinus. There is almost a total lack of tree planting of the indigenous tree species (these are seen more in the line of being able to grow on their own).

There is almost no direct reference to tree planting in relation to the supply of fuelwood and the only point of reference is in the form of a by-product, and/or split wood that is purchased as fuelwood on the market.

2.4. Sources of Woodfuel

Without exception charcoal is purchased from the local market.

Fuelwood procurement (on collection basis) is viewed as a woman's task within the household's division of labour, and the women collect the fuelwood on their husband's shamba and occasionally along the foot paths and river banks where a bit of bush still exists. In some areas fuelwood is purchased from the market. Generally it is seen that fuelwood supply has a positive correlation to the available bush cover on the farm. The absence of bush reflects a critical fuelwood shortage. Fuelwood on the farm is collected from bush (where bush exists), hedges and dry branches of the trees on the farm. Planted trees are rarely felled for the specific supply of fuelwood to the households.

2.5. Agroforestry Concept

Trees are currently not planted for the supply of fuelwood. The only exception is in Ebusikhale area where

trees (Sesbania) are seen in the agricultural land. The question of whether Sesbania is viewed as a tree then arises. The mode of growth and its multipurpose function (which happens to have a positive effect on soil fertility) seems to contribute positively to this end. Sesbania is however seen more in the context of fuelwood rather than a tree.

Generally the concept is viewed with some degree of suspicion especially in reference to fuelwood -- as it is seen to exclude the participation of men and hence indicative of allocation of resources at the household level, between the husband and wife. This tends to point at a primary area of conflict which is seen to leave a question mark in the minds of the men. The general impression given seems to be that by linking tree planting to the direct supply of fuelwood, the men are being conveniently excluded (customarily men are not seen to play any role in the procurement of fuelwood) from the programme's activities, and such a possibility will certainly not be welcomed by the men.

2.6. Household Farm Histories in Relation to Tree Planting and Fuelwood Procurement

Apart from Murhanda where the Kakamega forest is seen to have a direct impact on fuelwood procurement and Mayoni where the advent of sugar-cane growing as a cash crop has resulted in a rather abrupt change from a plentiful fuelwood situation to an acute fuelwood shortage situation, generally there is a gradual decline in the supply of fuelwood in relation to the disappearance of bush as reflected by pressure on land. Acute fuelwood shortage is displayed in the southern parts where the population density is very high and is reflected in increased incidences of fuelwood purchases from the market. The situation is then seen to vary greatly in relation to land sizes (as a reflection of population density), cropping patterns as reflected by absence of bush, etc.

On the whole fuelwood procurement is predominantly a woman's specific task, and fuelwood collection outside the individual's farm is no longer possible. Women are therefore finding it necessary to engage in practices that will enable them to procure fuelwood either on their own farms or from the market.

2.7. Utilization of Woodfuel, Inclusive of Types of Woodfuel, Storage, Stoves, etc.

What is Enungo?

The main area of interest here is the fuelwood storage facility of "enungo" (raised platform) in the kitchen which customarily provided foe effective control of fuelwood. According to custom, only the owner of the enungo could store fuelwood on it and also remove fuelwood from it.

2.8. Women Groups and Woodfuel Related Activities

Although the women group movement is widespread in the District and especially so the informal groups, their activities in relation to woodfuel are very limited. The only direct points of reference is where on group basis, funds have been raised for the purchase of charcoal or a tree which is then felled and split into fuelwood and sold to the individual members. In Murhanda women groups were seen to provide transport for fuelwood either from the forest or when purchased by any one individual.

In general the women's group concept forms an integral social function within the overall community matrix. Women are generally seen to function on group basis whenever they are faced with a social problem that is beyond the individual's capabilities. The group is then seen to function collectively tackling the problem, e.g., helping each other out in times of hardships or misfortunes -- funerals, prolonged sickness, etc. Group efforts are also seen to play a role in times of other social events, e.g., weddings, and also such tasks as may benefit from collective labour, e.g., various types of farm work (land preparation, planting, weeding, harvesting, etc.) and also household activities, e.g., building houses, etc.

3. The Sub-Locational Scale

3.1. A number of general issues can be derived out of the available information at the sub-locational level. An attempt is made to summarise such issues below:

3.1.1. - Well manipulated cultural practices (taboos) have resulted in an almost total lack of the involvement of women in tree planting activities.

3.1.2. - Current tree planting activities are dominated by the men and have no direct contribution to the supply of fuelwood to the households.

3.1.3. - Fuelwood procurement is strictly a women's task and women are still expected to meet the household's fuelwood requirements without relying on the available household tree resources.

3.1.4. - Current fuelwood procurement activities do not in any significant manner affect the allocation of the available land resource at the household level. Fuelwood is either collected from bush (which is viewed as surplus land resource to the household's requirement for both subsistance and cash economy),

hedges, along foot paths, river banks, etc., obtained as donations (handouts) from neighbours or friends (within the social obligation of helping each other out in times of need), or purchased from the market.

3.1.5. - Fuelwood collection outside the individual household farm is no longer possible with increased pressure on land, and women are finding it necessary to engage in practices that will enable them to procure fuelwood either on their own farms or from the market.

3.1.5.1.- Women in Ebusikhale have adopted the agroforestry system of trees in the agricultural land, based on Sesbania (tsikhule or tsisabasabi) to supplement the collection from own farm and purchases from the market. The Sesbania is viewed more in the context of fuelwood rather than "a tree".

3.1.5.2.- Women in the other sub-locations do not seem to have evolved any intermediary solution and are either relying solely on collection from own farm or "handouts" from friends and relatives (Mayoni, Chekalini, Lukume, Eshianda and Murhanda) or supplementing such efforts with purchases from the market (Kegoye, Ebusikhale, Mayoni, Eshianda and Murhanda).

3.1.5.3.- Women in Murhanda supplement the above efforts with collections from the Kakamega forest (a traditional source of fuelwood which has been recently restricted by the Forest Department).

3.1.5.4.- There is therefore seen a jump from collection of fuelwood to purchases from the market, which appears to be contrary to the normal sequence of events in farm based activities, where families try to meet their basic requirements through farm based production activities before considering purchases from the local markets (if such basic requirements can be met in such a manner). This indicates "a missing link" in the fuelwood procurement cycle, which is seen to start with collection and jumps to purchases, missing out the production step.

Current Practice : Collection Market

Proposed Practice : Collection Production Market

3.1.6. - Women are seen as the primary end-users of woodfuel with a heavy reliance on fuelwood and marginal input of charcoal in the "acute fuelwood shortage" areas (Kegoye, Ebusikhale and parts of Mayoni).

3.1.7. - There is a general preference for multipurpose tree species by both men and women and the general opinion

expressed is that with increased tree planting activities of the multipurpose species, the household's fuelwood requirements will be sufficiently catered for. This is despite the fact that the available multipurpose tree species have no direct point of reference to the supply of fuelwood.

4. Possible Lines of Approach -- Issues and Options

4.1. The Need for an Awareness Programme

In efforts towards the establishment of a complete chain of events in the fuelwood procurement cycle it is considered necessary that the fuelwood production concept be initiated. A possible point of entry may be through the launching of a major awareness programme.

The current practice is such that, although tree planting activities are widespread throughout the District, there is no deliberate action in terms of planting trees for fuelwood. The women who are responsible for the procurement of fuelwood have not been in a position to plant trees because of the cultural practices (taboos). Due to increased land pressure (bush, which is the traditional source of fuelwood is rapidly disappearing), the women find themselves confined to their household farms in their search for fuelwood. They (women) cannot however make use of the production function and the only alternative open to them is purchases from the market.

Now comes the critical point!

- Is it necessary to slot in the production step?
- How can this be achieved?
- Can the launching of an awareness programme provide an appropriate point of entry?

It is felt that such a programme aimed at making "tree planting for fuelwood" an acceptable proposition to the community at large and the households in particular could pay dividends.

4.2. The Case for Sesbania (Tsikhule)

Could it be possible to cash in on the experience with Sesbania in Ebusikhale in a meaningful way? Is Sesbania seen as a tree or just as fuelwood -- thus paving the way for the promotion of a fuelwood specific tree species?

4.3. The Male Ego

Could it be possible to cash in on the male ego as seen in Murhanda? Culturally a woman is not expected to plant trees for the husband when the husband is still alive. In addition the man is looked upon as the overall provider for his family. Taking into consideration the fact that most women do rely, to a certain degree, on their friends and relatives for "fuelwood handouts" -- thus implying that the husband is unable to make provision for them! Could this provide a breakthrough for the man to plant fuelwood tree species for the wife?

4.4. The Multipurpose Species Approach

Generally men in persuance of the case for multipurpose tree species, seem to imply that with increased multipurpose tree planting activities on the farms, the households fuelwood needs will be sufficiently catered for! Can such an approach meet the programme's main objective of self sufficiency in fuelwood at the household level?

4.5. Division of Resources at the Household Level

In as far as a fuelwood tree species only approach is indicative of "no control of such trees by the men", an area of conflict of interests at the household level is seen to emerge. How can the implied division of resources at the household level between husband and wife through the promotion of fuelwood only tree species be overcome? Otherwise the men may tend to be on the defensive as they seem to feel that the programme may be out to interfere in the way they run their households!

How can the concept of fuelwood requirement be made to reflect the important role of energy in the total welfare of the households and not just the traditional concept of a woman related function or role? Currently the general impression given is that since fuelwood is a woman's problem, then it cannot be important and hence men still consider it as a "laughing matter".

4.6. Target Group Concept

If an awareness programme can make a significant contribution to the acceptance of tree planting for fuelwood concept, then the target approach concept may be of secondary importance. In other words, as long as trees can be planted for the specific supply of fuelwood, then the question of who does the planting

may no longer be seen as critical (except of course in the light of cultural taboo limitations).

However since women are the main end-users of fuel-wood, it stands to reason that they are the direct programme beneficiaries and despite the sentiments expressed in 4.5. above, the approach that is likely to facilitate active participation by the women may be the one likely to have a significant bearing to the success of the programme's activities.

KWDP

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 5

THE SEARCH FOR VIABLE DEVELOPMENT OPTIONS

Berry van Gelder — KWDP/ETC Foundation
Phil Bradley — KWDP/The Beijer Institute

Nairobi, October 1984

P.O.Box 56212, Nairobi, tel.582004

THE SEARCH FOR VIABLE DEVELOPMENT OPTIONS

INTRODUCTION

The role of this last paper is to stimulate a discussion which takes as its focus the search for well-adapted options for technical intervention. In seeking to set the "terms of reference" for the discussion, we have chosen first of all to bring to the forefront those aspects of the programme which we see as distinctive. We do this by comparing our basic position with some of the more usual alternatives.

To do full justice to project activities in a short description is always difficult, but it becomes even more sensitive when such a description involves comparisons between situations within the project and those outside it. This is particularly the case when significant differences are evident. In the following paragraphs such comparisons are made, but in highlighting the contrasts between the approach of the Kenya Woodfuel Development Programme and approaches we have perceived in other programmes, it should be clear that we acknowledge that ~~for~~ for these other activities, different criteria and reasonings apply. Undoubtedly there are many and justified reasons for the situations that unfold in any programme. All we say here is that in the context of the KWDP we find ourselves at variance with the more usually encountered scenarios in development programmes.

By drawing attention to these differences, we are seeking to focus the discussion within the terms we see as relevent for the KWDP. The presentation of these divergencies, in terms of comparing two cases side by side, is based on our observations. It does not mean that one approach is better than the other, but merely draws attention to the fact that a change in the basis of observation has consequences in terms of future activities.

The purpose of the comparison then, is to provide the context for a structured discussion on the pros and cons of adopting a different observational stance. That these consequences might be dramatic is illustrated by the examples we have presented in the preceding KWDP working papers. However, our aim at this stage is to inform outsiders of our findings, and to receive positive criticism of the way in which we are pursuing the goals of the programme.

A : POINTS OF DIVERGENCE

1

NO TREES ON THE FARMS, ACCORDING TO EXISTING STATISTICS

Very little attention has been given to the estimation of the number of trees, or the woody biomass to be found on the small farm. The land is usually classified as agricultural land, and virtually no statistical data is available on standing stocks, still less the production capacities of these trees. The conclusion is that they are either non-existent or insignificant.

TREES OUTSIDE THE FOREST

The clear visual evidence of large numbers of trees within the agricultural highlands demonstrates that **trees outside the forests** play an important role in the supply of woodfuel. The KENYA FUELWOOD CYCLE study presented a first quantitative overview of production figures for the highlands.

Ask for the
KENYA FUELWOOD CYCLE

2

FORESTS ARE DECREASING BECAUSE OF THE HIGH DEMAND FOR WOODFUEL ON THE FARMS

Because so little attention has been paid to trees in agricultural land, it is almost automatically assumed that the high demand for woodfuel is being met by extraction from forests. These forests have therefore come under increasingly high pressure. The accepted practice is that in order to halt this destruction, existing forestry services have to be strengthened, as they are the guardians of trees and forest. The result has always been that major tree-growing projects are automatically linked with the forest service, to the extent that the role played by trees in agricultural land is not considered at all.

TREES ARE INCREASING AS POPULATION INCREASES

New information shows quite clearly that trees outside the forest are both numerous and increasing. The KWDP data from Kakamega reveals that a large proportion of agricultural land is devoted to tree cultivation. The proportion ranges from 7.4 to 30.0 percent, but the most striking result is the fact that as population density increases then the amount of land supporting woody biomass also increases. There is every reason to believe that this pattern will also be true in most of the high-potential land areas. If we extrapolate from this trend then it is clear that in future trees outside the forest will become even more important. In the present situation the involvement of farmers in tree-planting activities is underestimated and insufficiently recognised, and has yet to be given the prominence it deserves by most government organisations.

