KENYA FORESTRY
RESEARCH INSTITUTE

JAPAN INTERNATIONAL
COOPERATION AGENCY

KENYA/JAPAN

SOCIAL FORESTRY TRAINING PROJECT

PROCEEDINGS OF THE SOCIAL FORESTRY

REFRESHER COURSE II

MUGUGA, JUNE, 1989

KENYA/JAPAN: SOCIAL FORESTRY TRAINING PROJECT

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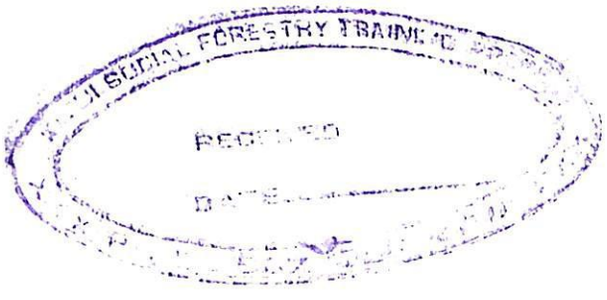
SOCIAL FORESTRY REFRESHER COURSE II



MUGUGA, JUNE 1989

CONTENTS

SOCIAL FORESTRY REFRESHER COURSE II PROCEEDINGS

Introduction

1.0 Approaches to evolving and implementing sound social forestry programmes and policy have varied from country to country. Some have no social forestry policy at all while others have forestry management policies ranging from no social forestry to intensive social forestry. In those countries where a clear policy is evident, it may not be carried out because of lack of information transfer between the policy makers, researchers and resource managers.

Kenya lacks social forestry policy. The need to evolve, develop and implement one has however been fully realized. Ways of achieving this must therefore be developed and with a view of facilitating communication between researchers, policy makers and resource managers in the country. A system must also be found through which research findings and policy matters can be transmitted to resource managers and the public.

The two Social Forestry Refresher Courses organized and hosted by Kenya/Japan: Social Forestry Training Project (SFTP) at Muguga from 25th September to 1st October 1988 and 2nd to 7th April 1989 were tailored to meet the goals outlined herein and more specifically to:-

(a) Provide Senior Forest Department (FD) Field Officers in-charge of Management and Extension with up-to-date information in social forestry such as global trends, policy orientation, measures being taken and current issues;

(b) Enhance the awareness of the Senior (FD) Field Officers and others of similar rank, the current global emphasis in social forestry as oppossed to traditional forest management.

The First Course was attended by 25 out of 30 invited participants representing the following organizations:

Forest Department	21
British American Tobacco (K) Co. Ltd. (BAT)	1
Ministry of Energy (MoE)	1
Kenya Forestry Research Institute (KEFRI)	1
Kenya Freedom From Hunger Council	1

The second Course attendance was rather poor because out of the 30 invited participants, only 13 attended. Of the 13, one was from Green Belt Movement, one from the Ministry of Water and the rest from the Forest Department.

2. PROGRAMME

2.1 1st Course

T I M E T A B L E

SOCIAL FORESTRY REFRESHER COURSE II

25TH SEPTEMBER - 1ST OCTOBER 1988

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
25/9	16.00	Arrive at Forest Dept. Headquarters Uhuru Park, Opposite Serena Hotel	Training Officer	
26/9	08.00 - 08.30	Registration	Training Officer	
	08.30 - 09.15	Introduction	Training Officer	
	09.15 - 10.15	Concept of Social Forestry	Mr. K. Watanabe	
	10.15 - 10.45	**COFFEE BREAK**		
	10.45 - 11.30	Opening Ceremony	Mr. C. R. J. Nyaga	Director of Forestry
	11.30 - 12.30	Social Forestry Policies and Practices in Kenya	Dr. F. K. Sang	Moi University
	12.30 - 14.00	**LUNCH BREAK**		
	14.00 - 15.00	Nursery Techniques	Mr. P. Konuche Mr. J. Kimondo	KEFRI KEFRI
	15.00 - 15.30	**COFFEE BREAK**		

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
26/9	15.30 - 16.30	Demonstration of Nursery Techniques	Mr. Konuche Mr. Kimondo	KEFRI KEFRI
	16.30 - 17.30	Selection of Appropriate Tree Species	Mr. P. Milimo	KEFRI
27/9	08.00 - 09.00	Collection, Treatment and Storage of Seeds	Mr. G. Rode	Senior Researc Officer, GTZ
	09.00 - 11.00	Tour and Demonstrations at Seed Centre	Mr. G. Rode	
	11.00 - 11.30	**COFFEE BREAK**		
	11.30 - 12.30	Concept and Application of Agro-forestry for the Promotion of Social Forestry in Kenya	Prof. F. Owino	ICRAF
	12.30 - 14.00	**LUNCH BREAK**		
	14.00 - 15.00	Social Forestry and Land Ownership in Kenya	Okoth Owiro	University of Nairobi
	15.00 - 15.30	**COFFEE BREAK**		
	15.30 - 16.30	Farmers' Attitude to Tree Planting in Relation to Livestock Production	Mr. P. Mung'ala	KWDP

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
28/9	08.00	Departure for Kitui	Training Officer	
	11.15 - 12.00	Notable Points in Planting and Tending (Kitui)	Mr. C. Kiriinya Mr. Y. Watanabe	KEFRI SFTP
	12.00 - 13.00	**LUNCH BREAK**		
	13.00 - 15.00	Field Trip to the Pilot Forest Project Site (Kitui)	Mr. C. Kiriinya Mr. Y. Watanabe	KEFRI SFTP
	15.00	Departure for Nairobi		
29/9	08.00 - 09.00	Current Situation of Social Forestry Development - Welfare Economics Approach	Mr. B. G. Wamugunda	Forest Department
	09.00 - 10.00	Group Discussions: Participants' Experiences in implementating Social Forestry Programmes	Discussion Leaders	Forest Department
	10.00 - 10.30	**COFFEE BREAK**		
	10.30 - 12.30	Group Discussion Continues	Discussion Leaders	
	12.30 - 14.00	**LUNCH BREAK**		
	14.00 - 15.00	Presentation of Groups' Discussion 30 Minutes each and a Short Paper	Training Officer/ Deputy Director	KEFRI
	15.00 - 15.30	**COFFEE BREAK**		
	15.30 - 17.00	Groups Presentation Continues		

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
30/9	08.00	Departure for KEFRI Dryland Agro-forestry Centre, Kakuyuni		
	10.30 - 12.00	Tour of Above Centre	Dr. D. Nyamai	KEFRI
	12.00	Departure for ICRAF Field Station (Machakos)		
	13.00 - 13.45	**LUNCH BREAK**		
	13.45 - 15.30	Tour of ICRAF Station	Mr. P. Kurira	ICRAF
	15.30 - 16.00	Tour of KEFRI Research Station adjacent to ICRAF Station	Dr. D. Nyamai	KEFRI
	16.30	Departure for Nairobi		
1/10	08.00 - 10.00	A strategy for Improving Farm Forestry in Kenya	Dr. J. A. Odera	KEFRI
	10.00 - 10.30	**COFFEE BREAK**		
	10.30 - 12.30	Course Evaluation	Training Officer	KEFRI
	12.30	**LUNCH & PARTICIPANTS DEPARTURE**		

2.2 2nd Course

T I M E T A B L E

SOCIAL FORESTRY REFRESHER COURSE I

4TH - 7TH APRIL 1989

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
4/4	09.00 - 10.00	Collection, Treatment and Storage of Seeds	Mr. Joerg Albrecht	GTZ
	10.00 - 10.30	**TEA BREAK**		
	10.30 - 11.30	Tour and demonstration at Seed Centre	Seed Centre Staff	KEFRI
	11.30 - 12.30	Farmers' Attitude to Tree Planting in Relation to Agriculture	Mr. P. Ongugo	KEFRI
	12.30 - 14.00	**LUNCH BREAK**		
	14.00 - 15.00	Farmers' Attitude to Tree Planting in Relation to Livestock Production	Mr. A. E. O. Chabeda	MoL
	15.00 - 15.30	**TEA BREAK**		
	15.30 - 16.30	Concept of Social Forestry	Mr. K. Watanabe	SFTP

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
4/4	16.30 - 17.30	Nursery Techniques	Mr. J. Kimondo	KEFRI
5/4	08.00 - 10.00	Concept and Application of Agroforestry for the Promotion of Social Forestry in Kenya	Dr. G. Amare	ICRAF
	10.00 - 10.30	**TEA BREAK**		
	10.30 - 11.30	Selection of Appropriate Tree Species	Mr. P. B. Milimo	KEFRI
	11.30 - 12.30	Contributions Expected from Field Officers for the Development of Research in Social Forestry	Mr. P. K. Konuche	KEFRI
	12.30 - 14.00	**LUNCH BREAK**		
	14.00	Departure for Kitui Night in Kitui	Training Staff	KEFRI
6/4	08.00 - 10.30	Tour of the Pilot Forest Project Site	Mr. Kimani	
	10.30	Departure for ICRAF		

DATE	TIME	SUBJECT	RESOURCE PERSON	REMARKS
6/4	12.30 - 13.30	**LUNCH IN MACHAKOS**		
	14.00 16.00	Tour of ICRAF Field Station	Mr. P. Kurira	ICRAF
	16.00	Departure for Muguga		
7/4	08.00 - 09.00	Group Discussions: Experience in Implementing Social Forestry Programmes	Group Leaders	
	10.00 - 10.30	**TEA BREAK**		
	10.30 - 12.30	Presentation of Group Discussions	Participants	
	12.30 - 14.00	**LUNCH BREAK**		
	14.00 - 15.00	Presentation Continues	Participants	
	15.00 - 15.30	**TEA BREAK**		
	15.30 - 16.15	Course Evaluation	Training Officer	SFTP
	16.15 - 17.00	Closing Remarks	Dr. J. A. Odera	Director KEFRI

3. TOPICS AND MEMBERS OF THE DISCUSSION GROUPS

Towards the end of each Course, all participants were divided into discussion groups and each group assigned a topic for discussion on which, they were to make observations and recommendations in a plenary session.