FARMERS HAVE NO KNOWLEDGE OF TREES, AND NEED TO BE "REACHED"

Because trees in agricultural land are seen not to exist, then they have to be brought to the farms. A great many nurseries have therefore been established in order to produce seedlings for distribution to the farms. A consistent pattern of large, centralised nurseries growing a restricted range of species is noted. Tree species choice is determined only by large-scale ecological factors.

THE KNOWLEDGE OF FARMERS ABOUT THEIR ON-FARM WOODY BIOMASS IS OVERWHELMING

The KWDP surveys reveal a considerable number of different systems within which trees are traditionally produced and planted on the farms. Each area has its own characteristics; sometimes overlapping and sometimes in complete isolation. The present potential for tree growing is enormous, and ways have to be found for incorporating this potential into nation-wide production targets. The government should play more of a coordinating role than one of attempting to meet production targets.

WOODFUEL SHORTAGES CAN BE OVERCOME BY PLANTING LARGE NUMBERS OF TREES

The alternative energy crisis is brought to the surface by a growing awareness of the increasing shortage of traditional renewable energy sources in the world. To solve this problem a considerable number of tree-planting programmes have been instituted. Results are expressed in terms of the number of nurseries that have been développed and the number of hectares planted. Indeed, woodfuel requirements for the future are discussed in terms of the number of hectares to be established. As an example we may cite the figure of a 100-fold increase in the area of fuelwood plantations which needs to be established in sub-saharn Africa.

TREE PLANTING ON FARMS IS ACTIVELY UNDERTAKEN, BUT FOR THE SPECIFIC PURPOSE OF WOODFUEL SUPPLY MORE ENCOURAGEMENT HAS TO BE GIVEN

A large proportion of planted trees in Kakamega are produced in order to generate a cash income. A common purpose is for the sale of construction poles. More recently trees are also being sold specifically for fuelwood purposes. The person responsible for the production of wood on the farm is not necessarily the one who is responsible for the collection and consumption of fuelwood. In most cases a division of labour is obvious. Usually it is the men who plant and subsequently cut trees, while the women are responsible for the supply of fuelwood.

FARMERS NEED TO BE CONVINCED OF THE ADVANTAGES OF CERTAIN TREE SPECIES. ADOPTION WILL THEN QUICKLY FOLLOW

Demonstration plots, and/or farms are established to show neighbouring farmers the effects. If the results of such demonstrations are sufficiently convincing the farmers will follow the lead. Consequently demonstration plots or farms are the most important component of extension programmes within present forestry projects.

THE PARTICULAR TREE SPECIES WHICH ARE FOUND ON FARMS HAVE SPECIFIC FUNCTIONS. WITHIN THIS CONTEXT THEY ARE REPLACEABLE BY OTHER SPECIES PROVIDED ADEQUATE CONDITIONS ARE CREATED

Construction wood, utility wood (for granaries, fencing etc.), and fuelwood are examples of major wood usage on farms. All are different, and require different types and ages of trees. Therefore an anlysis of woody biomass end-use is important. At present it seems that different tree species can have the same function. It is therefore difficult to prescribe specific uses for specific tree species. The results from initial intervention show that farmers plant the same new species for different purposes. A one-way approach: one species for one purpose, will be difficult to justify.

THE SPECIFIC SOLUTION FOR A SPECIFIC PROBLEM OF WOODFUEL SHORTAGE IS NORMALLY DETERMINED BY THE INTERVENTIONIST RATHER THAN THE RECIPIENT

Problem identification is usually the basis for any major woodfuel project. One or two main problems are often sufficient justification for raising project money, particularly when accompanied by convincing evidence that specific solutions are at hand. Quite often, pre-determined solutions are built into the initial schedule of operations of a project. Any major changes to these solutions are difficult to put into practice once the project has entered its execution phase.

THE PATTERN OF WOODY BIOMASS ON FARMS VARIES FROM PLACE TO PLACE; TO SUCH AN EXTENT THAT THE TYPES OF PROBLEM AND APPROPRIATE SOLUTIONS WILL ALSO VARY FROM PLACE TO PLACE

Differences in the size of smallholding, traditional practices, and social structures are all instrumental in determining on-farm woody biomass; in terms of species preferences, tree and shrub forms and configurations, and so on. "Woodscapes" therefore vary enormously, and any intervention is only likely to succeed if it complements these different patterns; if it takes as its base locally-derived solutions.

see KREDP

THE MOST COMMON SOLUTION TO WOODFUEL SHORTAGES ON THE FARM IS TO CONVINCE FARMERS TO TRY A WIDE RANGE OF DIFFERENT TREE SPECIES

A long list of potential and new tree species is often suggested as a possible solution. Logistical problems rather than ecological limitations determine the applicability of these species.

THE FORM AND FUNCTION OF EXISTING WOODY BIOMASS SHOULD ACT AS THE BASE FOR THE DETERMINATION OF TREE SPECIES WHICH MIGHT BE INTRODUCED

Observations on farms reveal the importance of existing woody biomass configurations. To neglect this importance would be a serious omission. When contemplating the introduction of new species, intervention choices can only be made following a careful analysis of the role of present woody biomass in the area concerned.

B : THE KAKAMEGA SITUATION

We are stressing the importance of analysing and understanding what is actually happening on the farms: what the farmers are doing with respect to their tree requirements, and how these requirements are traditionally met in different ways in different places. It is from observations about these points that the propositions itemized above have emerged. Within such a perceptual framework we have conducted the surveys that have been described in the three preceding working papers. From the knowledge we have gained it is possible to seek well-adjusted solutions. Before moving towards those solutions it is useful to have a final look at some of the particular situations which exist in Kakamega. In so doing we attempt to combine the different types of information we have gained; in a way that picks up and exemplifies some of the propositions we have made in the previous section. In the previous papers we have drawn attention to EBUSIKHALE, a small sublocation in a very densely populated subregion of Kakamega. We may compare this sublocation with one or two others: KEGOYE and MAYONI.

Ebusikhale is characterised by its small farms, dependence on locally-grown food combined with cash income from outside the sublocation, and a high proportion of land devoted to trees and shrubs. In more detail we can draw attention to the following features, with the aim of narrowing down the choice of possible avenues of intervention.

Ebusikhale is not unique in Kakamega with respect to its small farmsizes. Most of the land in the divisions of Vihiga and Hamisi suffers a similar pressure. As an example we may consider Kegoye, another sublocation visited by the KWDP. It too has small farms; in fact even smaller than in Ebusikhale, and it too relies on remittances from emigrant workers. For both sublocations the farms are simply too small to support a family. Large numbers of men leave these sublocations to search for work in the towns and in other districts. The high percentage of female respondants in these two sublocations to the agroforestry questionnaire illustrates this phenomenon of male migration. From the cultural survey we learn that even if the male head of the family is absent, females are still unable to take major decisions about the management of the shamba. However there are some indications that this division of responsibility is less rigid in Ebusikhale than in other parts of the district. Of particular significance is the presence of Sesbania sesban in the maize fields: a small tree which is managed by the women rather than the men. It is rarely found in Kegoye however, suggesting that even in two areas very close together, and with many similarities there are also some important differences which have a bearing on potential intervention choices. In Ebusikhale there already

exists a practice of growing fuelwood trees within agricultural crops. It might be possible to work on this existing practice and seek to modify it in a way that promises greater returns in terms of woodfuel. In Kegoye by contrast there is no such commonly-accepted practice, and a similar type of intervention may not be so fruitful. Thus we find a clear example of the need to base intervention on what is actually happening in the farms. In fact in Kegoye the women expressed an interest in more efficient ways of utilising what limited woodfuel already exists, rather than in augmenting the supply. Kegoye is different in other respects too. There are fewer hedges, for reasons we do not yet know, but if there is no general resistance to the idea of hedges it may be possible to think in terms of hedge-based woodfuel strategies, rather than moving directly to classic agroforestry ideas such as alley-cropping.

Of course we should take into account that potential solutions must also recognise the resistance of men to the idea of women planting trees for fuelwood. For this reason it will not be possible to judge the merits of possible solutions purely on technical grounds. In Ebusikhale, particularly where church influence is felt, and where the farming family is young, there is a greater flexibility with respect to the roles of men and women on the farm. On the other hand in MURHANDA , another sublocation in Kakamega, traditional values are still rigidly adhered to. An intervention which assumes a major contribution on the part of women may succeed in Ebusikhale, but is unlikely to in Murhanda. Technical solutions are still conditioned by the fact that it is only the men who plant and manage trees while it is only the women who are concerned with woodfuel. In Kegoye we see an abundance of Eucalyptus woodlots, occupying 8.5 percent of the land, and in some parts of its neighbouring areas even as much as 17 percent. Yet these woodlots do not seem to play a major role in woodfuel provision. The cultural survey has shown us that the women of Kegoye recognise that these woodlots are beyond their reach (although of course branchwood and trimmings will be available to them).

In another part of the district: the core sugar zone, the KWDP has selected MAYONI as a characteristic sublocation. We find there a completely different pattern to landuse and the rural economy. Farmsizes are large, with an overwhelming concentration on sugarcane cultivation. Field sizes are large, but because of the semi-mechanised nature of cane farming in the area, contain very few trees. Again because of the large fields, hedges are relatively few. It appears that locally-gathered woodfuel comes from the few remaining areas of natural bush and riparian woodland, but these are disappearing rapidly, and we note from the agroforestry survey that a significant number of households are purchasing charcoal and split wood. The suggestion of intercropping with something like Sesbania sesban would be totally inappropriate in this sublocation, but it might be possible to develop ideas about double or triple-width hedges stocked with quick-growing woodfuel shrubs. The cultural survey suggests that the fuelwood problem in Mayoni is a recent one, coincident with the spread of sugarcane cultivation in the last 10 years. It seems that because it is such a recent phenomenon, the problem is not yet adequately recognised, and a programme with an "awareness" component might be particularly useful in this situation.

In each of the three sublocations: EBUSIKHALE, KEGOYE and MAYONI, different conditions demand different solutions. Before proceeding further with the discussion, it is useful to examine in more detail some of the salient features of these three areas, particularly within the framework of the propositions specified in the previous section. Figure 1 shows the general landuse pattern, and table I gives a detailed breakdown of the nature of the existing woody biomass.

FIGURE 1 : LANDUSE ON A TYPICAL FARM FROM EACH OF THE THREE SUBREGIONS: A1(EBUSIKHALE), A2(KEGOYE), C1(MAYONI)

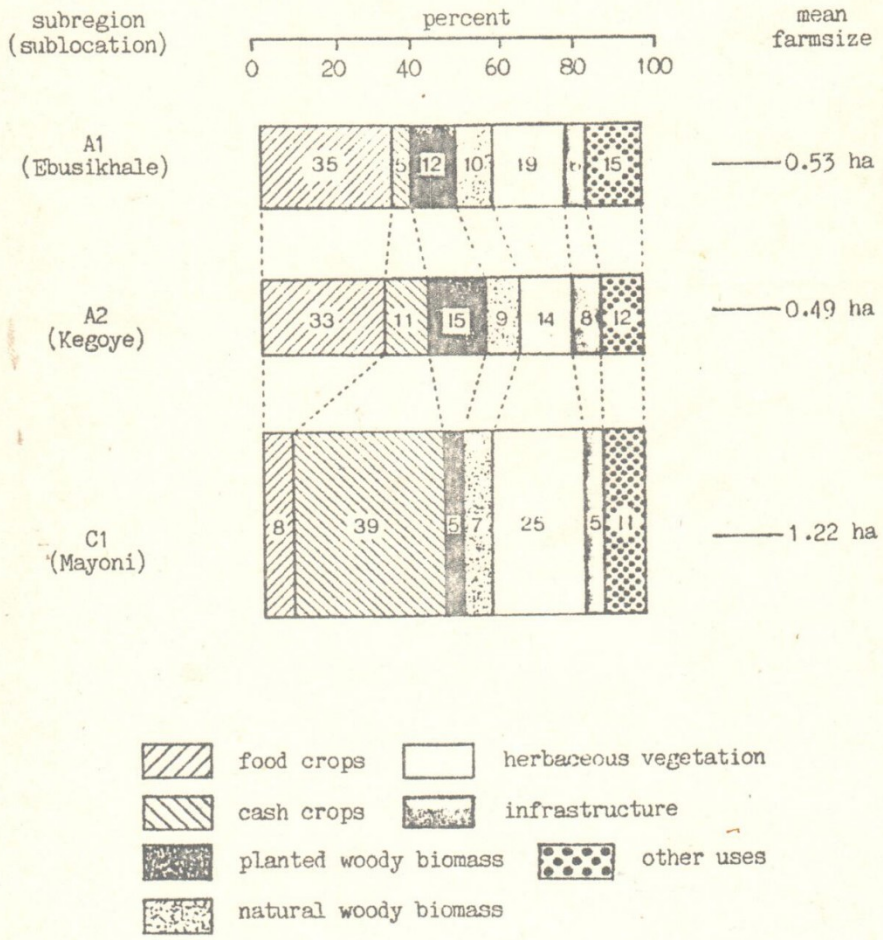


TABLE I : WOODY BIOMASS ELEMENTS OF THREE SUBREGIONS : A1(EBUSIKHALE), A2(KEGOYE), C1(MAYONI)

data in ha/sq.km (= % ground cover)	A1 (EBUSIKHALE)	A2 (KEGOYE)	C1 (MAYONI)
INDIVIDUAL TREES			
trees in agricultural land	1.5	1.7	0.8
trees around homesteads	1.8	1.5	0.4
trees along paths	0.2	0.3	0.7
subtotal	3.5	3.4	1.3
PLANTED STANDS			
hedge	4.1	2.0	1.3
woodlot	2.9	8.5	1.4
windrow	1.2	1.5	1.1
subtotal	8.2	12.0	3.9
NATURAL VEGETATION			
bush	6.2	6.5	3.9
trees in bush	0.4	0.7	0.9
trees in open grassland	1.2	0.2	0.6
riparian woodland	1.7	1.0	1.5
subtotal	9.5	8.5	6.9
total	21.1	23.8	12.0

C : DEVELOPMENT OPTIONS

INTRODUCTION

The preceding working papers, especially the positions adopted under section A of this paper, have formed the basis for an internal seminar of the full KWDP team, with the goal of establishing development options for the future. The suggestions which follow are thus the result of deliberations of the full team.