3.1 First Course

The topics and members of the discussion groups were as follows:

Topic 1

Social Forestry and Land Ownership in Kenya

Members:

Hoveka, E.

Kalenda, M.

Kisioh, K.

Kubo, B. K.

Topic 2

Seedlings Production in Kenya

Members:

Gitonga, M.

Isiaho, E. T.

Macharia, J. K.

Mbaya, J. K.

Muchiri, M. N.

Muita, D. M.

Mutyota, J.

Topic 3

Appropriate Social Forestry Species and their Management Strategies

Members:

Kahemba, M.

Kanja, F. M.

Kariuki, C. K.

Macharia, M. N.

Muriu, P. G.

Mwema, J. M.

Topic 4

Social Forestry Extension Problems and their Remedies

Members:

Maina, E. G.

Mbugua, D.

Munuve, J. M.

Njenga, g. S.

Ngumi, J.

Onam, W. O.

3.2 **Second Course**

The topics and members of the discussion groups were as below:

Topic 1

What are the existing and anticipated problems and their

solutions in implementing Social Forestry Programmes at the district level?

Members:

Bisia, K. D.

Kanji, B. J. W.

Methu, B. G.

Mwangi, M.

Ojiambo, M.

Wangari, J.

Topic 2

What are the subjects for emphasis in future work of the Social Forestry Extension Officers?

Members:

Kaudia, A.

Kariuki, E.

Karuru, D. N.

Lonzi, M. T.

Maina, M.

Mbita, G. M. K.

Theuri, D. K.

OBSERVATIONS AND RECOMMENDATIONS

4.1 First Course

Topic 1: Social Forestry and Land Ownership In Kenya.

(i) Observations

(a) The bulk of the country's land is either arid or semi-arid and communally owned, thus making it difficult for individuals and/or communites to plant and control cutting of trees

(b) Where land is privately owned there are always problems associated with border trees and especially where land holdings are small

(c) The County Council forests, most of which are ungazetted are poorly managed. This is probably because the government does not have complete control of these forests because the country's Forest Policy (Cap. 85 of Kenya) does not cover the ungazetted forests

(d) Not much has been done in developing and managing urban forestry

(e) Depletion of trees in the private lands has yet to be controlled. However, control of planting and harvesting of trees on private lands is a counter productive measure in afforestation.

(ii) Recommendations

(a) Has an incentive to social forestry development, land adjudication in areas where land is communally owned should be hastened

(b) On both the communally and privately owned land, restrictions on tree cutting should be enforced

(c) There is urgent need for a National Forestry Policy i.e. a forestry policy that would cover forests and trees on gazetted and ungazetted forests and on private land

(d) Trees should always be planted for a purpose and technical advise should be given for border trees

(e) Though no clear recommendation was advanced on the poor management of the County Council forests, it was strongly felt that these forests should be gazetted and handed over to the central government so as to ensure that they are properly managed

(f) In order to boost afforestation in the country, those exploiting the forests (individuals, companies, statutory bodies, etc) should be made to pay some form of tax or contribute directly.

Topic 2: Seedlings Production

(i) Observations

(a) At present, genetic variations are not taken seriously when collecting seeds

(b) The existing seed stands are inadequate and particularly those of indigenous species

(c) The country's seedlings demand has yet to be met

(d) The seedlings prices and particularly those from the Forest Department are very much subsidised.

(ii) Recommendations

(a) All those collecting seeds should be advised and preferably by KEFRI on the importance of genetic variations when collecting seeds

(b) More seed stands and particularly those of the indigenous species should be established

(c) If the country's seedlings demand has to be met, a seperate vote for seeds collection and seedlings production should be established in the ministries directly responsible for seedlings production

(d) In order to boost seedlings production in terms of quality and quantity, there is urgent need for interaction between researchers and forest managers and lifting the government subsidy on the seedlings.

(ii) Recommendations

(a) Those promoting social forestry should emphasis on local species rather than exotics; and when doing so, they should not ignore the farmer's priorities

(b) If social forestry development must succeed, planting of multipurpose trees should be emphasised

(c) For even growth of social forestry, there is urgent need to identify, develop and promote suitable species for each of the country's ecological zone

(d) As a result of the rising demand for poles and posts coupled by the banning of the most popular poles (cedar) by the government, there is urgent need for researching and promoting other species suitable for poles and posts

(e) In order to avoid conflict with other land users, those promoting social forestry should work closely with the District Development Committees

(f) There is urgent need to monitor the performances of the planted trees in order to gauge the success of the social forestry.

Topic 4: Social Forestry extension problems and their remedies

Observations and Recommendations

(i) (a) A strong national social forestry extension service is lacking. There is therefore urgent need to establish one and preferably by strengthening the Forest Department Extension Division

(b) At present, resources allocated to social forestry are inadequate. There is therefore urgent need to allocate more funds to social forestry

(c) At present the political climate in the country is very favourable for forestry development; those promoting social forestry should therefore capitalize on this.

3.2 Second Course

Topic 1: What are the existing and anticipated problems and their solutions in implementing social forestry at the district level?

(a) Existing problems:

(i) Land tenure System

In some parts of the country, land has yet to be adjudicated. Since farmers are not sure of continuing to own the same piece they now own, they are afraid of planting trees. The solution to this would be to speed up land adjudication in these areas and when doing so, the areas unsuitable for agriculture should be set aside for community tree planting.

(ii) Policy Matters

The existing Forest Policy (Cap. 385 of the Laws of Kenya) does not sufficiently cover the aspects of social forestry e.g. protection of on farm trees, pricing of on farm tree products, etc. There should therefore be a review of the Forest Policy so as to incorporate all aspects of forests.

(iii) Extension Methodology

This is a major constraint in that the training of the Extension Foresters does not sufficiently cover the aspect of social forestry. The solution to this would be to train Foresters as trainers.

(iv) Farmers/Extension Officers Ratio

This is a major constraint in that the department has staff upto divisional level i.e. there is only one person in-charge of a division and cannot therefore cover all the farmers. There is therefore urgent need for the government to create more job opportunities by training and deploying more staff at locational and sub-locational levels - cf. the Ministry of Agriculture.

(v) Mobility of social foresters

Most of the extension foresters do not reach the farmers due to lack of transport. It is therefore important that they are provided with either vehicles, bicycles, motor cycles, boats and in some areas either with donkeys and horses.

(vi) Poor interdepartmental co-ordination

Most of the Forest Department Extension Foresters do not know what is happening in other departments such as KEFRI, National Environmental Secretariat (NES), Ministry of Agriculture, etc. As a result there is either duplication of efforts or conflict among the departments actively participating in social forestry. The end result is that the farmers are confused.

The solution to this would be a more integrated approach by all those promoting social forestry.

(vii) Motivation of Forest Extension Officers

This is prevalent in the district where the DFEO is considered equal to other foresters in terms of enumeration though assigned more responsibilities.

There is therefore urgent need to review the forest officers Scheme of Service to boost their morale.

(viii) Lack of incentives to farmers

At present there are no incentives to forestry farmers. The government and preferably through the Forest Department, should introduce incentives such as trophies, loans, etc to forestry farmers - c.f. Ministry of Agriculture.

(ix) Traditional/cultural ways of life

Farmers are known to refuse to plant some tree species because of cultural beliefs e.g. ficus, chrolophora, parkinsonia, etc, which are associated with bad omen and/or witchcraft. Farmers should therefore be taught that such beliefs are not true by either demonstrating by planting such species or by taking them to visit those who have planted these species.

(x) Lack of sufficient funds

At present the funds allocated to social forestry are inadequate. There is therefore urgent need to provide more funds.

ANTICIPATED PROBLEMS

(i) Inadequate information exchange system

There has been a problem on co-ordination and exchange of research findings at district level.

The result is that the research findings are either confined at the Forest Department Headquarters or at the source. Consequently there is a delay in communicating new techniques to farmers.

The solution to such a problem would be decentralizing information centres and research findings to district level.

(ii) Population growth in relation to land size

As a result of rapid population growth, the family land holdings continue to grow smaller and smaller. This tends to discourage on-farm afforestation because faced with such a situation, farmers will prefer agricultural crops to trees. The solution would be to stop uneconomical sub-division of land.

(iii) Departmental administration

Forest Department should be re-organized in such a way that all matters pertaining to forestry in a district, are channelled through the District Forest Officer - at present the tendency is that the forest extension matters from the headquarters are communicated directly to the DFEO's.

Topic 2: What are the Subjects for Emphasis in the Future Work of Social Forestry Extension Staff?

For clarity, the social forestry extension staff was defined as the "DFO's, DFEO's, Foresters and all those other persons working in forestry, down to Forestry Headmen and those who have received some form of instructions in Forestry".

The following were the subjects that were identified as requring emphasis:-

(i) Mode and media of communcation

There is urgent need to identify the most effective mode and media of passing over the information to the farmers.

(ii) Advertisement and publicity

Social forestry publicity has yet to be adequate. There is therefore urgent need to provide more funds for development and publicity of such packages.

(iii) Training

Social forestry training is hampered by lack of funds. Funds should as such be provided for training of both Extension Officers and farmers.

(iv) Supply, establishment and care of seedlings

To date, the national demand of seedlings has yet to be met. It is therefore imperative that more seedlings are raised. However, there is the danger of excess production. It is therefore important that the establishment of the supplied seedlings is monitored.

(v) Demonstrative forestry

Those promoting social forestry should establish demonstration plots (farm woodlots, soil rehabilitation, shelter belts, etc), first per every ecological zone and finally in every sub-location/village.

(vi) Utilization of the whole tree

Farmers should be educated on the value of their trees and how to effectively utilize them efficiently and wisely.

(vii) Agroforestry

It was felt that most of the Forest Extension Officers do not stress agroforestry as an important land use system when dealing with the farmers. This is contrary to the current global trend where agroforestry is being emphasized in order to reduce land pressure

in rural areas. It is therefore imperative that agroforestry be emphasized forthwith.

(viii) Soil conservation

The extension staff should emphasize soil conservation as a parcel of social forestry because of the role of trees in soil management and in both agricultural and livestock production.

(ix) Harmonization of tree product value

Currently the farmer does not know the value of his trees or their products because various agencies dealing with such products have different values. There is therefore urgent need to standardize the values of these products; for example a farmer with one kilogramme of Grevillea seeds should know how much to sell it just like the agricultural crop seeds.

ANNEX 1: LIST OF PARTICIPANTS

FIRST COURSE: 25TH SEPTEMBER TO 1ST OCTOBER 1988

	NAME	ADDRESS	NATIONALITY
1.	Aoko, Gerald	KEFRI, P. O. Box 20412, NAIROBI.	Kenyan
2.	Gitonga, M.	P. O. Box 546, MURAN'GA.	Kenyan
3.	Hatori, Hiroyuki	SFTP, P. O. Box 50572, NAIROBI.	Japanese
4.	Hoveka, Esther	P.O. Box 21552, NAIROBI.	Kenyan
5.	Isiaho, E. T.	P. O. Box 22, KERUGOYA.	Kenyan
6.	Kalenda, M. N.	RAES, P. O. Box 30513, NAIROBI.	Kenyan
7.	Kanja, F. M.	KEFRI, P. O. Box 20412, NAIROBI.	Kenyan
8.	Kariuki, C. K.	Kenya Freedom From Hunger Council, P. O. Box 30762, NAIROBI.	Kenyan
9.	Kimemia, J.	Corner Photo Studio, NAIROBI.	Kenyan
10.	Kimondo, J. M.	KEFRI - Silviculture, P. O. Box 20412, NAIROBI.	Kenyan
11.	Kisioh, K.	P. O. Box 229, KAJIADO.	Kenyan
12.	Kubo, B. M.	P. O. Box 25, ELBURGON.	Kenyan
13.	Maina, E. G.	Forest Management, P. O. Box 30241, NAIROBI.	Kenyan
14.	Macharia, J. K.	P. O. Box 2, EMBU.	Kenyan
15.	Macharia, N. M.	P. O. Box 289, OLKALOU.	Kenyan

16.	Mbaya, J. K.	P. O. Box 8, NYAHURURU.	Kenyan
17.	Mbugua, D. K.	P. O. Box 235, KAPSABET.	Kenyan
18.	Muchiri, M. N.	KEFRI, P. O. Box 20412, NAIROBI.	Kenyan
19.	Muita, D. W.	P. O. Box 34, NAROK.	Kenyan
20.	Mung'alla, P. M.	KWDP, P. O. Box 56212, NAIROBI.	Kenyan
21.	Munuve, J. M.	P. O. Box 2, MACHAKOS.	Kenyan
22.	Murema, J. M.	BAT P. O. Box 363, MERU.	Kenyan
23.	Muriu, P. G.	Forest Management, P. O. Box 30241, NAIROBI.	Kenyan
24.	Mutta, D.	KEFRI, P. O. Box 20412, NAIROBI.	Kenyan
25.	Mutyota, J. M.	P. O. Box 74, KIKUYU.	Kenyan
26.	Ngumi, J. W.	Forest Department, P. O. Box 30513, NAIROBI.	Kenyan
27.	Njenga, G. N.	P. O. Box 106, KITUI.	Kenyan
28.	Nyaga, C. R. J.	Forest Department, P. O. Box 30513, NAIROBI.	Kenyan
29.	Onam, W. O.	Forest Department, P. O. Box 30513, NAIROBI.	Kenyan
30.	Ongugo, P. O.	P. O. Box 28, NYERI.	Kenyan

31.	Rotich, J. K.	P. O. Box 1, LONDIANI.	Kenyan
32.	Sang, F. K.	Moi University, P. O. Box 3900, ELDORET.	Kenyan
33.	Senelwa, A. K.	KEFRI, P. O. Box 20412, NAIROBI.	Kenyan
34.	Wamugunda, B. G.	Forest Department, P. O. Box 30513, NAIROBI.	Kenyan

SECOND COURSE: 2ND - 7TH APRIL 1989

	NAME	ADDRESS	NATIONALITY
1.	Bisia, K. D.	P. O. Box 7, Mokowe, LAMU.	Kenyan
2.	Kanyi, B. J. N.	P. O. Box 247, KILIFI.	Kenyan
3.	Kariuki, E.	P. O. Box 74, KIKUYU.	Kenyan
4.	Karuru, D. N.	P. O. Box 28, ELDAMA RAVINE.	Kenyan
5.	Lonzi, M. T.	P. O. Box 99, KITALE.	Kenyan
6.	Maina, A. M.	P. O. Box 110, MARALAL.	Kenyan
7.	Mbita, G. M. K.	P. O. Box 5, KWALE.	Kenyan
8.	Methu, B. G.	P. O. Box 111, BUSIA.	Kenyan
9.	Mwangi, M.	P. O. Box 1043, NYAHURURU.	Kenyan
10.	Ojiambo, O. M.	P. O. BOx 67839, NAIROBI.	Kenyan
11.	Theuri, D. K.	P. O. BOx 397, ITEN.	Kenyan
12.	Wandeto, G. S. M.	P. O. Box 376, SIAYA.	Kenyan
13.	Wangari, J.	P. O. Box 67545, NAIROBI.	Kenyan

CONCEPT OF SOCIAL FORESTRY

Mr. K. Watanabe
The Chief Adviser
Kenya/Japan: Social Forestry Training Project

1. NEEDS FOR SOCIAL FORESTRY DEVELOPMENT

Use of forests by mankind for subsistence has been a practice from time immemorial. However, social forestry, as a policy tool of satisfying basic needs for forestry products was never emphasized until very recently (about a decade ago). It is therefore imperative that ways and means of promoting social forestry development in the third world (developing countries) must be reviewed thoroughly taking into consideration historical and socio-economic context of the respective countries.

Generally, the picture of forest policy and forestry administration in the developing countries in the tropics could be described as follows:-

(a) Post Independence Era

During this era, the forest policy and administration were mostly the continuation of the policy and structure set during the colonial period which were formulated,

generally speaking, to pursue a maximum revenue earning from the forestry sector of the colonies. To take an example, Burma endowed with the invaluable natural teak forests, by far the largest portion of the inputs was made into the conservation and management of the teak forests, whereas the mixed tropical hardwood forests which at that time would not be exploited profitably due to less value in the international market and high exploitation cost, were largely outside the interest and concern of the forest administration. They were left open to the utilization by the rural people for their subsistence.

(b) Pre-Independence Era

Though by mid 1970s the international timber market expanded greatly, no sign of changes in the forest policy and administration in the developing countries had been observed. As a result of the rapidly expanding market, lesser known tree species in the tropical hardwood forests begun to gain market value. In order to accommodate this change, the Forest Departments in the developing countries were compelled to expand their coverage of

the mixed hardwood forests with substantial increase in staff and more closely knit forest administration network. During this period, the major requests for international co-operation by the developing countries in forestry sector, was either "institutional buildings" or "strengthening of forestry institutions" with background as mentioned above.