These suggestions are by no means complete. We are constantly searching for new ideas, and new means to implement them. So far we have arrived at the following position, a position which has emerged from consideration of the issues that have been raised in the first section of this paper. These principals have evolved during the short life span of the KWDP. The thinking of the team is constantly guided by the need to keep in touch with farmers, with what already exists on the ground, and with what is already going on in terms of woody biomass management.

Three broad issues face us in the immediate future and beyond. The first is that of production: the development of fuelwood production activities on the farms of Kakamega. Of course it is concerned with technical matters, but not in isolation. We have seen from the cultural survey, and from our initial work on a limited number of farms, that a basic problem is the indifference of men as far as fuelwood is concerned, coupled with the fact that with one or two minor exceptions women are not permitted to take an active part in growing trees. As a consequence a second issue arises; that of attempting to resolve this dilemma. The KWDP sees a fundamental need to develop an awareness programme, through which the concept of growing fuelwood specifically for that purpose is promoted. A third issue is concerned with organisational and man-power development. The KWDP has to look to the future, a future in which the knowledge and expertise which has been gained can be made available to the broader group of institutions actively concerned with fuelwood.

PRODUCTION

The land area presently covered by woody biomass on farms in Kakamega is considerable, but the land area specifically used for fuelwood production is very limited. The option therefore is to concentrate more explicitly on fuelwood production on farms: to make use of the accepted fact of a high woody biomass cover in a more direct manner.

The great variety of existing woody biomass patterns that we have observed are good starting points for future interventions. Some practices could be usefully transferred from an area where they exist to other areas where they are not currently in use. Other configurations or practices might be improved with minor modifications, while renewal or replacement strategies will gain in effectiveness with small technical improvements.

In Ebusikhale we have seen the example of Sesbania sesban incorporated into the farm production system, as an intercrop in maize fields, and as a "fertilizer" (and ultimately fuelwood supply) on fallow land. This is an example which might be transferable to other areas under similar conditions. But what are these circumstances? Why in Ebusikhale, but apparently not in Kegoye - an area with many similarities in overall agricultural conditions?

Elsewhere we have seen "open" hedges, where intervening shrubs and trees would seem to have disappeared. Can such hedges be infilled with fast growing fuelwood species like Mimosa scabrella, Calliandra calothyrsus or Leucaena leucocephala. Alternatively should existing species such as Lantana camara be replaced altogether with more productive fuelwood species.

Suitable improvements to the many nurseries which already exist on farms could make a significant difference to production activities, particularly with respect to the introduction and deliberate cultivation of fuelwood species. What seem to be required are simple things: seed that is easily germinated, seedlings that grow well on minimal nursery inputs and yet show high survival rates on outplanting. Small inputs such as these can make a significant contribution. In addition we have begun to put into practice the idea of seed production units (small plots of densely-planted, quick-growing fuelwood species). These plots have the dual function of providing locally-available seed in a very short period of time, and serving as an extension and demonstration aid.

AWARENESS

At a general level, the KWDP has noted a trend whereby when women find the fuelwood supply inadequate, they pass directly from collection to purchase on the market. There seems to be very little acceptance of the idea of deliberately producing fuelwood once the pre-existing "natural" supplies have become inadequate. At least in part we have seen the reason for this: men do not recognise the need to plan for fuelwood supply - their tree-growing activities are geared towards other objectives - and with minor exceptions women are not allowed to cultivate trees at all. Even if women appreciate the need to provide for the future, they have little authority to do anything about it. The general principal of an awareness programme is therefore to make the family in toto recognise the need to plan for the future, and to engage in fuelwood production as a deliberate activity.

The first intervention phase concentrated on a limited number of individual households in order to learn more of the knowledge and experience of farmers, but ultimately an awareness programme cannot be conducted at the level of individual households. To broaden its outlook the KWDP needs to develop a mass approach to such an awareness programme, but a full and effective awareness programme will take some time to design and put into practice. Therefore in the short term we have observed that in our initial intervention, dealing with a limited number of individual farms, neighbours and passers-by have shown an interest, and a request for assistance. The audience quickly expands from a single individual to a small number of individuals. Therefore as a first input to an awareness programme, and as a means of learning the most effective way to design and present it, it would seem logical to work with a number of farmers as a group, rather than to merely enlarge on the number of individual farms we are presently concerned with. One immediate question which emerges from this approach is what should be the criteria for the selection of these farmers?

Social Experiment

More specifically we see the next six months as a period in which we can focus on a limited number of such groups, coupling minimal technical assistance with an awareness component. Initially this might take the form of pre-structured and pre-designed group discussions. These discussions would seek to use the specific technical interventions which have been purposefully designed with the farmers as a means of broadening the debate; in terms of discovering what prompted their interest, what their reaction to specific fuelwood species is, and more generally, how they react to the suggestion of the need to provide fuelwood for the future. As both a technical input and an extension aid, the seed production plots can play a significant role in this respect. They clearly illustrate the benefits to be gained from an integrated approach, whereby specific inputs have multiple functions. In doing all this the KWDP can sharpen its approach to the awareness issue, noting what items in a discussion promote interest, what forms of presentation are most effective, and monitoring the general effect of awareness activities on what we have seen as a major constraint: the respective roles of men and women in the management of household resources.

ORGANISATION

The KWDP has from the start adopted the general principal that progress can be best achieved by trying to assess the situation from the farmer's point of view; by, as it were, looking through his eyes. Such a "bottom up" approach requires a specific commitment. A deliberate policy such as this is ultimately reflected in the technical options the KWDP proposes. In this issue we are seeking to avoid a "top down" approach, and it is logical therefore that related organisational structures should also follow this guiding principal.

In following this line, earlier statements on the need to consolidate a broad outlook also relate to organisation and man-power development: cultural factors, the socio-economic base, the total picture of land use, the integration of tree-growing activities within an agricultural economy should all be reflected in the way the organisation develops. We require a structure and a level of expertise which allows us to monitor our activities and to modify them in the light of the response of farmers to our suggestions. The KWDP has to review its activities in the light of changes that may unfold, particularly with respect to the production blockage based on the respective roles of men and women in the household. The KWDP intends to strengthen its links with farmers by training and learning from village energy workers, whose roots are firmly based within the rural communities they serve.

At the practical level we anticipate the development of strong and continuing links with a number of groups of farmers. A village energy worker will oversee and monitor the technical inputs that are developed with the farmers. An extension worker will co-ordinate the activities of several village energy workers and their groups. Whilst the focus is on production, the village energy workers and extensionists will develop their monitoring skills, their abilities to generate discussions and offer advice. Of course the extension workers will take on a major role in supervising the village energy workers, and in becoming directly involved with the farmers in order to assess their responses, but what should be the specific role of the village energy worker - merely as a final, structural link with the farmer, or as a trainee in more substantive issues? Should they adopt a passive role, or should they develop into local catalysts? Whatever the ultimate choice should be, all of these activities will also serve two other functions: to learn from the experience in such a way that that future extension choices can be properly addressed, and to re-inforce the "broad" outlook which goes beyond the concrete focus of technical inputs.

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 6

THE AGROFORESTRY SURVEY IN KAKAMEGA DISTRICT

Final Report

Berry van Gelder KWDP/ETC Foundation
Paul Kerkhof KWDP/ETC Foundation

Nairobi, May 1985

P. O. Box 56212, Nairobi, tel. 582004/582916

KENYA WOODFUEL DEVELOPMENT PROGRAMME

WORKING PAPER
NO. 6

THE AGROFORESTRY SURVEY IN KAKAMEGA DISTRICT

Final Report

Berry van Gelder KWDP/ETC Foundation
Paul Kerkhof KWDP/ETC Foundation

Nairobi, May 1985

P. O. Box 56212, Nairobi, tel. 582004/582916

Table of Contents

Annexes

Annex NO.

I.	Main subjects of the KWDP agroforestry questionnaire in 1984.
II.	Selected land-use elements of 11 sub-regions of Kakamega. (KWDP Working Paper NO. 2, Bradley, P., 1984).
III.	List of exotic and local tree species, fruit trees and shrub species found on the farms in Kakamega District.
IV.	Numbers of seedlings raised in the Kakamega District.
V.	Seven tables forming the background for the description of the "neighbourhood effect".
VI.	KWDP Terminology.
VII.	Fuelwood - self-sufficiency index.
VIII.	Nursery pattern in seven sub-locations of Kakamega District in 1983.

Summary and Conclusions

The Kenya Woodfuel Development Programme operates essentially at the level of the district. The approach of the work is holistic and is characterized by its step-wise evolving nature. The anticipated activities within a district have been divided into five steps and as part of the first step, the District Resource Analysis (DRA) and the Agroforestry Survey (AFS) were executed in April/May 1984 in Kakamega District.

The survey was conducted in seven sub-locations located in zones previously determined by DRA guidelines. Within each sub-location local enumerators were selected to interview about 25 farmers in their direct surroundings. In total, 528 farmers were surveyed.

The main subjects of interest were the present woody biomass situation on the farm, the activities undertaken by farmers to try to maintain present woody biomass and the present fuelwood supply situation within the households. Socio-economic data was not included due to the fact that it would be covered by the DRA and a separate Cultural Survey (CS).

To describe the present woody biomass, a farm was divided into five major components -- trees around the house, hedge rows, trees within agricultural fields, woodlots and bush. For each farm records were made of how many components were present, and which major tree species occurred within each component.

Present activities are described by presenting the percentages of farmers involved. Five major activities were defined -- raising seedlings, buying seedlings, obtaining seedlings free of charge, collecting wildlings and direct seeding. A combination of different activities is expressed in the percentage of farmers planting or seeding trees in 1983.

For each activity records were taken of which tree species farmers were using, where seed or seedlings originated, and in which component of the farm the trees were planted. For each relevant question records were taken of whether male or female was involved, in order to determine the role of the man and woman within the woody biomass production.

Fuelwood scarcity was expressed via a self-sufficiency index, a value calculated on the basis of the number of farmers using only fuelwood for cooking and of those, how many were obtaining fuelwood from the non-market sector. The results were very spectacular. Trees around the house, hedge rows and trees in agricultural fields are to be found on virtually all farms; woodlots (64%) and bush (45%) to a lesser extent. Local tree species are most frequently found among the trees around the house, shrubs in hedges. Local species are dominant among trees in agricultural fields, and exotic tree species in

woodlots, while local species are mostly found in the bush.

The different agroforestry components on the farm are to a great extent created by the farmers. Looking at the percentage of farmers involved (mainly men) in the different activities: raising seedlings (43%), buying seedlings (51%), getting seedlings free of charge (28%), collecting wildlings (53%) or direct seeding (30%) are all well known activities among farmers. About 79% of all households planted trees and/or directly seeded trees on their land in 1983.

The total number of nurseries raising mostly exotic tree species is estimated to be 100,000 producing about 63 million seedlings. Both figures are very crude and should be seen as a rough estimation of the potential production of seedlings within small farm nurseries against the set-up of large central nurseries.

Farmers do buy seedlings (mostly exotic), and the most common place is the local markets (66%) where vendors sell small packages of naked-root seedlings.

Even if seedlings are distributed free of charge (mostly exotic) within the district the majority of the seedlings come from neighbours (49%).

Collecting wildlings is mostly restricted to local species and/or fruit trees. The activity turned out to be the most frequently-mentioned one among the farmers.

Also direct seeding is used by farmers to multiply the woody biomass on the farm. Both of the previously mentioned activities have been primarily undertaken by farmers, and until now, very much underestimated by government agencies or aid organizations.

Seedlings are raised in small farm nurseries following the naked-root system for outplanting. Also the wildlings are transplanted by naked roots and the majority of the trees bought on the market are packed in mud and banana leaves which will only give protection against dehydration for a short while. It simply means that the production of seedlings and planting out is limited to local areas. Within such a system, local techniques and habits develop easily, even creating totally different systems within short distances in the district. This neighbourhood restriction is probably one of the reasons responsible for the differences between the sub-locations in the district. For example, Kegoye is characterized by a high degree of activities undertaken by the farmers themselves. That is to say, they raise or collect the seedlings for outplanting, while in Ebusikhale (only 20 kms. apart) farmers are more used

to buying seedlings on the market or directly seeding Sesbania sesban (up to 44% women) on their farms.

Also in Chekalini and Mayoni, farmers tend to buy more seedlings than they produce, while Eshianda, Lukume and Muranda, farmers are more used to collect wildings, particularly local species and fruit trees.

The existence of woody biomass on the farm is obvious and also the activities as such show a high degree of involvement of the farmers in the production of the woody biomass on the farms. However, the impact of these tree activities on the fuelwood supply is very limited.