In the meantime, the population increase in the rural areas was remarkable and it was not rare that the population doubled or even tripled in some developing countries. Consequently, people's demands for forest products (fuelwood, fodder, poles, etc), was doubled or tripled. Under such circumstances conflicts between the forest administration and the rural people became very common. The relation between Foresters and the rural people deteriorated rapidly and in many cases led to hostility and at best indifference.

The common situation in the rural area can be described as follows:

(i) The rural people who used to get forest products freely from the

forest were not only suddenly told to follow the forest laws and regulations and obtain permission to harvest these products, but also to pay royalty to the governments. However, because of various problems, distance to local forest offices, forms to be filled in, etc., people felt they were actually prohibited from the use of forests for their survival.

(ii) Forestry officials, given the impossible task of protecting forests from the rural people with insufficient provisions in the number of staff and operational budget, were only able to arrest people when they could spot those illegal acts by the people. As a result of these arrests, the relation between the Foresters and the people deteriorated.

(iii) Until 1979s this paradoxical situation continued and became more and more complex in many countries. The harder the Foresters tried, the more detriment to the rural people. The people felt that their compatriot forest officers

were more cruel than the colonial masters. Regrettably, the forestry sector assistance provided by the donor agencies only worked to add to this unfortunate situation.

2. DEVELOPMENT OF SOCIAL FORESTRY POLICY

The worsening situation was reported by the field Foresters to the administration and many Forest Departments begun to feel the need for policy changes towards the end of 1970s. Deforestation in the tropical forests became the main agenda item of the international meetings and the world was alarmed by a number of reports to this effect.

"The Global 2 000 Report" published by the U. S. Government in 1980 made forecasts into several factors related to the future of mankind including forests. The major point was that the global deforestation, of which by far the majority was in the tropics, was reaching the size of 20 million hectares per year.

In 1981, the "Tropical Forest Resources Assessment Report" by UNEP/FAO gave a smaller estimate on the global deforestation as 11.3 million hectares per year through improved methodologies. The size became less but not to much relief. The reasons for the deforestation were firstly by expansion

of shifting cultivation followed by conversion into agricultural land, escalated harvesting, etc.

The findings of these reports including their implications to the global environment and other sectors were well taken note by the policy makers and the basis for the consensus to conserve tropical forests and to rehabilitate the deforested lands was laid down.

In the course of the above events it became clear that the traditional forest policy and administration structure would not be able to meet the needs of the changing world. Consequently, Social Forestry Policy was first declared in India in 1975, although similar policy measures had been practiced in some States of India since 1930s. FAO started its Forestry for Local Community Development (FLCD) Programme in 1977. The VII World Forestry Congress held in Jacarta, Indonesia, unanimously agreed on the required policy changes under the slogan "Forestry For People". In the subsequent international meetings of the world foresters, forest policy to directly benefit the rural people was more and more emphasized. Social forestry development projects started to emerge under financing of multilateral and bilateral donor agencies.

It is however still worthwhile to note that the current global situation is yet considerably far

from ideal, i.e. the global consensus was reached in numerous international meetings but reform in policy and administration back home is lagging behind and social forestry implementation needs to be accelerated in many developing countries. Most government Foresters are still performing their duties along the traditional lines of forestry in their respective countries.

3. SOCIAL FORESTRY - TERMINOLOGY AND DEFINITION

The main objective of social forestry is to meet the daily needs of the rural population for wood-fuel, fodder, poles and timber without excluding fruits for food, mainly based on their spirit of self-reliance. Therefore, the produce of social forestry activities is mainly for domestic consumption by the rural people but may exceptionally be for increasing cash income of the farmers. Social forestry would also have environmental protection and soil conservation functions. In promoting social forestry development, agroforestry is a very useful tool as agroforestry techniques would enable farmers to combine their cropping with the tree planting and achieving an optimal use in the limited land they own. This would be essential in areas where the population pressure on the land is high.

As social forestry development would be relying on the people's initiative and their spirit of self-reliance, cash income generation would not be one of its main objectives.

There are some terms which are related to, and sometimes might be confused with but are slightly or quite different from social forestry.

Agroforestry is, as well known, a land use technique which enables the production of perennial plants i.e trees, and annual plants i.e. agricultural crops in co-existence on the same unit of land. Therefore agroforestry is one of the most useful tools of promoting social forestry in rural areas.

On the other hand, terms community forestry, farm forestry, village forestry can broadly be covered by social forestry. They are also policy concepts but with slight different context.

Community forestry can be defined as social forestry to be developed on the basis of a strong community structure and close community ties existing among the members of the community.

Farm forestry could be defined as forestry undertaken by the farmers. But depending on the size of their farms, the products of farm forestry can either be sold or domestically consumed. As most of the farmers are small-scale, a large portion (say 80 - 90%) of

farm forestry would overlap those covered under social forestry.

Village forestry would have practically no difference from community forestry but can again be interpreted as social forestry to be undertaken in a village as a unit.

These terms are still misunderstood sometimes, for instance in Ghana two Forest Departments are operational; one Department called the Forest Department In-charge of Protection and Management of State Forests and another, Agroforestry Department In-charge of Extension Forestry dealing with farmers. The latter would better be called Social Forestry Department but without excluding agroforestry as one of its important policy measures to promote tree planting by the farmers.

4. FUTURE PROSPECTS

The obvious conclusion coming out of the present situation would be that forest policy and administration in developing countries must be aligned to the needs of the rural people urgently.

Contrasting features are observed in Kenya:

- strong political will to promote social forestry countrywide contrasting with a low level of tree planting on farm.

- the rural people wanting to plant trees but little assistance reaching grass-roots' level.

No doubt there are various constraints which are creating these contrasting pictures such as financial, organizational and political reasons. However, apart from overcoming the mentioned constraints, there is need for continuous efforts to be made by the government Foresters to correct misunderstanding within the allies, and of which the most important task of the government would be to establish clear-cut social forestry policy and re-organize forest administration.

When doing so, it should strongly be emphasized that the people's felt needs must be taken into account. Concomintantly any policy changes and administrative reforms must reflect the people's felt needs.

The developing countries often react to and criticise "Paternalism" of donor agencies with reason. It is unfortunate, however, that the government's paternalism override the felt needs of the rural people even in implementing social forestry measures.

An example is quoted from Nepal. In 1977, the officials of the Ministry of Forest felt that the people in the mountain areas of Nepal were ignorant of the importance of forests, they had no spirit of self-reliance and lacked initiative to plant trees. These were the reasons

for the government not being able to promote people's tree planting in the area. However, it turned out that the people clearly had their own priority order for tree planting: the first priority - a few fruit trees around the house, the second - more number of fodder trees on the farm, third - woodfuel forests around the community, and the fourth - timber species in the more remote area. What the government was doing was in fact to plant pines on the government land, meaning that they were persuing the lowest priority given by the people without involving the people in the decision making process and its implementation. Moreover, the pine was the only manageable species by the government officials for woodfuel or animal fodder. Start of the Community Forestry Development Project was made, first of all, by correcting this misunderstanding.

OPENING ADDRESS

Mr. C. R. J. Nyaga
Director of Forestry
Kenya Forest Department

Distinguished Guests, Fellow Officers, Ladies and Gentlemen,

I am happy to be among you today to share experience in the field of social forestry. Social forestry, community forestry, farm forestry and rural forestry which are all very inter-related refer to tree planting activities by the "wananchi" on land outside the gazetted forest land.

This Seminar on Social Forestry has been organized by Kenya Forestry Research Institute (KEFRI) under the auspicies of Japan-funded Social Forestry Training Project.

The Seminar objectives are:

(a) To provide Senior Forest Department Field Officers in-charge of Management and Extension with upto date information in social forestry such as global trends, policy orientation in other countries, measures being taken and current issues.

(b) To enhace the awareness of the Senior Forest Field Officers and others of the same rank, with the current global emphasis in Social Forestry

Management as opposed to Traditional Forest Management.

I am indeed grateful to KEFRI and JICA for moving fast and for their keen interest in making these Seminars a reality. This will indeed go a long way in meeting the committment of satisfying the tree-related needs of the rural population.

However, in the recent past, forest cover has continuously decreased due to the pressure exerted by the high population growth rate. This has consequently meant that forests are further pressed to supply more timber, poles woodfuel.

Gazetted forest comprises of only 2.9% of the country's total land area rendering the forest resource not sufficient to supply the needs of the rapidly increasing rural population.

Only 20% of Kenya is classified as high and medium potential land in which 80% of the forest area lies. 80% of the population is concentrated in this small area also creating pressure on the agricultural land which therefore results in illegal cultivation, over-grazing and illegal cutting of trees in our meagre forest land.

The hope of acquiring more land for gazettement for forest development in this area is non existent. Yet our rapidly increasing human population calls for increased forestry

resources for use in various domestic and industrial requirements. This trend can only be reserved by encouraging the local population to plant trees in their farmlands to satisfy their increasing demand for woodfuel, poles, timber and fodder.

Other benefits accruing from trees are shade, aesthestics, fencing, wind break, honey, medicine, dyes, fibres, etc.

We all know the integral part played by trees and especially their extensive root structure in conservation of soils and water. The advantages of tree growing by the wananchi are unlimited and hence the importance of such a Seminar that tackles issues concerning tree planting by the people and for the people.

Trees well intergrated in the farming system can be an important cash crop, earning the farmers huge sums of money.

We cannot talk about social/rural forestry as a means of rural development without considering the department's extension services. Extension is an integral part of rural development in that it is a means of introducing new knowledge or information to the people.

Extension, a term which is open to a wide variety of interpretations, is an educational process directed towards

the rural population to help them solve their problems. Extension also aims at increasing the efficiency of the family farm,to increase their farm production and generally increase the standard of living for the farm family.

The objective of extension is to change the farmers' outlook towards their difficulties. It is concerned not just with the physical and economic achievements but also with the rural people themselves. Extension Officers therefore discuss matters with the rural people, help them to gain a clearer insight into their problems and also to decide how to overcome some of these problems.

Hence forestry extension is a means of helping the farmer identify his tree-related problems and assisting him by demonstrations and supply of materials and tools to solve the problem in the easiest, quickest and cheapest way.

In this respect, the role of a District Forest Officer, assisted by the Rural Afforestation Extension Officers and other relevant Senior Government Officers in the field will be:-

- To assist wananchi start and operate small tree nurseries either as individual farmer or farmers or as women groups.

- To help in the selection of tree species for the differenct ecological zones and according to end use.

- Raise seedlings in Forest Department nurseries for sale or distribution to wananchi.

- To show wananchi which system is best suited for their farm, e.g. agroforestry, woodlot, boundary planting, alley cropping, etc.

- To demonstrate to wananchi how trees can be integrated into farming systems in agroforestry.

- To help identify the market and fix prices for the products.

- To provide technical advice and material assistance to wananchi.

In the past, the DFO has focused more in the development of the industrial and gazetted water catchment forests and had very little to do with the farm forestry. This Seminar, and the others proposed, will inject new approach into the look of future forestry development in the country. In addition to the current and past forestry development practices, the DFO will now be required to focus even more emphatically on tree growing on the farms. As an overall Forestry Manager in the district, he will be required to work closely with and give appropriate guidelines to the Rural Afforestation Extension Officers. He (the DFO) will be expected to be R.A.E.O. No. 1 in his District. In future, the DFO's successfull performance

and even promotion will be determined by his success in developing and encouraging tree growing on the farms. I will personally visit all districts regularly to assess our overall performance in this field.

The Forest Department is also committed to the afforestation of arid and semi-arid lands. In these areas, special measures like species selection, water harvesting, soil conservation and control of grazing are given special emphasis for the success of any afforestation programme. The conservation of the existing shrub vegetation should be enhanced to provide suitable microcatchments for tree growth.

Various other government ministries, national and international organizations are involved in the tree planting activities. These include the Ministry of Agriculture, Ministry of Energy, UNEP, ICRAF, Environment Liaison Centre (KWDP), CARE (K), KREDP, KENGO, Green Belt Movement, KEFRI, Church Organizations and several other non-governmental and self help groups.

Our duty in the Ministry of Environment and Natural Resources and especially Forest Department is to take the lead, co-ordinate and direct all these well intended tree planting activities. These are all our supporters and they must be given every possible support and guidance.

The government established the R.A.E.S. under the Ministry of Environment and Natural Resources way back in 1971. Although the start of our activities was slow and many times very poor, we must now assure the members of the public and all the participating institutions of our effective co-ordination and lead in agroforestry.

Alot of resources especially funds have been directed into various supportive organizations but now the time has come for all these groups to be unified and all the activities co-ordinated by Forest Department to avoid resource waste by duplication of efforts. Every DFO therefore must co-ordinate all rural afforestation supportive agencies/organizations in his district and regularly report these performances and future projections.

IMMEDIATE TARGET

Our immediate assignments are to ensure that all schools start tree nurseries as soon as possible. This way the pupils will be involved in greening the school compounds, and even their home compounds. The schools can also be involved in tree planting along the road reserves and on any public grounds.

CHIEF NURSERIES

It is our responsibility to visit all the Chiefs to help them start or maintain the locational nurseries. This practice is spreading down to the sub-locations and this

must be encouraged as far as possible. Such nurseries are classrooms which will enable the members of the public to have the feel of tree raising problems.

OTHERS

Similarly, all KANU nurseries, individuals and group nurseries, etc must be encouraged. Other organizations both governmental and non-governmental must also be co-ordinated.

Regular meetings and localised seminars for all such supportive institutions should be organized to solve the problems and improve their performance. As I said, your success in this field will be determined not by the number of tree seedlings you grow and distribute to the farmers using departmental funds, but the number of tree nurseries and seedlings you cause to be raised by the farmers and all the supporting and willing rural tree growing agencies or institutions.

I do not wish to dwell much on this vast subject of social forestry because as I see in the Programme we have experts to deal with each technical subject.

It is my hope that after your deliberations, you will have a chance to attend our ASK, Nairobi International Show.

My task today is to welcome you to the Seminar and for those of you from the districts, you are welcome to Nairobi.

With these few guiding remarks, I wish to declare the Social Forestry Refresher Course II now officially open. I wish you all a very enjoyable and worthwhile stay.

Thank you.

TREE NURSERY TECHNIQUES IN SOCIAL FORESTRY

Mr. P. K. A. Konuche
&
Mr. J. M. Kimondo
Kenya Forestry Research Institute

1. INTRODUCTION

For any afforestation programme to achieve reasonable measure of success, there must be well stocked nurseries having high quality planting material available at the right time and produced at low cost. These objectives can only be achieved through the use of sound nursery techniques.

The existing social forestry programmes, through Rural Afforestation Extension Schme of Kenya's Forest Department (RAES), other organizations have largely adopted various nursery techniques gained, though some modifications have been made. The rapid expansion and the changing forestry polices call for urgent review of existing techniques so that the problems facing the Extension Forester can be minimized. This paper therefore reviews existing techniques and highlights those relevant to social forestry programmes.

2. SETTING A NURSERY SITE

In industrial forestry, a good nursery site has to meet the following considerations: be accessible to vehicles, be close to reliable source of water and soil. It should also be on a level ground or on an area with slight slope having good drainage. Such a site has not been difficult to select within forest estate.

However, under farm forestry, it is extremely difficult to find land to locate a tree nursery. The four factors normally considered in selecting a nursery site all become limiting. In arid and semi-arid areas water alone is a common limiting factor.

Since social forestry implies close participation of the people, the Extension Forester can however, still overcome the above constraints. The constraints could be reduced by adopting strategies which need limited land and reduces the need for much water and soil collection. A practical way to do this is to encourage and train some farmers to raise their own seedlings for their own use and for sale.

2.1 PREPARATION OF SEED BED

Seed germination beds may be constructed using

timber planks, or bricks and concrete blocks as has been the practice in industrial forests. The most important factor is sufficient drainage. However, for the small community or individual nursery, a well structure soil, on a flat ground like with agricultural crops makes a reasonable seedbed.

In the farm forestry, a cut 'debe' perforated at the bottom also constitute a seedbed. The bottom of the 'debe' should be filled with coarse material like rocks and the top 20 cm with top soil collected locally on the farm.

2.2 SOIL MIXTURE

In the early years of plantation forestry in East Africa, efforts were made to standardize nursery potting mixture through development of the well known Muguga Soil Mixture. The mixture had the following ingredients as parts by volume:-

5 forest top soil
1 chopped peat
1 clay crumbs
1 crushed stone
1 well rotted animal manure

NPK fertilizer was added to the mixture at approximately two kilogrammes per cubic metre. Pine soil was also added when raising pines.

Outside Muguga, the mixture was greatly modified to make the best use of locally available ingredients. This is still the practice today. However, the forest top soil is still the basic ingredient in most nurseries even those managed by RAES and far away from forest reserves. This practice in RAES nurseries has not only increased the cost of seedling production, but also limited the production. There is therefore a need to use the locally available top soil as the basic ingredient provided that it has good drainage and reasonable fertility. Experience in some tree nurseries indicates that it is possible to do so. The fertility can be improved by use of compost, well rotted animal manure and even addition on NPK fertilizers. Vegetable farmers have been using such techniques and there is no reason why they cannot be used in small tree nurseries.

In arid and semi-arid areas, most nurseries are located along the riverine areas where good top soil is readily available. High quality seedlings have been produced in such areas without addition of any other ingredient.