Men are mostly involved in seedling production and planting activities, while the women are responsible for the procurement of fuelwood. Men produce woody biomass, but mostly trees for poles, timber or fruit. Trees for fuelwood only are not common in the district and the women are only allowed to collect fuelwood from the natural woody biomass, a source definitely decreasing in the densely and very densely populated areas.

The shortage of fuelwood has been expressed in the fuelwood self-sufficiency index; landholding smaller than 1 ha have severe shortages, between 1 and 2 ha a shortage, and above 2 ha are still self sufficient in fuelwood.

Kegoye and Ebusikhale do have a severe shortage in fuelwood. In Eshianda and Murhanda a shortage occurs while Mayoni, Lukume and Chekalini have still sufficient amounts although probably substitution of fuelwood by sugar cane or maize stalks takes place.

The AFS presents a clear picture of the present situation in the District. It provides information on what farmers are doing, but it does not give the incentives behind the different activities.

Together with the information of the DRA and CS sub-location profiles can be made to be used as guidelines for the possible future interventions.

Cultural values dictate the role of men and women within the woody biomass production, but shortages as presently occuring in Kegoye and Ebusikhale are already changing these values to a certain extent. The role of women within these activities is increasing in those areas.

Trees play a role in land demarcation and ownership within the district and only men have title deeds. They therefore plant the trees. A sudden change towards an increase of the role of the woman within the tree-planting activities is therefore not to be expected.

Most of these values as described above have to be investigated further in the later stages of the project. The most important function the AFS has had so far is to reveal the spectacular involvement of farmers in the production of woody biomass on their own farms. Farmers not only know how to raise trees but also how to plant them in great quantities on their farms.

This involvement of farmers becomes even more meaningful if KWDP is able to incorporate their knowledge and working habits in the methodologies which have to be developed to increase the woodfuel production within the district in the future.

1. KWDP

The Kenya Woodfuel Development Programme has been assigned to look into the potentials and constraints of substantially increasing woodfuel production in Kenya and, on the basis of its findings, to develop pragmatic woodfuel supply strategies.

The Kenya Woodfuel Development Programme operates essentially at the level of the district (in line with the district focus for rural development of the Government of Kenya). The approach of the work is holistic and characterized by its step-wise, evolving nature. The anticipated activities within a district have been divided into five steps:

(1) District Resource Analysis

(2) Formulation and testing of technical options and extension methods

(3) Formulation and testing of manpower, organizational and logistic requirements for a Woodfuel Development Project at a district-wide scale

(4) Training and manpower development within existing government and non-government organizations in the district

(5) Rendering technical advice, monitoring the effects of the Woodfuel District Development Project.

In the first step (DRA) the district's natural and human resources are thoroughly studied. District-level information, derived from aerial photographs, is combined with documentary information on population, soils, rainfall, land ownership, etc. The analysis of this information yields a detailed "map" of the district, on the basis of which intra-district differences can be determined, critical areas with respect to woodfuel deficit, and of related aspects such as soil conservation, can be delineated. The specified areas within the district can be described in detail on the basis of this information.

Specific household information is collected through field based investigations to establish the existence of ongoing agroforestry practices, the utility and consumption of available woody biomass (Agroforestry Survey (AFS) and the socio-economic forces within the household which mediate domestic production and the utilization of woodfuel (Cultural Survey (CS).

This report deals with step 1 and concentrates on the presentation of the agroforestry activities as presently found in the district of Kakamega. This pilot area of KWDP was surveyed in April/May 1984 and on the basis of the combined results of the preparatory surveys (DRA, AFS and CS) carried out in Phase I, technical options and extension strategies/methods will be designed and tested in cooperation with selected farmers in Phase II (step 2).

The agroforestry survey has been focussed on the present knowledge of farmers on tree growing within the rural household. Preliminary investigations showed much activities by farmers and the objective of the survey was to quantify as much as possible their knowledge on trees and present tree production in connection with woodfuel supply.

The survey shows a high degree of involvement of farmers in tree-growing. Indeed their knowledge has been very much underplayed and underestimated, but in order to develop a useful strategy towards a sustained woodfuel supply, additional field work should be undertaken to determine the major incentives for tree planting. The report therefore presents also an example of how to use the survey information in step 2 of the programme.

To address farmers on their own knowledge on tree growing means the development of a flexible approach. Often unexpected information is provided, for example, farm nurseries are established when the rains are starting, while foresters produce the seedlings during the dry season in order to start planting during the first rains.

The questions in the survey, therefore, had to be frequently adjusted in the beginning to cope with the incoming information and to formulate a relevant questionnaire. Nevertheless, some subjects were not very well covered (collecting wildlings) or were even overlooked (cuttings).

KWDP will soon start similar projects in other districts and with the experiences gained in Kakamega a more appropriate survey can be set up to achieve, in the long run, the main objective to develop a methodology to inventorize and quantify the ongoing tree-growing activities of the farmers.

Earlier reporting on the results might differ from the figures in this report. Re-interpretation and adjustment of the figures will in fact constantly change during work of this nature. It is important, however, to see the figures as a representation of certain trends previously underplayed and underestimated.

2. Survey Methodology

2.1 Setting

The District Resource Analysis provided the information in which areas the survey should take place. Seven sub-locations were chosen representing the major zones in which the district was divided (see Figure 1). For an overview and more details on the zoning, see Annex II.

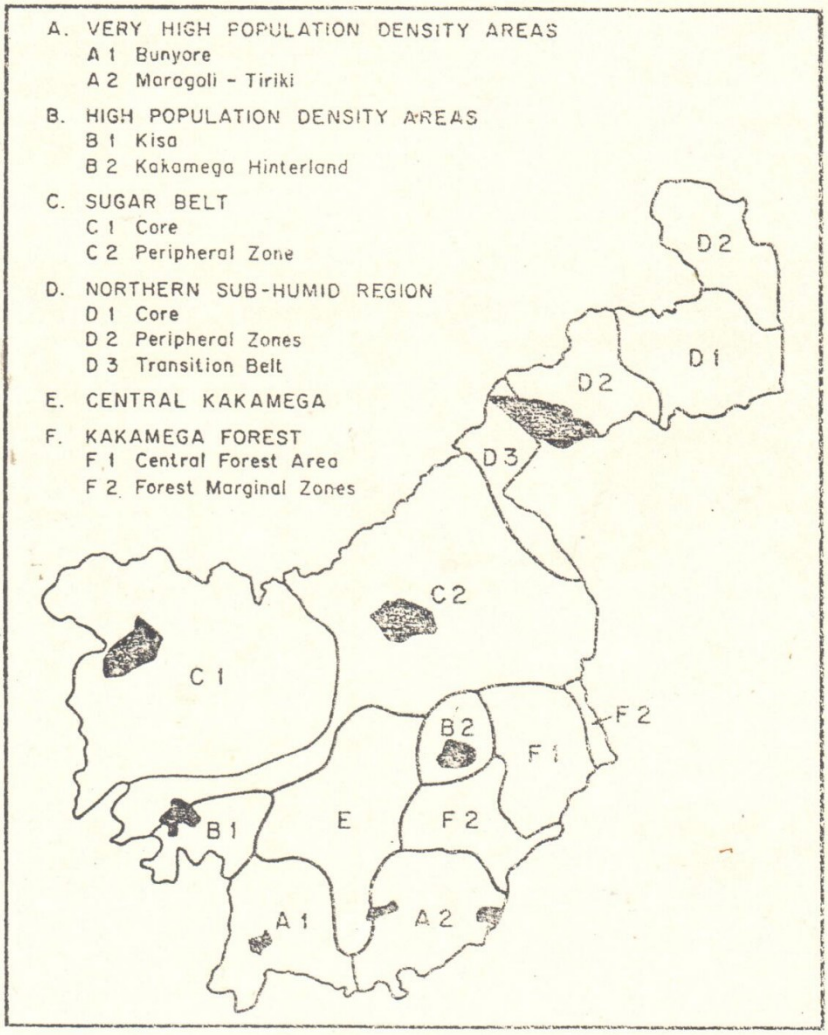
The seven sub-locations are:

Ebusikhale	Zone A1	Very high population density
Kegoye	Zone A2	Very high population density
Eshianda	Zone B1	High population density
Murhanda	Zone B2	High population density
Mayoni	Zone C1	Core sugar belt
Lukume	Zone C2	Peripheral sugar zone
Chekalini	Zone D2	Peripheral sugar zone

To inform the farmers about the survey, the Administration in Kakamega was briefed and asked to undertake the necessary steps. Assistant Chiefs were asked to assist in the selection of local people who could serve as enumerators.

The requirements for enumerators were set at an age between 20-30 years, must have passed Form IV and residing in village areas pre-selected by KWDP staff. Half of the total group of candidates should be male, the other half female, and all respected in his/her neighbourhood. Final selection and training was undertaken by the KWDP staff.

Figure 1. The 11 sub-regions of Kakamega District according to the District Resource Analysis.



The knowledge of the local language and the trust farmers would have in their own people were considered to be the advantages. Also the fact that KWDP would continue to work in the areas over a long period of time and therefore to have local staff in the long run was an important criteria to opt for this system.

The training took much longer than anticipated and soon it became clear that "why questions" should be kept to a minimum. Only straight forward yes/no questions and observations were possible to be incorporated in the survey.

In total 35 people were trained and employed throughout the seven sub-locations in a progressive manner whereby later on earlier-trained enumerators were involved in the training of new people as the programme proceeded to the other sub-locations. Finally, a selected number of enumerators were asked to assist in the collation of the data and presently 10 are working in their own areas as KWDP Village Energy Workers (VEWs).

What Training materials are there?

The sub-locations were assumed to be one homogeneous unit in which a vested sample was taken. Around the house or within a nearby village of an enumerator, 25 farmers were selected to take part in the survey. A total of 528 farmers were interviewed.

Table 1. Number of farmers interviewed in the seven sub-locations.

Sub-location		Number of Farmers
Kegoye	(Ke)	60
Ebusikhale	(Eb)	90
Eshianda	(Es)	54
Murhanda	(Mu)	60
Mayoni	(Ma)	60
Lukume	(Lu)	138
Chekalini	(Ch)	66
	Total	528

The analysis was computerized to comply with the large sample of 528 respondants. Data processing was carried out by the University of Nairobi, Institute of Computer Science, by means of a standard statistical programme (SPSS).

2.2 Main Subjects

The survey included a few socio-economic aspects, agro-forestry configuration, agroforestry activities and fuelwood supply on the farms. A list of terminology used within KWDP is attached as Annex VI.

Socio-economic Aspects

The questions were kept to a minimum as much of this information would be obtained by the District Resource Analysis and Cultural Survey. Reporting on this specific subject will be done in a separate working paper later on.

Agroforestry Configuration

This subject concentrates on what is actually present on the farm in terms of agroforestry components and species growing within these components. The configuration is the overall picture of the farms. Observation in the field revealed clearly that farmers had specific preferences for certain tree species to grow in different parts (components) of the farm.

The survey was limited to the recording of the existence of those components. Quantitative information is lacking, but will be provided in later surveys when adjustments to the DRA and AFS have been made.

The species found within the components were later on regrouped in four main classes in order to make a comparison more useful.

Agroforestry Activities

In particular, the tree production activities were of interest and five different forms were distinguished:

- raising of seedling
- buying seedling
- obtaining seedlings free of charge
- collecting wildlings
- direct seeding of trees.

The tree species raised, bought, obtained free of charge, collected as wildlings or directly seeded were recorded and later on regrouped for easier comparison.

Most trees are produced and planted by naked-root systems, restricting the production of seedlings to a limited area. Special consideration was given to this phenomenon and presented in the form of the "neighbourhood effect". The

preference for certain planting sites was also recorded. To determine the level of involvement of women in the overall production of trees, questions on who undertook the activity, male or female, were added.

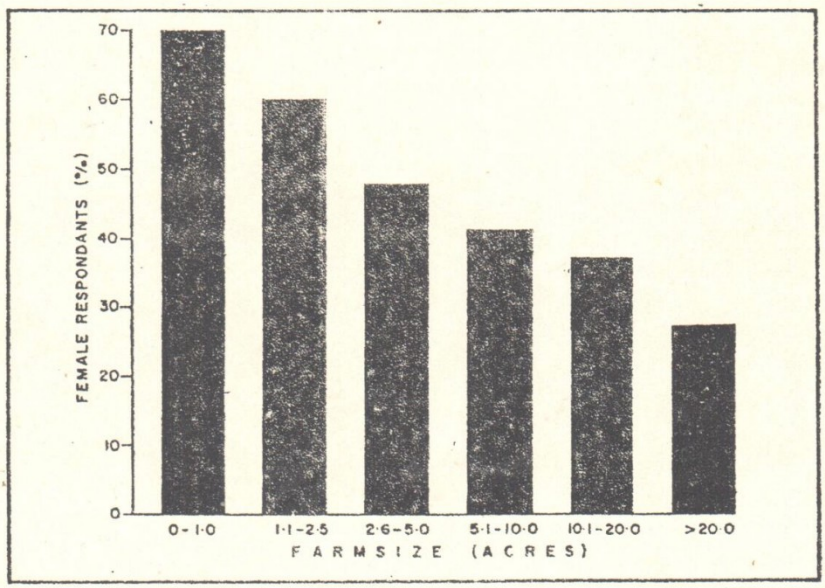
Fuelwood Supply on Farms

Actual consumption figures and questions on who was responsible for the procurement of woodfuel on the farm were not included. A consumption survey would follow later and the role of the woman in the woodfuel procurement would be covered by the Cultural Survey. The fuelwood supply concentrated on what farmers were using as energy for cooking and if fuelwood, how they were obtaining the fuelwood.