2.3 NURSERY CONTAINERS

In plantation forestry, boxes and Swaziland beds have been used for a long time in raising planting

stock. In mid 1960s and early 1970s, some nurseries introduced the use of clear polythene tubes in an effort to improve field survival. Since then, the 150 gauge tubes which are 10 cm lay flat and 15 cm long (popularly sold as 4 x 6) have been adopted as standard tubes. Each tube has a soil volume of about 500 c. c. (half litre) and weighs about 0.75 kg.

The choice of the size of container depends on field condition i.e. how the planting site is prepared. With the standard tubes seedlings of 25 - 35 cm height have been found to give satisfactory survival in high potential areas. Slightly larger tubes are preferred in semi-arid areas where planting stock of 35 - 50 cm height is required.

In current farm forestry programmes, very many types and sizes of containers have been introduced. They range from the 200 c. c. school milk containers to 50 litre (50 000 c. c.) containers for "ceremonial" trees.

The nurseries use huge amount of soil and a lot of money goes into soil collection. For example a small nursery producing 10 000 seedlings using standard polythene tubes requires 7.5 tons of soil

A large nursey producing one million seedlings requires 750 tons (100 lorry loads). 100 seedlings in litre tins requires 3 tons of soil. What all this means is that the Forester has to consider carefully what type of container to use. It also means that the price of seedlings must be raised to cover the price of containers as well as the cost of soil collection and plant maintenance.

In farm forestry, individual farmers can still produce high quality planting material using open beds as has been the Forest Department's practice in the high potential areas. This is because the distance the seedling is transported at the planting time is minimal and thus may not affect the survival.

2.4 SEED SOWING AND PRICKING OUT

The commonest method of raising planting material is to sow the seed in seed beds and then prick out into containers 2 - 3 weeks after germination. This technique is time consuming and results in losses of seedlings through damping off and damage.

In farm forestry, it is advisable to use direct sowing into containers of open beds. Though requiring a lot of seed, this method is simpler and cheaper. Most of the indigenous species have

large seeds and they fit well into this technique. However, for the small sized seeds, a small seed bed is advisable where seeds should be sown densely.

2.5 SHADING

Shading in nurseries help to maintain moist conditions which improve germination and survival of seedlings In humid areas, shading is necessary in seed beds and a few weeks after pricking out. In hot arid and semi-arid areas, however, shading may be necessary for upto two months after germination (in directly sown containers) or after pricking out. The practice in some nurseries in dry areas is to plant trees in the nursery to provide shade. As trees grow bigger they provide too much shade. It is therefore necessary to carry some regular thinning and/or pruning in order to avoid over-shading the seedlings. Shaded seedlings must be removed gradually for a period of three weeks before planting out otherwise they suffer great shock when taken directly from shade to field for planting.

2.6 WATERING

This is the most important operation in tree nurseries. Watering is mostly carried out by

hand using fine-rose watering cans. Containers should have drainage holes to avoid water-logging. With some soil containing large proportion of clay, watering results in soil compaction which prevents infiltration. Lossening is therefore necessary otherwise the water only moistens the upper surface. This is easily achieved through disturbance of the top layer of the soil.

The quantity of water necessary depends on the weather, the type of soil used and the amount of shade provided. In polythene containers in semi-arid areas, 1 000 seedlings require about 30 litres per day. In humid and sub-humid areas half that amount is probably adequate. What must be stressed is that there is a tendency to over-water the seedlings particularly in semi-arid areas. The occurrence of green algae on the surface of the containers is an indication of over-watering. Such over-watering increases damping-off, water-logging, reduction of temperatures, leaching of nutrients and results in stunted, yellow seedlings which establish poorly in the field.

2.7 WEEDING

The top soil collected for nursery use contains huge quantities of weed seeds. Weeding in nurseries

is manually done and can be labour intensive. Therefore weed seeds should be reduced before filling the soil into containers. A possible way of doing this is to induce weed germination through watering to stimulate weed growth and then remixing the soil, thus killing germinated weeds. This can be done in the nursery or on soil collection site.

2.8 ROOT PRUNING

The purpose of root pruning is normally to prevent development of long tap root and promote growth of fibrous roots. It is important to water the seedlings heavily before and after pruning. Pruning is normally done with a taut wire for underneath and sharp knife for side pruning in boxes or Swaziland beds. In tubed stock a taut wire can be used. However, even lifting or shifting the tubes or moving as if re-arranging has been found to be an effective way of underneath root pruning.

2.9 NURSERY PERIOD

The longer the seedlings are kept in the nursery, the higher the cost of production. The nursery period should therefore be as short as possible. In arid and semi-arid areas, a period of 3 - 5

months is normally adequate to raise seedlings of about 30 cm height. In cooler sites twice that period is required. However, with the introduction of larger containers and the need to raise the ceremonial planting type of seedlings, longer period of upto 2 years might be required.

Seedlings kept for unnecessarily longer period in the nursery require regular top dressing as they soon exhaust nutrients. They also consume alot of water and hence require extensive nursery labour unnecessarily. Too long a period also produces seedlings with deformed roots which tend to affect their field performances. The Forester should therefore minimize the stocking of such large seedlings unless the price is such that they can cover the costs.

3. HARDENING AND CULLING

This is a technique to recondition the seedlings to field conditions. It is done by gradual reduction of the quantity of water applied or by removal of the shade or by partial lifting or root pruning. Seedlings grown in open beds and which have not been pruned before can be hardened by partially pruning them several weeks before planting. Heavy watering should always be done before planting out hardened seedlings.

Transporting seedlings to the field requires a lot of care to ensure the seedlings are in their best form. Therefore the weak, abnormal and stunted ones should be left in the nursery (culled) and only the healthy ones used in the field planting.

3.1 SPECIES

The type of species to be raised depends on the objective of the tree planting.

For social forestry programmes, the choice will be made by the communities involved. However, the Extension Forester should attempt not only to diversify the species to include a variety of fruit trees, but also ensure species - site compatibility right from the start.

SELECTION OF APPROPRIATE TREE SPECIES

Mr. P. B. Milimo
Kenya Forestry Research Institute

BACKGROUND

What Kind of Forests Do We Need?

Kenya's forests, and of the world, are undergoing profound changes. The natural forests with their jumble of sizes and species are giving way to forests uniform size, uniform age, all neatly spaced.

The trees themselves are bing transformed.

These changes and yet more - to the fungi, the bacteria, to the very soil of the forest - are being brought about by one other change, the most fundamental of all: a change in our relationships to the forest. We have begun to "manage" the forests, and in so doing, we ourselves are being transformed.

We once were simple wood cutters - harvesters - we are attempting to become as well growers - forest farmers.

Done well, forest management can yield almost incredible benefits. Done badly, the hazards are appalling. The difference will lie on the choice we take.

HISTORY OF SELECTION

The selection of species is still not a precise science and is largely reliant upon personal knowledge, judgement and experience augumented by literature reviews. Thorough knowledge of the planting site, the proposed end-use of the trees and of the range of potentially suitable species available is required - (Boland 1987).

All tree planting programmes require clearly stated objectives before planting can start with all economic, staff and time-frame constraints carefully analysed and documented. A study of expected goals and final results of similar projects, including personal visits, if possible, are desirable pre-planting exercises.

Few individuals or groups have all this knowledge. It is therefore essential that a research component involving species, seed sources, management and silvicultural options be built into new programmes. Although there have been instances where a single species has been chosen and planted widely from the start, one should be aware that new 'miracle' species often have not been adequately tested and may not meet the projects' expectations.

The problem of selecting tree species for non-industrial uses in developing countries has been made more difficult because of the recent world awareness of the importance of forestry to rural development. Coupled with this is the pressure to achieve results quickly. Unfortunately, there is often lack of experienced personnel for the work involved. Reliable information on the ecology, silviculture and utilization characteristics of many of the potentially valuable species is still unavailable and hampers their selection. Typically, emphasis is still given to fast-growing trees for fuelwood, shelter, and agroforestry uses but with acquisition of information it may be possible to trade-off species with rapid growth for those with slower but greater resistance to drought, fire or pests, lesser water and nutrient requirements, or providing other products than wood. Compounding this problem is the difficulty in properly evaluating species performance, especially for those species providing more than one product or benefit.

EVOLUTION

As a result of evolution - plants and animals sharing the earth with us - have been classified into discrete and identifiable categories termed taxa (singular taxon). Some taxa include members that are only physiologically distiguishable; others manifest clearly unique visible structural differences. An example of the former may be two Eucalyptus camuldensis provenances that look quite alike but are differentially hardy.

Science concerns itself with methods of classfying life forms. One logical way of arranging the plant kingdom is evolutionary relationships. Very closely related taxa are grouped as sub-units of the same species; most distantly related and distinctive taxa fall into groups of higher rank. The name attached to an organism not only identifies it, but relates it to all others.

The basic taxon used in classifying living organisms is the species (singular and plural). This was presumed by early botanists to be the unit of creation, the distinctive entity (Janick et al. 1981). Species may be sub-divided into sub-species or varieties, for additional identification. These are important because they represent natural variation that we base work on species and provenance selection. Selection for improvement is one element of a domestication process that is often considered for increased yields.

Trees, unlike agricultural crops, have been difficult to improve genetically, because of their long generation times and the prevalance of out-breeding. Although some genetic gains have been achieved, Foresters have traditionally improved yield and form by provenance transfer. Recently, however, they have started to use techniques of clonal forestry in exploiting the considerable amounts of genetic variation present within wild populations.

As man began influencing on which trees he would produce in forests, and further, began planting and husbanding forests,

domestication of forest trees surely commenced. Today, tree breeders can call on centuries of wisdom accummulated during the domestication of our agricultural plants and animals, and decades of experience with applying the principles of genetics and evolution to create modern breeding theory and practice. This paper addresses problems and strategies of tree species selection in forestry.

There are two levels of selection to be discussed:

(a) Selection from the original genetic variability within a species:-

  (i) Selection of desired genes or trees

  (ii) Converting these gene packages into growing trees to be harvested as renewable resources

(b) Selection at a species level for those species that have desired characteristics.

ORIGINAL VARIABILITY

Man in ignorance, has made some mistakes during millenia of domesticating crop plants and animals. We wish he had studied the ecology of the native ancenstral populations before he changed them and with domestic varieties, for this knowledge would be useful as well as satisfying today.

We wish we had saved more of the variability which was present in the ancestral populations, as the modern breeder could effectively draw on such a reserve of variability to better buffer against diseases, insects, and other environmental insults which wreak havoc with our ecologically-fragile, genetically-narrow modern crops.

NATURAL SELECTION

The action of the environment, as opposed to the action of man, on individual organisms such that those possessing genotypes better suited to the environment will survive and reproduce more successfully than those with less favourable genotypes, which will eventually die out. By this process the characteristics of a population may diverge into a number of distinct groups each adapted to a particular microenvironment. This process will be hastened if there are barriers to gene flow between the groups. The concept of natural selection is the cornerstone in Darwins theory of evolution.

Allele: (Allelomorph) A form in which a gene may occur. Different alleles of a gene give rise to different expressions of a character. Hence alleles for 'green' and 'yellow' are alternative expressions of the gene governing the characteristic for seed colour.

SPECIES RANGE AND TOLERANCE

The tolerance of a species is represented by the range of

climatic and soil conditions within which it can exist and reproduce. The expression ecological amplitude is sometimes used to describe this range of conditions.

In ecological literature, many theories of tolerance have been proposed. One defined in terms of applicable to crops that is of great interest to ecologists and geographers is by V. E. Shelford. This is stated as follows:

1. Species with a wide range of tolerance are likely to be widely distributed.

2. When one environmental factor is limiting, the range of tolerance to others is likely to decrease.

3. The range of tolerance is likely to be narrowest during the period of reproduction.

Tolerance has a genetic base: The environment can influence the growth and development of organisms only within genetically imposed limits. Species with a wide range of genetic diversity are more likely to respond favourably to new and changed environments than those with a narrow genetic base.

The evolutionally forces that determine the range of species involve differentiation and speciation. Long-term forces apply only icidentally to crops, plants, because people

have imposed evolutionary changes through artificial hybridization and other kinds of genetic manipulation. Adaptability becomes one of the main goals of modern plant breeding. The relatively slow migration of natural species, hampered in many cases by natural topographical barriers, havs given way to widespread and rapid introduction to exotic species.

Plants in different stages of growth may have different tolerance. Like animals, they change in structure as they develop. The developmental phases respond differently to environmental factors.

The limits of tolerance are often narrow in the seedling stage. For example the stem of a newly regenerated Dobera glabra has no protective bark and may be killed quickly by temperatures of greater than 50°C or lower than 20°C. But the same tree when ten years old or more will tolerate temperatures approaching the boiling point for a few minutes, because a thick layer of bark will have developed.

Because the geographic ranges of species are tolerance-limited, much effort has gone into world-wide search for areas with similar climates in order to weigh the prospects of ssuccessfully introducing plant species from other areas. Areas with similar climates are called homoclines, and if it is with reference to agricultural production they are called agroclimatic analogues. Trevor Booth at CSIRO has

developed homoclines of Australia in relation to similar sites in Africa and South East Asia. This he has done by use of mean temperatures and rainfall. This makes it possible to introduce plant species into sites that closely resemble those of the plants natural range. This way, the introduced plant favourably responds to selection pressure of the new site because they closely resemble those of the original site.

HISTORY OF TREE INTRODUCTION AND SELECTION

The cultivation of exotic plants has had a long history. The introduction and domestication of real crops such as wheat from the old world and fruit crops like tomatoes from the new world, are reasonably well known; but the equally long history of tree crop introduction is often overlooked.

The history of tree introduction for non-food purposes is much more recent. The Romans introduced the shruby plant Rhus carlarea into spain to use its leaves as a tannin source (Gonzalez 1982). While in East Africa, Arab Dhow Captains planted Casuarina equisetifolia to clearly mark habour entrances (Perry and Willan, 1975). Though native trees were used in situ for a wide range of non-food uses such as shelter, weapons and handcrafts, it was not until in the 19th century that scientifically managed indigenous and exotic plantations were established.

Extensive plantations of exotic Pines and Eucalyptus were planted widely during the 20th century for industrial wood and this development overshadowed the need to cultivate trees for other purposes like fuelwood.

The scientific techniques and methodology employed in species selection, introduction and breeding that has been developed for industrial plantations can also be adated for selecting trees for non-industrial uses. However, the only change to be made is the selection criteria and may be some of the management techniques. There is no doubt that the range of species available for selection has greatly increased because of the increased diversity of products. Also, tree size, stem straightness and wood quality are no longer vital factors.

The major research effort in any tree improvement programme involving tree species for the so-called 'non-industrial' uses must be in the initial species screening stage. Unfortunately, this is made difficult by lack of basic information to be included in trials.

QUALITIES REQUIRED OF SPECIES FOR AGROFORESTRY AND FUELWOOD

The goal of agroforestry is to optimise per unit area production while respecting the principle of sustained yield (Combe and Budwski, 1979). Trees and shurbs are the dominant features of mature agroforestry systems and

in choosing species for the system it is necessary to decide on the following:

(a) What species?

(b) How many trees?

(c) How should the trees be arranged?

To resolve these questions, one must develop a feeling for those characteristics that enhance the value or diminish their suitability for any particular agroforestry system (Huxley, 1983). In this case, technical, managerial and socio-economic considerations must all be addressed.

A restricted list of special uses for which tree species may be required include fuelwood, roundwood (poles and posts), fodder, live fences, shade, windbreaks, soil protection (erosion control) and soil improvement.

FUELWOOD

Fuelwood is required by both industrial and non-industrial nations but consumed much more in countries where domestic fuelwood is often essential for cooking and heating. Rural people who traditionally obtain fuelwood from indigenous species whose burning and smoke properties are well-known, are often extremely reluctant to change to exotic woods for a number of psychological or practical reasons. These preferences must be considered in the selection of species for fuelwood.

The qualities needed for fuelwood can be divided into physical properties of the wood and silvicultural/ environmental properties of the species. Thornless trees or shrubs with small stem diameters are easier to cut with primitive impliments and to transport. The wood should be easy to split and have a low moisture content or be relatively fast drying (e.g. Grevillea robusta), as considerable heat is lost in burning moist wood.

For health reasons, smoke should be minimal and non toxic (Poynton, 1974) as ventilation is traditionally poor in most rural houses. For safety reasons, wood should not split or spark while burning. Studies to date indicate that a negative correlation exists between fast growth rate and density, so that fast grown trees have inferior burning qualities compared to those that have grown more slowly.

ROUNDWOOD (POLES AND POSTS)

Poles and posts are very important for home and fence building in many parts of Kenya. Commonly, posts and poles are taken as saplings from native forests or are by-products of forest plantations grown for other purposes. Eucalyptus plantations often have the first thinnings used for fence posts and the remnants for telephone or electrical transmission poles.

Poles are in great demand for rural house construction especially as rafters that can bear heavy cross loads. Acacia mearnsii or Eucalyptus are often used as house poles. In urban areas, poles are required for scaffolding and it is not uncommon in India to see all building surrounded by a maze or bamboo, eucalyptus, or casuarina poles.

Quality of species for suitability as poles can be divided into wood and silvicultural characteristics. Poles should be durable, light, capable of taking high cross-loads (high strength to diameter rations for a given length is vital), have minimal spirality to avoid opening up when in use, be resistant to termites and other wood bores, or be capable of taking preservatives easily.

The tree should be straight, having strong apical dominance, few or thin branches and preferably self-pruning without leaving knots that cuases weakness, little taper from bottom to top, and the bark should strip easily.

FODDER

In dryland areas, trees may be required as an emergency fodder supply, especially during drought periods. Ideally the follage should be palatable, nutritious and digestible.

Fodder trees have to be carefully protected during their early years from all forms of livestock, especially goats. Trees should produce large crowns above livestock reach.