3. District Results

About half of the 528 respondants in the survey were women. Particularly, on the smaller farms (see Figure 2) only women were present while their husbands were elsewhere. On small farms the dominant crops were food crops and bananas while the larger farms showed more cash crops such as coffee, tea, sugar and maize.

Figure 2. Female respondants in relation to farm size.



3.1 Agroforestry Configuration

Visual observations of Kakamega District show a complex configuration of trees on the farms. In order to analyze this, a system of different agroforestry components together describing the configuration was developed, whereby the components were defined as:

(1) Trees around the house, including fruit trees and shrubs

(2) Hedge rows, up to double rows of trees and shrubs

(3) Trees in agricultural land (crop land), shamba in the sense of intercropping

(4) Woodlots or group of trees of at least 20 in number

(5) Bush, generally the remaining woody biomass.

Figure 3 shows an example of the different components of a given farm.

Figure 3. Agroforestry configuration, an example of the five different components on a given farm.

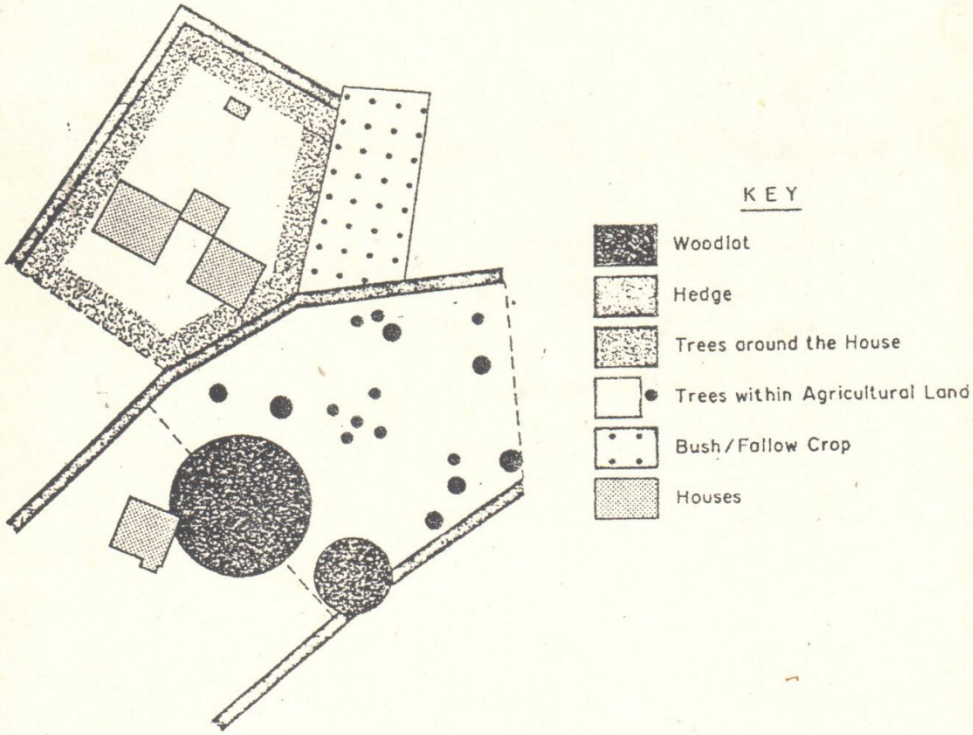
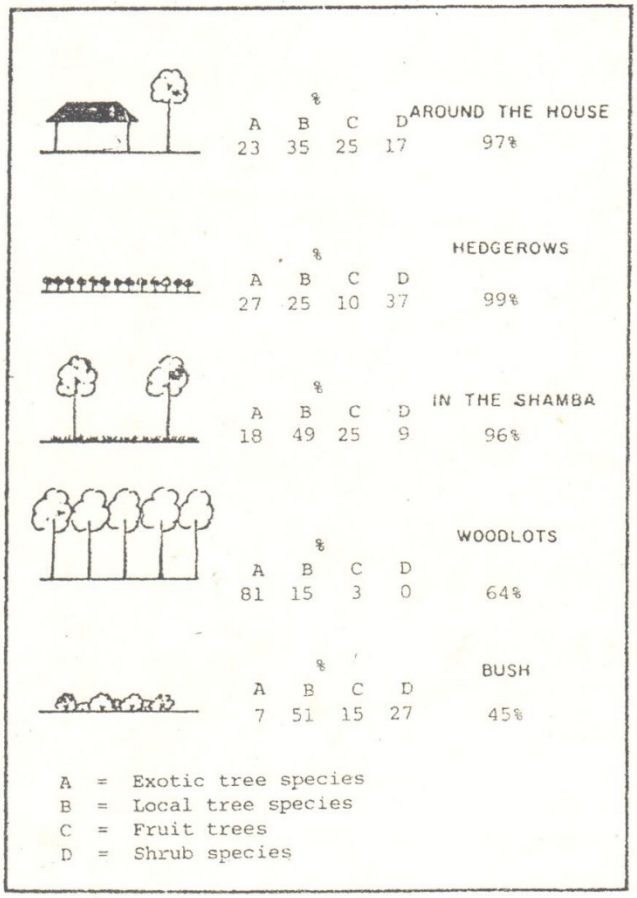


Figure 4. Agroforestry configuration, the average distribution of the components and tree species on the farms in the district expressed in percentages.



The percentages of farms having their own woody biomass components is presented in Figure 4. Trees around the house, hedge rows and trees in agricultural fields are to be found on virtually all farms; woodlots and bushes

to a lesser extent. About 64% of all farms independant of farm size have a woodlot, while 45% of all farms (particularly the larger landholdings) have a bush component. (See also Table 8.)

The distribution of tree species is also presented in figure 4, classified in four main groups (A = exotics, B = local species, C = fruit trees and D = shrubs). Local species are most frequently found among the trees around the house, shrubs in hedges, local species are dominant in agricultural fields and exotic tree species, particularly eucalyptus, are dominant in woodlots, while local species are mostly found in the bush.

3.2 Agroforestry Activities

The different agroforestry components are to a great extent determined by the farmers themselves, judging from the percentages of farmers (mainly men) involved in the different activities. The figures are presented in Table 2 and about 79% of all households planted trees and/or directly seeded trees on their land during 1983.

Table 2. Agroforestry activities. Overview of the different activities of the farmers and the tree species used in the district, expressed in percentages.

		Tree Species Used in %		
	%	A	B	C
Raising seedlings	43	85	7	8
Buying seedlings	51	93	4	2
Getting seedlings free	28	90	6	3
Collecting wildlings	53	9	52	39
Direct seeding	30	47	25	28
Planting or directly seeding trees in 1983	79			

A = Exotic tree species
B = Local tree species
C = Fruit trees

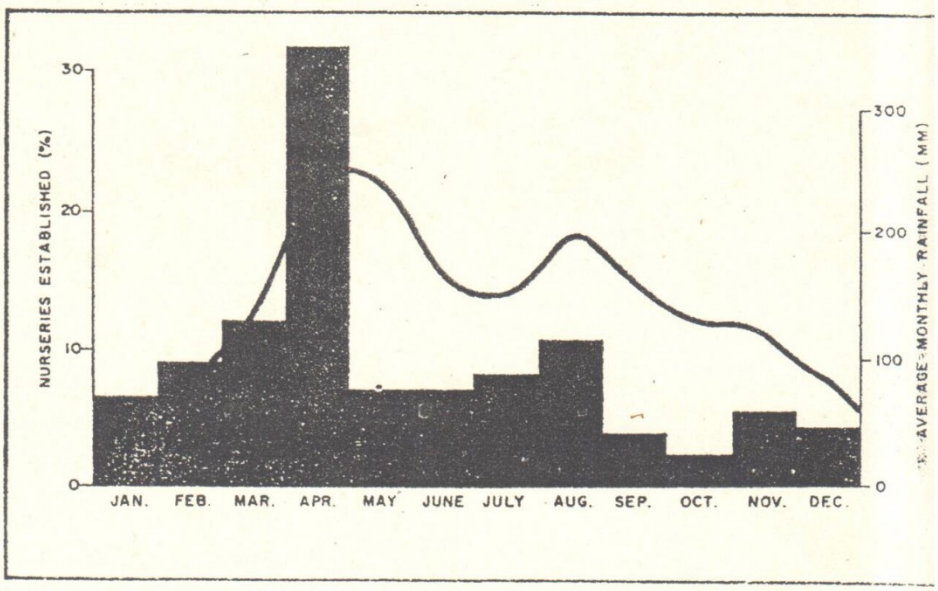
Nurseries

The number of small farm nurseries (varying from tin cans full of seedlings to nurseries of 3 m^2) is very impressive. About 43% of the households established a nursery, with a preference for exotic species (83%). (See Table 3.)

Nursery production is predominantly men's work. The nursery techniques practiced by the farmers differ substantially from standard practices, and even within those techniques, great differences occur. Even so, some general characteristics can be given of the nurseries in the survey.

Farmers usually start their nurseries at the beginning of the rainy season, although the general forestry practice is that seedlings should be ready for planting out during the first rains (see Figure 5).

Figure 5. Agroforestry activities, the initiation of farm nurseries in 1983 and the rainfall pattern in the district.



Containers are hardly used; even local pots such as milk cartons or banana fibre pots play an insignificant role. Site selection of the nursery is largely a local custom, and it varies from zone to zone. The sites include old wash basins (7%), site of a previous old hut (7%), site of former charcoal production place (10%), among bananas (22%) or a specifically well-prepared place (54%). The district averages presented disguise the large zonal differences. Why these exist cannot be explained.

The total number of nurseries is estimated to be 100,000 (with an estimated seedling production of 63 million). Both these figures are very crude estimations and should be seen as an indication of the activities which are very well-known among farmers and offers an enormous potential for wood production on the farms. More detailed information is provided in Annex IV.

How do you reach this figure?

Buying

Farmers buy seedlings (mainly exotics, 90%, see table 3) not only from government nurseries (21%) but also on local markets or in the immediate neighbourhood. In fact most farmers buy within their direct surroundings (66%, Table 4) and several examples were found of vendors selling seedlings on the market which they had produced on their own land, varying from 0.5 to 1.0 Shs. for exotics up to a few shillings for fruit trees. Luanda market is a good example and their outreach goes far beyond Kakamega district! Some are in plastic pots, but the majority are packed in banana leaves and mud and kept very wet.

Free of Charge

Again, not only the government (23%) but also farmers provide seedlings free of charge. Around 45% (Table 4) of farmers mentioned that they received seedlings free of charge from their neighbours.

Collecting of Wildlings

Collecting wildlings (59% local species) and direct seeding (47% exotic) are typically only farmers activities. Collecting wildlings turned out to be the most frequently mentioned one among farmers. Most farmers collected these trees not on their own farm (only 34%), but from other sources which could not be determined (See Annex V, Table 6).

Direct Seeding

The district average for direct seeding is low in comparison to collecting wildings (53%), but in some sub-locations

(Mayoni and Ebusikhale) the percentage is about the same. Both activities are well known by farmers but so far unacknowledged by the government and other agencies.

Activities and Tree Species

An overview of the tree species involved in the different agroforestry activities in the district is presented in Table 2. Tree species raised in nurseries are mostly exotics, and the influence of the forestry department over the last decades might account for this pattern. In the collection of wildlings local species (52%) and fruit trees (39%) are prefered. Direct seeding of trees is usually done with exotic species such as black wattle (Acacia mearnsii) -- even eucalyptus, or Cassia siamea. However, local species (mainly Sesbania sesban) are used in some parts of the district.

Neighbourhood Effect

The tree production activities are very much locally determined. In order to indicate how much they depend on the locally available resources to produce and plant trees, Table 3 has been composed. It indicates the degree of dependance on the immediate surroundings in terms of trees. For each of the five activities the dependancy on their neighbours, local market or their own shamba has been calculated and provides an overview which was called the "neighbourhood effect".

Table 3. Agroforestry activities. The "Neighbourhood Effect" for the district expressed in percentage of farmers involved.

	Seed for farm nursery (o.s.+n.b.)	Nursery knowledge learned by experience or family member	Seedlings raised for own consumption	Buying seedlings (l.m+n.b.)	Free of charge (n.b.)	Collecting wildlings (o.s.)	Seed for direct seeding (o.s.+n.b.)
District Average.	89	77	60	66	49	34	68

o.s. = own shamba
n.b. = neighbour
l.m. = local market

Most of the seed (89%) for nurseries is obtained from the farm or a neighbour's. Sixty percent of the seedlings are produced for self consumption, while the nursery technique (77%) is learned by own experiences, from other family members or from other people in the direct surroundings. About 66% of the farmers bought seedlings from their neighbours or on the local market. Only 34% collected wildlings on their own shamba, while 68% obtained the seed for directly seeding trees from their own shamba or from the neighbours. The "neighbourhood effect" provides important information for possible intervention later on. It shows clearly that the system is local and possibly difficult to penetrate with clear cut general improvements due to the great variation of techniques used by the farmers.

Planting Site

On average, hedge row sites are the preferred place on the farms to plant trees. Table 4 presents the average figures for all the five components in which farmers plant trees. It is important to realize that planting techniques depend very much on the species produced, reflecting knowledge of trees among farmers. Later on when the results per sub-location are discussed, more details will be provided.

Table 4. Agroforestry activities. The preference for planting sites on the farm in the district, expressed in percentages.

	Farm Components				
	A	B	C	D	E
District Average	22	36	18	19	5

A = Trees around the house
B = Hedge rows
C = Trees in agricultural land
D = Woodlots
E = Bush

3.3 Fuelwood Shortage

The AFS shows clearly the high involvement of farmers in the production of trees at present.

Annex II reveals data that the total woody biomass (planted and natural) per sq. km^2 increases due to an increase in the area of planted woody biomass. In areas with a very high population density (Zone A1) the percentages of land covered with tree canopy is as high as 24% while in Zone D1 (large landholdings-lower population density) the figure is only 7%.

Trees are planted by male farmers to demarcate their land and to obtain cash income according to "CS" findings. Most wood is sold as poles or timber on the market, and the impressions are that little planted wood ends up in the kitchen as fuelwood.

The procurement of fuelwood is the responsibility of the women, who, according to cultural traditions, are not allowed to cut planted trees. To a large extent they are therefore dependant on natural woody biomass for fuelwood collection. It is the natural woody biomass, however, which decreases dramatically as population density increases; 3,263 sq. m. per rural household for zone D1 to 525 sq. m. per rural household for Zone A1 (see also Annex II), causing fuelwood shortages despite the efforts of farmers to increase the woody biomass on the farms.

Apparently knowledge of tree growing already exists, but the divergence of responsibilities between men and women on the farms creates fuelwood shortages at the household level. The level of fuelwood shortage is expressed in the self-sufficiency index. The index is an expression of how the fuelwood situation is within the sub-locations or district and is calculated on the basis of two questions from the survey results (see Annex VI). About 80% of farmers use only fuelwood for cooking, while about 70% obtained this from a non-market source (i.e., from their own farm or direct surroundings). Fuelwood is clearly the major source for energy requirements and the index shows the landholdings in which the non-market source is no longer sufficient to cope with the demand for fuelwood at the household level. The assumption is that if farmers using only fuelwood for cooking cannot obtain sufficient fuelwood from the non-market source only, a certain level of scarcity is occuring.

An index value of 100 or above presents a situation in which no shortage of fuelwood occurs; 75 to 100 has a light shortage, 50-70 a clear shortage, and values below 50 indicate a severe shortage. The classification is

arbitrary and lacks all support of quantitative data. Nevertheless, it gives an impression of the present situation and provides at least information for discussions with the farmers during step 2.

Table 5. Fuelwood self-sufficiency. The values for the fuelwood self-sufficiency index in the District.

	Farm size classes in acres					
	0-1	1.1-2.5	2.6-5.0	5.1-10.0	10.0-20	Over 20
District	58	65	85	94	97	100

Table 5 shows that in Kakamega District, on average, landholdings below 1 ha (2.5 acres) have a shortage of fuelwood on landholdings of 1 to 2 ha, a light shortage exists. Above 2 ha, fuelwood is not a scarcity.

4. Sub-location Results

Table 6 presents the distribution of landholding size within the seven sub-locations. The average weighted landholding size varies from 0.6 ha. in Kegoye up to 6.2 ha. in Chekalini. The District average calculated from the survey results is 2.6 ha.

Table 6 also presents the percentage of women respondants per sub-location; Kegoye as high as 73%, Chekalini about 40%. The district average is 50%.

Table 6. Landholding classes distribution within the sub-locations (expressed in percentages), average landholding and percentage of female respondants per sub-location.

Sub Location	Acreage 0-1	1.1-2.5	2.5-5	5.1-10	10.1-20	Over 20	Average Size Landholding (ha)	Female Respondants (%)
Ke	53	37	8	2	0	0	0.6	73
Eb	40	44	14	1	0	0	0.7	67
Es	15	33	39	7	4	2	1.5	39
Mu	3	40	45	12	0	0	1.4	52
Lu	1	6	35	36	13	9	3.3	55
Ma	0	2	27	18	37	17	4.7	28
Ch	0	0	3	6	77	14	6.2	40
						District Average	2.6 ha	51%

4.1 Agroforestry Configuration

The distribution of the different agroforestry components is presented in Table 8. Trees around the house, hedge rows and trees within agricultural land are more or less on every farm to be found independantly from landholding size.

Woodlots are less frequent (below average) in Eshianda and Mayoni, but are equally represented over the land-holding size classes. Bush is virtually absent in Kegoye but present in Ebusikhale, despite the fact that population pressure in both sub-locations is high and the average farm size low, 0.7 ha. A possible explanation is that within Ebusikhale farmers have a so-called planted bush. Sesbania sesban is seeded on fallow land and after 3-5 years, cleared to be used as crop land again. The percentages of farmers having an area of bush on their land decreases if the land size increases, as is clearly shown in the bottom row of Table 7-B; 18% in class 0-1 acre up to 94% in landsize class of over 20 acres.

Table 7. Agroforestry configuration. Presence of agroforestry components on the farm by sub-location and farm size classes, expressed in percentages.

A. Sub-location

	Sub-locations							
Components	Ke	Eb	Es	Mu	Lu	Ma	Ch	D.A.
Trees around the house	95	98	98	98	97	93	99	97
Hedge rows	100	100	100	100	99	98	97	99
Trees in agricultural land	97	98	96	98	95	98	92	96
Woodlots	77	72	56	68	70	42	64	64
Bush	3	46	15	27	79	83	63	45

B. Farmsize classes

	Acreage classes					
Components	0-1	1.1-2.5	2.6-5	5.1-10	10.1-20	Over 20
Trees around the house	94	97	96	99	99	100
Hedge rows	100	100	99	100	98	97
Trees in agricultural land	95	97	95	99	94	100
Woodlots	64	68	62	67	65	74
Bush	18	27	44	76	74	94

The tree species distribution within the different components on the farm within each sub-location is presented in Table 9. The different tree species are classified in four main groups. A = exotic trees. B = local species. C = fruit trees and D = shrubs.

Trees around the house in Kegoye and Ebusikhale are dominated by fruit trees, while in the other five sub-locations, local species are playing the major role. The second most important group of species in Kegoye are shrub species; in Ebusikhale exotics, Eshianda fruit trees, Murhanda shrubs, Lukume and Mayoni less pronounced and Chekalini exotic.

Hedges in Kegoye, Ebusikhale, Eshianda Murhanda and Lukume are dominated by shrub species, while exotics play the major role in Mayoni and Chekalini. The second most important species in Kegoye and Ebusikhale are exotics, in Eshianda, Murhanda, Lukume and Mayoni local species and in Chekalini shrub species.

Trees in agricultural land in Kegoye are dominated by fruit trees and in the other six sub-locations by local species. The second most important species is less pronounced within this component.

Woodlots in all sub-locations are dominated by exotics (mostly eucalyptus). It is interesting to note the high percentage of local species in woodlots in Murhanda.

Bush in all sub-locations is dominated by local species, except for Ebusikhale where fruit trees play the major role.

Each component can be described with one more or less dominant tree species group. Woodlots have mainly exotics, but within the other components, all four types of species play a role in the description of the woody biomass in each sub-location. It presents a picture as it was in 1984, but it does not give an explanation of how and why these differences came into existence.

Table 8. Agroforestry configuration. Tree species distribution within the different components on the farm in the sub-locations.

	Trees around the house				Hedge rows				Trees in agricultural land				Woodlots				Bush			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ke	9	29	35	27	26	22	11	41	13	24	53	10	98	0	2	0	17	67	0	17
Eb	30	19	43	8	30	15	18	36	25	43	28	4	80	6	14	0	13	29	34	23
Es	20	32	29	19	18	25	7	50	15	50	24	11	93	7	0	0	4	40	27	29
Mu	22	40	9	29	23	32	10	34	19	55	20	6	54	40	5	1	10	39	18	33
Lu	18	47	19	16	9	33	14	43	16	57	14	13	76	20	2	2	4	49	20	27
Ma	25	43	23	9	40	37	6	16	24	48	19	9	77	23	0	0	2	50	5	43
Ch	34	38	20	8	43	14	3	40	13	64	15	8	90	9	1	0	0	83	3	14
D.A.	23	35	25	17	27	25	10	37	18	49	25	9	81	15	3	0	7	51	15	27

A = Exotic tree species
B = Local tree species
C = Fruit trees
D = Shrubs

4.2 Agroforestry Activities

An overview of the activities for the different sub-locations is presented in Table 9. Next to the percentages of farmers involved also a ranking order is mentioned to have an overview in which sub-location the activity is most frequent.

Table 9. Agroforestry activities. Different activities undertaken in the sub-locations expressed in percentages of farmers involved.

A. Male and female

	Activities											
	I		II		III		IV		V		VI	
Sub-location	R	Perc	R	Perc	R	Perc	R	Perc	R	Perc	R	Perc
Ke	1	57	6	41	6	17	1	65	2	37	2	90
Eb	6	36	2	59	7	12	7	37	3	34	7	63
Es	4	42	4	53	5	24	2	62	5	29	6	66
Mu	2	52	7	39	4	27	4	52	7	14	4	83
Lu	3	45	5	47	2	40	3	59	3	34	5	68
Ma	5	40	3	54	3	32	5	49	1	44	3	89
Ch	7	29	1	65	1	41	6	45	6	19	1	92
D.A.		43		51		28		53				79

R = Ranking order Perc = Percentage

B. Percentage of Women undertaking the activities

	I	II	III	IV	V
Ke	10	41	44	17	11
Eb	10	21	30	21	44
Es	6	0	0	9	11
Mu	0	14	6	0	0
Lu	2	4	5	5	14
Ma	0	3	0	7	0
Ch	0	9	7	10	8
D.A.	3	13	13	10	13

I = Raising seedlings
II = Buying seedlings
III = Free of charge
IV = Collecting wildlings
V = Direct seeding
VI = Planting and directly seeding trees

Nurseries

Raising seedlings in farm nurseries is frequently done in Kegoye, 57%, and much less undertaken in Chekalini, 29%. Population density or farm size does not explain these differences for in Ebusikhale farm nurseries are not very common (36%). In Kegoye farm nurseries are most commonly established among the bananas. In Eshianda the site of an old hut is preferred, while in all other sub-locations, a well-prepared bed is used. Of interest to note is that in Lukume old wash basins are used as small nurseries. The average number of seedlings raised in the farm nurseries vary from 175 in Eshianda up to 1,128 in Ebusikhale. The high average figure in Ebusikhale is due to a number of large nurseries at some farms which primarily produce trees to sell in the area. See also Annex VIII.

Buying

Apparently the availability of seedlings within the direct surroundings does influence the production of woody biomass. Close to Chekalini a forest nursery sells seedlings, which explains the high percentage of farmers buying seedlings (65%); also the chief's nursery in the area had its influence on the market (see Annex V, Table 4). Apparently the local market in Mayoni also has a high number of seedlings for sale. Whether they are sold as at Luanda Market in Ebusikhale, is not known. But so far in Ebusikhale, Mayoni and Eshianda there are known cases of farmers specialized in tree-growing, who sell in their direct surroundings. This goes some way to explaining the major importance of the local markets for seedling availability.

Free of Charge

The chief's nursery in Chekalini is probably the main reason for the high percentage of seedlings obtained free of charge in this area. In Lukume, most free seedlings were obtained from neighbours. Although in Ebusiihale, the distribution of free seedlings is limited, of those which were distributed, 70% were supplied by the government. On average the neighbours, however, seem to be the major source for free seedlings.

Collecting Wildlings

Farmers are very active in Kegoye (65%), Eshianda (62%), Lukume (59%) and Murhanda (52%) (the most frequently undertaken activity within Murhanda). Local species and fruit trees are the species collected, reflecting their importance to the farmers.

Direct Seeding

Direct seeding is practiced by 44% of farmers in Mayoni, 37% in Kegoye and 34% in Ebusikhale. Only 14% of farmers in Murhanda seed directly. Exotics in Mayoni, local tree species in Ebusikhale or fruit trees in Kegoye indicate preferences in the different sub-locations.

Considering the activities per sub-location, the following observations can be made (see also Table 9):

Kegoye.

Collecting wildlings is the highest activity (65% highest in the district). Nurseries are found among 57% of the farmers; about 41% are buying seedlings and 37% directly seeding trees on the farms. About 17% obtain seedlings free of charge. About 90% of the farmers planted or seeded trees in 1983.

Ebusikhale.

Buying seedlings (59%) seems to be most popular in this sub-location, followed by collecting wildlings (37%), and direct seeding (34%). Nurseries were found in 34% of the households and the distribution of seedlings free of charge hardly occurs (12%, lowest in the district). About 63% of the farmers planted or seeded trees in 1983.

Eshianda.

The highest activity in Eshianda is collecting wildlings, 62%, followed by buying seedlings. About 42% of the farmers admitted to having a nursery in 1983; 29% directly seeded trees and 24% obtained trees free of charge. About 66% of the farmers planted or seeded trees in 1983.

Murhanda.

Collecting wildlings and having farm nurseries appears to be at the same level of intensity (52%). Buying seedlings is undertaken by 39% of the farmers, 27% obtained seedlings free of charge, while 14% directly seeded trees on the farms (lowest district). About 83% of the farmers planted or seeded trees in 1983.

Lukume.

Around 59% of the farmers collected wildlings; 47% bought seedlings and nearly 45% of the farmers had a nursery. Even free of charge seedlings are frequently obtained (40%)

and 34% of the farmers directly seeded trees. About 68% of the farmers planted or seeded trees in 1983.

Mayoni.

Buying seedlings is the highest activity among the five. Collecting wildlings is done on 49% of the farm, direct seeding by 41% (highest in the district) and 32% of the farmers obtained seedlings free of charge. About 89% of the farmers planted or seeded trees in 1983.

Chekalini.

Buying seedlings is very common (65% and the highest in the district). Collecting wildlings is done by 45% of the farmers. Apparently also the distribution of seedlings free of charge is high (41%), highest in the district. Nursery activity is low (lowest in the district).

Activities and Tree Species

Major differences occur only in the species collected or directly seeded within the sub-location. Tree species raised, bought or obtained free of charge are dominated by exotics. Fruit trees are apparently the most important species to collect in Kegoye, Ebusikhale and Eshianda, while local species are more important in Murhanda, Lukume, Mayoni and Chekalini. Fruit trees are also the most important species for direct seeding in Kegoye, local species (Sesbania sesban) apparently in Ebusikhale and Eshianda, while exotics are playing a major role on the larger farms (black wattle and eucalyptus).

Table 10. Agroforestry activities. Tree species raised, bought, obtained free of charge, collected or directly seeded in the sub-locations, expressed in percentages.

	I			II			III			IV			V		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Ke	68	16	16	98	0	2	100	0	0	6	28	66	28	3	70
Eb	90	2	18	92	8	0	100	0	0	11	29	60	7	52	41
Es	87	6	16	89	5	5	89	0	11	5	14	82	11	78	11
Mu	80	10	10	93	5	2	94	6	0	10	84	5	69	6	25
Lu	82	8	9	97	2	1	80	17	3	4	85	11	55	5	38
Ma	95	4	1	89	6	5	73	18	9	11	68	20	69	22	9
Ch	95	3	3	96	1	2	98	2	0	17	55	28	92	8	0
D.A.	85	7	8	93	4	2	90	6	3	9	52	39	47	25	28

A = Exotic species
B = Local species
C = Fruit trees

I = Raising seedlings
II = Buying seedlings
III = Free of charge
IV = Collecting wildlings
V = Direct seeding

Role of Women

Particularly on the small landholdings, the role of women in the production of woody biomass becomes more important. In Kegoye 41% of those farmers who buy trees are women; for obtaining seedlings free of charge, the figure is even higher at 44%. In Ebusikhale, women are more involved in the direct seeding of trees (44%) and obtaining trees free of charge (30%). On the larger holdings, the percentages are considerably lower (see Table 9).

The degree of dependance on the immediate surroundings in terms of woody biomass production is presented in Table 11.

For the most part, seed for nurseries is obtained from the farm, with Mayoni highest at 95%, and Chekalini lowest at 75%. Locally-based knowledge of nursery techniques is high in Mayoni at 90% and in Lukume at 60%.

Seedlings raised for self consumption reach a high frequency in Chekalini (90%), but a much lower one in Kegoye (33%). In contrast the purchase of seedlings from local market or neighbours is highest in Eshianda (89%) and lowest in Chekalini (21%).

If trees are distributed free, the majority seem to come from neighbours (82%) in Murhanda but whereas only 19% come from that source in Chekalini. Collecting wildlings is not very restricted to interviewee's farm; as high as 66% of farmers in Murhanda but only 13% in Chekalini. Seed for direct seeding is mainly obtained from own sources or neighbours; up to 89% in Eshianda but as low as 31% in Chekalini.

Planting Site

The preferred components within the farm to plant new trees are trees around the house (Murhanda, Lukume), hedge rows (Ebusikhale, Murhanda, Mayoni, Chekalini) or trees within the agricultural fields (Kegoye, Eshianda). See Table 12.

Table 12. Agroforestry activities. The preference for planting site on the farm in the sub-locations, expressed in percentages.

	Farm Components				
Sub-location	A	B	C	D	E
Ke	17	18	33	26	6
Eb	13	46	8	27	6
Es	19	28	31	17	5
Mu	27	27	16	22	8
Lu	34	33	13	16	4
Ma	20	48	21	11	0
Ch	23	54	4	15	4
District Av.	22	36	18	19	5

A = Trees around the house
B = Hedge rows
C = Trees in agricultural land
D = Woodlots
E = Bush

The difference between Kegoye, Eshianda and Lukume on the one hand and Ebusikhale, Mayoni and Chekalini on the other, could be explained by the difference in activities. Within the latter sub-locations buying seedlings is very popular and most of the exotic trees bought are planted either in hedge rows or woodlots so as to avoid any effect on the crops. Collecting wildlings, the most frequent activity in Kegoye, Eshianda and Lukume probably explains the choice of planting sites in these sub-locations. Local species and fruit trees are common within the previously-mentioned components, and are well known to farmers in terms of their competitiveness within crop land.

4.3 Fuelwood Shortage

The sub-location results show clearly differences in activities among the sub-locations. Planting activities are important for all; farmers are definitely maintaining and/or enlarging their woody biomass on the farm.

As was previously indicated, the impact of the present woody biomass activities on fuelwood supply is not specifically known, but estimated to be insufficient for self-sufficiency on the smaller land holdings. Table 13 presents the situation for each sub-location.

Table 13. Fuelwood self-sufficiency. The values for the fuelwood self-sufficiency index in the sub-locations. (Also see Annex VII.)

Sub-location	Acreage Classes					
	0-1	1.1-2.5	2.6-5	5.1-10	10.1-20	Over 20
Ke	40	60	100	100	-	-
Eb	42	38	50	-	-	-
Es	100	88	90	100	100	-
Mu	50	59	61	100	-	-
Lu	-	100	100	100	100	100
Ma	-	100	100	100	100	100
Ch	-	-	100	66	88	100
D.A.	58	65	85	94	97	100

Within Kegoye and Ebusikhale, the fuelwood supply is inadequate. Not all the wood can be collected on the farm or direct surroundings, but has to be bought on the market or obtained from neighbours. Eshianda, with its larger farms, experiences a less acute situation. Murhanda forms an exception. The influence of the Kakamega Forest in terms of gathering free fuelwood for resale in this area has probably induced the market process more rapidly than in other sub-locations. Lukume, Mayoni and Chekalini do not experience real shortages, although fuelwood could have been earlier substituted by sugar cane or maize stalks without influencing the index value (probably the case in Mayoni).

5. The Involvement of the Farmer, the Next Step

As presented, the results for the district and sub-location describe the present situation of the involvement of farmers in the production of woody biomass within their direct surroundings.

The involvement of farmers is very impressive and will form the basis for any future intervention. To reach this intervention stage, more "why questions" have to be raised with the farmers in order to determine their incentives for woody biomass production.

The AFS results together with DRA and CS provide a clear overview of what particularly the present situation within each sub-location is, and creates a base for further detailed discussions on the different subjects with the farmers.

On the basis of an exchange of views on issues such as nurseries, direct seeding, collecting wildlings, and cultural and social values within the area, an agreement can be made to try out the production of fuelwood within the area by means of tree species provided as seedlings or seed by the KWDP. The discussion leader (KWDP extensionist) will be able to guide the process on the basis of information from the AFS, DRA and CS results, compiled in sub-location profiles.

All five different tree production activities should be considered to increase the fuelwood production. Encouragement of one of the five activities will depend on the discussion results, and the willingness of the farmers to try new techniques.

The sub-location profile for Kegoye is an example of how AFS, CS and DRA information could be used during the initial intervention phase. The information provides a description of the situation in the sub-locations on the basis of survey results; several subjects for further discussion between farmers and KWDP.

On the basis of these discussions, a first intervention strategy can be formulated and technical options and extension methods tested. Later it should be possible to design a strategy for the district as a whole.

Sub-location Profile for Kegoye

The DRA estimates that 24% of farm land in Zone A2 in which Kegoye is located are covered with woody biomass,

15% planted by farmers and 9% natural woody biomass. The natural woody biomass consists of bush and riparian wood land, the major contributor to woodfuel supply. (See Annex II.)

In Kegoye, land formerly covered by natural woody biomass has been cleared. Not only agriculture crops, but also trees were planted. The present planted woody biomass has been raised, bought, obtained free of charge, collected in the form of wildlings or directly seeded by the farmers.

Considering the species which are reproduced by the farmers, exotics (mainly eucalyptus) and fruit trees are very popular. Eucalyptus is planted in woodlots, and preferably along the rivers (formerly riparian wood land), fruit trees around the houses and within the agricultural fields.

In Kegoye, farmers are very much involved in agroforestry activities. The most frequent is the collection of wildlings (65%). Fifty seven percent of the farmers had a nursery, 41% were buying trees (out of which 44% were women), 37% directly seeded trees, and 17% received trees free of charge. In 1985, 90% of farmers planted or seeded trees -- clearly reflecting the importance of trees to the farmers.

However, trees are not produced primarily for fuelwood, considering the low value of the self-sufficiency index. The question is, what the present incentives are to plant trees and whether these can be used to encourage fuelwood production.

If during the discussions the present fuelwood situation becomes more clear, particularly the role of the man and woman in the procurement of woodfuel, a strategy for the production of fuelwood could be developed.

For Kegoye in particular, several options are open. Farmers plant fruit trees within the agricultural fields and their own experiences of trees in relation to agricultural crops will bring in valuable information in order to determine a justifiable species choice for fuelwood trees. In fact, not only from fruit trees, but from all the trees on the farms, farmers will know the important characteristics in terms of competativeness or complementarity.

New trees should be produced by the farmers themselves. They know how to establish a small nursery, making use of the available resources on the farm, and the seedlings produced will find their way into the neighbourhood, either by selling or providing free of charge. It will be important to select a representative number of farmers and provide them with a substantial number of trees to estimate possible production and to secure future seed

supply on the farms. Also, directly seeding is known and in Kegoye a number of farmers should be asked to seed directly the seed of fuelwood tree species as selected by the KWDP in order to monitor that particular activity.

ANNEX I. Main subjects of the KWDP agroforestry questionnaire in 1984.

Date Name Enumerator

I. Setting

1. Name interviewed Male/Female

2. Division: Location Sub-location
Village Unit

3. Landholding in acre

4. Main agriculture crops

5. Number of animals

II. Agroforestry configuration

1. Describe present tree arrangement on homestead.

Trees around the house	Yes/No
Hedge row	Yes/No
Trees within agricultural land	Yes/No
Woodlot	Yes/No
Bush	Yes/No

2. What species are to be found within these components?

III. Agroforestry activities

1. -Have you planted or directly-seeded trees during the last year?

2. -Have you raised seedlings last year? If yes, male/female.
-Which species did you raise?

3. Did you buy seedlings last year?
If yes, male/female.
-Which species did you buy?
-What was the price of seedlings?
-Where were the seedlings bought?

4. -Did you get seedlings free of charge? If yes, male/female.
-Which species did you obtain free of charge?
-Where did you obtain seedlings free of charge?

5. -Did you collected wildlings last year? If yes, male/female.
   -Which species did you collect?
   -Where did you collect?

6. -Have you directly-seeded trees last year? If yes, male/female.
   -Which species did you seed?
   -How did you obtain the seed?

Nurseries

7. -Which month did you start raising seedlings last year?
   -Were the seedlings you raised last year with or without containers?
   -What do you use as seedbed?
   -Who was obtaining seed? Male/female.
   -How many do you raise? Up to 100, 100-1000, 1000-5000, Over 5000.
   -You raised seedlings:
   -Who tought you this knowledge?

IV. Fuelwood shortage

-Your energy sources for cooking are: fuelwood, charcoal, kerosine, other.
-How did you obtain fuelwood? collecting or buying.

ANNEX II. Selected Land-Use Elements of 11 Sub-Regions of Kakamega.
(KWDP Working Paper NO. 2, Bradley, P., 1984)

Sub-Region	NO. Rural Homes (KM^2)	Farm Size (HA)	HA. Maize (KM^2)	HA. Sugar (KM^2)	HA. Planted Woody Biomass (KM^2)	HA. Bush (KM^2)	HA. Total Woody Biomass (KM^2)	Total Woody Biomass Per RH. (SQ.M)	"X"	Total Planted Woody Biomass Per RH. (SQ.M)
A2	195	0.49	21	1	15.4	6.5	23.8	1220	525	790
A1	185	0.53	27	<1	11.7	6.2	21.2	1150	670	630
B1	176	0.56	13	5	16.3	11.7	29.0	1650	931	930
B2	160	0.57	10	<1	12.5	3.8	20.5	1281	1024	781
E	112	0.87	14	1	9.7	6.9	20.6	1839	1158	844
C2	80	1.16	10	5	5.6	7.0	15.4	1925	1467	700
C1	78	1.22	3	33	5.2	4.8	12.0	1540	978	660
F2	74	1.12	14	1	4.5	12.5	23.8	3216	2624	608
D2	54	1.70	31	0	3.4	6.1	13.7	2530	1950	640
F1	22	2.39	7	0	2.5	2.1	11.2	5091	3957	1136
D1	16	3.33	26	0	1.4	3.3	7.4	4590	3263	850

"X" = Hedge + Bush + Riparian Woodland (SQ.M Per Rural Homestead)
(the major woody biomass elements contributing to woodfuel supply)

Sub-Regions:

- A1 Very high population density - "Bunyore"
- A2 Very high population density - "Maragoli/Hamisi"
- B1 High population density - "Marama/Kisa"
- B2 High population density - "Kakamega Town hinterland"
- C1 Core sugar belt
- C2 Peripheral sugar zone
- D1 Core northern sub-humid zone
- D2 Peripheral northern sub-humid zone
- D Central Kakamega
- F1 Kakamega Forest
- F2 Kakamega Forest periphery

The division of the district into these sub-regions is based on the following domains:

1. population density
2. agroclimatological considerations
3. the relative importance of commercial and "subsistence" agriculture
4. indices of an agricultural economy undergoing a rapid transformation
5. resultant woody biomass characteristics

ANNEX III. List of exotic and local tree species, fruit trees and shrub species found on the farms in Kakamega District.

A. Exotic Tree Species

LUHYA	BOTANICAL NAME
Kampuni	Acacia mearnsii
	Acrocarpus fraxinifolius
	Cassia spectabilis
Emidarakwe	Cypressus lusitanica
Amanela : Tsikambi : Tsimbeku : Mitimbao :	Eucalyptus saligna
Ameyo	Grevillea robusta
Kwobuyefwe	Pinus spp.

B. Local Tree Species

Lusiola	Markhamia platycalyx
Omutoto	Ficus natalensis
Omunamsai	Haningeria madagascarensis
Eshikangania	Bridelia micrantha
Omukomari	Cordia abyssinica
Omufutu	Fitex doniana
Omutsulio	Spathodea nilotica
Omusembe	Entada abyssinica
Omusasa Omutsese :	Sapium ellipticum
Omusioma	Syzygium guineenses
Omukhuyu	Ficus capensis
Omukavakava	Ficus spp.
Shikhuma	Fagara macrophylla
Omutondo	Funtumia Ratifolia
Omutere	Maesopsis eminii
Musutsu	Croton macrostachyus
Mukhunzulu	Albizia gummifera
Omurembe	Erythrina abssinica
Tsifubu	Dracaena afromontana

ANNEX III.

(Con't.)

LUHYA	BOTANICAL NAME
Omukhonje	Terminalia mollis
Omukangu	Aningeria altissima
Mikhungula	Combretum molle
Musine	Croton megalocarpus
Omusangula	Premna angolensis
Shilaha	Combretum binderianum
Mushebeshebe	Maesa lanceolata
Mwanzu	Polyscias ferruginea
Mutukuyu	Olea welwitschii
Omunyama	Trichilia emitica
Mulundu	Antiaris toxicaria
Skikhomoli	Vangueria apiculata
Shisimbari	Clausena anisata
Lutari	Teclea nobilis
Shikunga : Likhomo : Likunga :	Chaetacme aristata
Mweyu	Celtis africana
Musa	Celtis durandii
Omunyenya	Acacia abyssinica
Eshivoyelambago	Piliostigma thonningii

C. Fruit Trees

Amapera	Psidium guajava
Lichungwa	Citrus aurantiuim
Litunda	Passiflora edullis
Paipai	Caiica papaya
Lipalapandi	Eriobotrya Japonica
Lihembae	Mangifera indica
Olwavari	Ribes grossularia
Omukato	Persea americana
Indinmu	Citrus limon
Mzambarau	Eugerie cuminli
Tsinyanya	Cyphomandra betacea

ANNEX III.
(Con't.)

LUHYA	BOTANICAL NAME
D. Shrub Species	
Lisatsi	Ensete ventricosum
Amarakalu	Acanthus arboreus
Mululusia	Chrysophyllum albidum
Lundu	Trimeria bakeri
Shirietzo	Erythrococa atrovirens
Lukhule	Sesbania sesban
Ebikhoni	Euphorbia tirucalli
Mwiliza	Prunus africana
Ingoyi : Inguhu :	Artabotrys nitidus
Amashindu	Phoenix reclinata
Olwavari : Olunani :	Caesalpinia spp.
Amaridadi	Tithornia spp.
Omubinu	Cassia didymobotrya
Makonge	Agave Sisalana
Tsndalandalu	Solanum spp
Ebimenenwa	Lantana camara
Millet	Elaisine coracana

ANNEX IV. Numbers of seedlings raised in the Kakamega District.

A. Average number of seedlings produced per sub-location.

The number of seedlings per nursery was recorded by classes (see Table 1). For each class, the class points were determined taking a low value in order not to over-estimate the total production.

Table 1. The estimated average numbers of seedlings raised in farm nurseries in the sub-location of Ebusikhale.

	Numbers of Nurseries	Classes	Class Points	Numbers of Seedlings
	10	1-100	25	250
	11	100-1000	325	3575
	5	1000-5000	2000	10000
	4	Over 5000	5000	20000
Total	30		Total	33825
			Average number per nursery	1128

From the survey, it is known that 36% of the farmers had a nursery. The population density of Emuhaya division is known and it is assumed that Ebusikhale is representative for the 36000 households of this division (see following table). The production for Emuhaya division is estimated to be 14.6 million seedlings.
The average number of seedlings in the nurseries for each sub-location is presented in Table 2 and varies from 175 up to 1128 seedlings.

Table 2. Percentages of farmers with a nursery and average number of seedlings produced per nursery within sub-locations.

	Ke	Eb	Es	Mu	Lu	Ma	Ch
Average number	610	1128	175	349	403	812	740
Percentage of farmers with nursery	57	36	42	52	45	40	29

B. The seven sub-locations represent seven divisions with a total of 174000 households. Kakamega district consists out of 10 divisions a total of 240000 households and the number of households from the division not represented have been divided over the represented divisions according to their weight as shown in Table 3.

ANNEX IV.
(Con't.)

Table 3. Number of households in Kakamega District.

Sub-Location	Division	Population ('000)	NO. Households ('000)	After Correction ('ooo)
Ke	Vihiga	168	32	43
Eb	Emuhaya	133	26	36
Es	Butere	77	15	21
Mu	Ikolomani	166	32	44
Lu	Kabras	120	23	32
Ma	Mumias	156	30	42
Ch	Lugari	81	16	22
	Hamisi			
	Lurambi		66	
	Khwisero			

The estimated total number of seedlings produced in the district is: 63 million.

ANNEX V. Seven tables forming the background for the description of the "neighbourhood effect".

Table 1. Sources of seed for own farm nursery.

Source \ Sub-Location	Ke	Eb	Es	Mu	Lu	Ma	Ch	AV.
Own shamba	57	78	33	26	70	33	63	51
Neighbour	37	16	53	67	15	62	16	38
Market	0	3	13	0	4	0	11	4
Comb. all 3	3	0	0	7	2	0	5	2
Other	3	3	0	0	8	5	5	3

Table 2. Purpose of raising seedlings in own nurseries.

Source \ Sub-Location	Ke	Eb	Es	Mu	Lu	Ma	Ch	AV.
Own consumption (A)	33	56	80	37	67	57	90	60
Free to neighbours (B)	0	0	0	0	0	5	0	1
Selling neighbours (C)	0	3	7	0	0		5	2
Comb. A + B	0	16	7	7	27	14	0	10
Comb. A + C	50	19	7	33	4	14	5	19
Comb. B + C	13	0	0	11	0	0	0	3
Other	3	6	0	11	2	10	0	5

ANNEX V.
(Con't.)

Table 3. From whom did you learn the knowledge of farm nurseries.

Source \ Sub-Location	Ke	Eb	Es	Mu	Lu	Ma	Ch	AV.
Self-learning by experience	30	29	43	26	30	43	44	35
Other family members	33	19	14	19	4	14	0	15
Other people	17	32	21	33	19	33	25	26
Government people	13	0	21	7	6	0	19	9
Working elsewhere	0	3	0	11	9	10	6	6
School	7	13	0	4	21	0	6	7
Other	0	3	0	0	11	0	0	2

Table 4. Source of seedlings bought by farmers.

Source \ Sub-Location	Ke	Eb	Es	Mu	Lu	Ma	Ch	AV.
Local market	36	42	83	36	59	57	72	42
Neighbour	59	16	6	36	9	20	19	24
Chief nursery	0	2	6	0	4	0	33	6
Government	5	26	6	14	22	3	29	15
Comb. within location	5	0	0	5	0	10	12	5
Comb. outwide location	0	9	0	5	2	0	2	3
Other	14	5	0	5	4	10	2	6

ANNEX V.
(Con't.)

Table 5. Source of seedlings obtained free of charge by the farmers.

Sub-Location / Source	Ke	Eb	Es	Mu	Lu	Ma	Ch	AV.
Local market	0	0	0	6	0	5	4	2
Neighbour	78	20	33	82	41	70	19	49
Chief nursery	0	0	11	0	3	0	59	10
Government	0	70	0	6	3	10	4	13
Comb. within location	11	0	22	0	18	15	15	12
Comb. outside location	0	0	0	6	18	0	0	3
Other	11	10	33	0	18	0	0	10

Table 6. Sources of seedlings collected by the farmers (collecting wildlings)

Sub-Location / Source	Ke	Eb	Es	Mu	Lu	Ma	Ch	AV.
Own shamba(A)	32	27	27	66	16	55	13	34
Along river(B)	0	9	9	0	15	28	7	10
Bush(C)	0	33	0	0	28	0	16	11
A and/or B and/or C	6	0	0	7	7	0	7	4
Other	62	30	64	28	34	17	58	42

ANNEX V.
(Con't.)

Table 7. Source of seed for direct seeding of trees by farmers.

Sub-Location / Source	Ke	Eb	Es	Mu	Lu	Ma	Ch	Av.
Own shamba(A)	20	56	78	13	29	31	23	36
Neighbours(B)	50	19	11	75	21	42	8	32
Market(C)	10	11	11	0	34	4	31	14
Government(D)	5	0	0	0	0	0	0	1
A and/or B and C	5	4	0	13	0	4	0	4
A and/or B and D	5	0	0	0	0	0	0	1
Other	5	11	0	0	16	19	39	13

5 Bush or bushland

Natural shrubland with or without a sparse tree cover. Bush varies in density from thicket to scattered bush (in which a scattering of shrubs is found within an open herbaceous cover).

A small number of additional elements have been recognised during the District Resource Analysis:-

6 Isolated or individual trees along paths or waysides

Individual or small clumps of trees growing on verges, beside paths or roads, but not in hedges.

7 Windrow

A row of trees up to two trees wide, usually continuous and in place of a hedge. In other circumstances, a relatively regular spacing of trees growing up out of a hedge, comprising more than 50% of the total canopy. Although not invariably the case, windrows tend to be mono-specific (Eucalyptus, Cupressus, Pinus, Acacia mearnsii).

8 Isolated or individual trees in open grassland

As the name suggests, individual, or small clumps of trees growing in open herbaceous vegetation (but not managed pasture which forms part of agricultural land).

9 Riparian woodland

Woodland or forest strips along valley bottoms.

ANNEX VI. KWDP TERMINOLOGY.

AGROFORESTRY CONFIGURATION = WOODY BIOMASS CONFIGURATION

The "set" or arrangement of the woody biomass components on a farm, or in a given area. The configuration is the combination of these different woody biomass components or elements.

AGROFORESTRY COMPONENTS(or ELEMENTS) = WOODY BIOMASS COMPONENTS, ELEMENTS.

1 Trees around the house, trees around homestead

Often fruit and shade trees, sometimes timber trees and/or shrubs growing in the compound within which the homestead buildings are located.

2 Hedgerows, hedges

Up to a double row of tightly packed, continuous shrubs. A hedge may include trees growing within it. In the case of the District Resource Analysis, a continuous row of tress growing above, or replacing a shrub hedge is termed a windrow (see below).

3 Trees in agricultural land = trees in shamba, trees in cropland

Individual or small groups of trees growing within fields. In some cases this component constitutes a deliberate intercropping of trees and crops.

4 Woodlot

A group of planted trees of at least 20 in number, forming a stand or "mini-plantation". These trees need not be arranged in regularly-spaced rows or blocks. Usually such a woodlot is dominated by one species (eg Eucalyptus).

AGROFORESTRY ACTIVITIES

1 Raising seedlings

Farmers raise seedlings on their farms, in kimbo tins, old wash basins, amongst bananas, on the site of an old house or a charcoal burning spot, etc. These farm nurseries are difficult to compare with typical forestry nursery practice with its formal layout. In the KWDP context, raising seedlings refers to the variable practice of nursery management on farms as described above.

2 Buying seedlings

Many farmers buy seedlings; not only from government or other centralised nurseries, but also from local markets and other private sources (neighbours, friends, relations, etc).

3 Free of charge

Tree seedlings may be obtained free of charge; from both private and government/institutional sources.

4 Collecting wildlings

The collection of wild seedlings (wildlings) is the uprooting of a naturally germinated wild seedling and its deliberate replanting on the farm.

5 Direct seeding

Direct seeding of tree seeds by man on the farm, or the natural regeneration of seed which has fallen to the ground "in situ".

ANNEX VII. Fuelwood - self-sufficiency index.

The level of fuelwood shortage in the district is expressed in the self-sufficiency index:

$$\text{Self-sufficiency index} = \frac{\text{Number of farmers obtaining fuelwood from the non-market only}}{\text{Number of farmers using fuelwood for cooking only.}} \times 100$$

N.B. If value of the index exceeds 100, only 100 is quoted in the tables for clarity purposes.

Table 1. Cross-tabulation of sub-location and landholding acreage for the question, your energy sources for cooking were: value fuelwood only, expressed in numbers of farmers involved.

Sub-Location	Landholding : Acreage						
	0-1	1.1-2.5	2.6-5	5.1-10	10.1-20	Over 20	Total
Ke	30	20	3	1	0	0	54
Eb	26	29	8	0	0	0	63
Es	8	17	20	4	2	0	51
Mu	2	22	23	3	0	0	50
Lu	0	6	34	43	12	7	102
Ma	0	1	12	10	16	7	46
Ch	0	0	1	3	43	7	0
							420

Table 2. Cross-tabulation of sub-location and landholding acreage for the question, how were you obtaining fuelwood for value: non-market only.

Sub-Location							
	0-1	1.1-2.5	2.6-5	5.1-10	10.1-20	Over 20	Total
Ke	12	12	3	1	0	0	28
Eb	11	11	4	0	0	0	26
Es	8	15	18	4	2	1	48
Mu	1	13	14	4	0	0	32
Lu	1	7	43	47	16	10	124
Ma	0	1	15	11	22	10	59
Ch	0	0	1	2	38	9	0
							367