Casuarina equisetifolia has helped to stabilize coastal sand dunes by binding the sand with numerous fine roots and sheeding or branchlets that form a thick and slowly decomposing interlocked mulch on the sand surface (Kondas, 1983).

Common tree qualities sought for erosion control are fast and healthy growth under adverse conditions.

Spreading crowns; vigorous vegetative reproduction, e.g. root suckers, or heavy natural seed fall and natural seedling development in situ without the tendency to become a weed; trees having roots with high strength values - especially in areas prone to land slip; and fire tolerance.

SOIL IMPROVEMENT

This usually involves planting trees to increase the nitrogen content of the soil. Therefore nitrogen fixing species are used. Such species may be rotated with the crops or grown as mixtures such that one may benefit from nitrogen and the other from shade.

There is considerable international interest in growing mixtures of leguminous species. Soil improvement can also occur through the transfer of nutrients from the lower layers to the soil surface where they are available to crop and pasture plants. Certain plant mycorrhizal associations are also able to tap refractory phosphate thus improving available phosphorous deficient soils.

The crowns must be capable of severing lopping during periods of high environmental stress.

Alternatively, in intensively managed agricultural areas, trees can be grown totally protected and the leaves then harvested and fed to livestock, e.g. Leucaena leucocephala.

LIVE FENCES

Fences created with trees or shrubs are common because of their low establishment cost. Few are totally effective and gaps created by drying plants have to be filled by either planting or more commonly by dead branches.

Species with prickles or spines, or having stiff branches, both with non-edible leaves are preferred. Ideally, species should be fast-growing and of medium height, long-lived, be capable of growing under adverse conditions and close together. Minimal maintenance is essential although some trimming can be undertaken.

SOIL PROTECTION - EROSION CONTROL

Trees are often required to prevent soil loss through wind or water action and often very hardy trees for poor sites are required. The basic idea is to prevent soil movement by root-binding the soil, preventing direct impact of rain-drops or by increasing the percolation of water through the soil. Leaf fall also provides a ground cover that further protects the soil.

COLLECTION, TREATMENT AND STORAGE OF SEEDS

Gert Rode
&
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Kenya Forestry Seed Centre

1.0 INTRODUCTION

The growth rate of Kenya's results in an expansion of agricultural acreage and an exponetially increased need for timber, firewood and charcoal, fodder, erosion-control, water catchments and other environmental effects of planting trees. It is estimated that Kenya's wood consumption exceeded the increment of the resources by 4.3 million tonnes per year (BEIJER Institute cited in Owino, 1988).

The demand for woodfuel and the supply projections to the year 2005 indicate a shortfall of 27.5 million tonnes (Gathaara, 1988).

Owino (1989) judges the increase in the number of trees grown in maturity to be almost tenfold to provide the services. One of the basic requirements to meet

these needs is the large scale production of vigorous and locally adapted plants derived from seeds of high quality and defined provenances (Rode, 1988).

It is the essential objective of the Kenya Forestry Seed Centre to procure forest seeds in sufficient quantity and quality from seed orchards, certified seed stands and selected trees.

Seeds are expensive and delicate goods, which have to be treated carefully. Every person involved in seed handling is therefore requested to make the best use of seedlot. That means for the Seed Centre to optimize the organization of seed collection and extraction to develop and recommend suitable pre-treatment and storage methods to minimize the period of delivery to the consignee.

2.0 ORGANIZATION

The Kenya Forestry Seed Centre at Muguga is a sub-programme within the Tree Improvement Programme of the Kenya Forestry Research Institute (KEFRI). The Seed Centre incorporates and handles the processes of final extraction, seed cleaning, testing, storage and distribution. Seed Collection is largely centralized to six Seed Collection Centres in:

Gede

Kakamega

Kibwezi

Londiani

Nyeri

Turbo

Thus all the different ecological zones are covered, special emphasis has been put on semi-arid areas and on indigenous species. The Collection Centres forward the seeds after extraction to the Seed Centre which supervises the work in the Collection Centres, and also conducts seed collection within the vicinity of Muguga.

3.0 SEED COLLECTION

3.1 Seed Sources

Seeds of the two most important plantation species Cupressus lusitanica and Pinus patula are collected mainly in clonal seed orchards, where we have a broader genetic base than in plantations or - it is also the case with Eucalyptus species - from certified seed stands with a size of at least 5 ha and with a superior phenotypical performance. Indigenous plantations species from high potential areas like Juniperus procera, Maesopsis eminii, Prunus, Africanum and Vitex keniensis, Premna maxima are obtained from selected seed stands in

various districts (Table 1).

The selection criteria for seed stands are:

- Superior volume production
- Uniformity
- Form and Growth
- Fine Branches
- Minimum are of 5 ha, exception for seed stands of rare indigenous species 1 ha
- Adequate age for long term seed production
- Accessibility

The selection occurs in plantations only as (1) frequently the size of the remaning natural forest area is too small, (2) the natural forest is not accessible, (3) species to be selected are mixed and scattered over a large area in a number of different forest types and (4) there is no possibility of demarcating the collection units. seed stands in Kenya are subjected to thinning and other treatments to improve the genetic quality. Due to their importance for seed supply and gene conservation, the selected seed stands should not be felled without authority from the Seed Centre.

Until 1988, 42 new seed stands were selected with a total of 456.3 ha comprising 5 species exotic to

Kenya (Eucalyptus saligna, Gmelina aroborea, Grevillea robusta, Pinus aribaea, P. patula) and 7 indigenous species (Brachylaena, Prunus africanum, Juniperus, Maesopsis, Eminii, Polyscias Kikuyu) stands were recommended for long term protection to the Forest Department (Jestaedt and Rode 1986).

Within the natural forest and in the semi-arid land the important indigenous species can only be found scattered over a large area. Selection and protection of idenfiable units as seed stands is thus not possible. The phenotypical selection of individual trees within a defined area of homogenous climatical and if possible soil conditions was considered the alternative. It proved to be good to restrain the area to the vicinity of forest station, as only their protection and actual collection from the selected and marked trees are ensured. Within the defined area 20 - 50 individual trees per species are selected with a miminum distance of 50 m apart. In this connection, criteria are taken into account, which distinguish the selected trees are thus phenotypically, better population mean. The selection standards depend absolutely on the purpose the respective species is used for. Heavy branching and a large crown are desired for firewood-, fodder-, or charcoal- species. On the other hand, species

providing quality timber are selected with emphasis on straightness of stem and vigour. The selected tree must have fully developed their characteristics.

In case the nature distribution of the species allows to do so, individual trees of the same species shall be selected in different forest regions of the country to obtain seeds from various provenances.

Recording of all individual trees on detailed maps is necessary containing all information about geographic location, ecological and phenotypical date. Similar to the selection of dry zone species in Central America (Hughes, 1984) are collectable populations frequently difficult to locate and the number of desired parent trees cannot always be reached due to rarity in the respective area. The genetic gain might be low since the selection criteria can show little heritability but it will extend the little knowledge we have about these species so far.

The demand for seed of the agroforestry species spectrum has increased considerably in the last years in Kenya. Seeds of e.g. Calliandra calothyrsus, Gliricidia sepium, Grevillea robusta, Leucaena leucocephala, Parkinsonia aculeata, Prosopis chilensis, Sesbania sesban, etc. can only be obtained in small quantities from stands (Grevillea robusta)

or scattered single trees (Parkinsonia aculeata, Sesbania sesban). For this reason a programme was set up which aims at the establishment of seed stands or seed production areas as immediate source of suitable origin. In 1986 one stand of Prosopis chilensis was planted, others followed in 1987 and 1988 including species like Calliandra calothyrsus, Albizia falcataria, Gliricidia sepium and Parkinsonia aculeata. The size of the stands is usually 2 ha, but depends on the respective possibilities in the area. Seeds of species in high demand which cannot be obtained locally, are imported in small quantities and subsequently used as a seed source for the establishment of a seed stand. In some cases a so-called "general collection" of a particular species has to be accepted due to a very high demand but the Seed Centre does not tolerate any seedlot without a clear information about the origin (Rode, 1987).

3.2 Method of Seed Collection

After checking the maturity by colour change of fruits or cones and the examination of seed contents by a cutting test on the spot, seeds are collected using different methods.

3.1 Collection from the ground

The collection of fallen fruits or cones is possible

with large and heavy fruits and cones.
Seeber and Agpaoa (1976) recommended collection from the ground of species with:

(a) heavy flesh fruits;
(b) medium sized fruits with hard kernel (e.g. Gmelina, Tectona);
(c) large capsules;
(d) large pods (e.g. Delonix regia, Tamarindus indica);
(e) large winged fruits (e.g. Pterocarpus, Dipterocarps)

Seeds can thus be collected easily and cheaply. Skilled labours are not required, but control of collection might be necessary to make sure that collection takes place under the desire trees. Collection should avoid to taking the first fruits as they are often of poor quality. Collecting should be delayed for some time until the greater portion has fallen. In Thailand for example, seed shedding of Tecona starts in March, the main collection is postponed until April.

On the other hand, some species lose viability within a few days so that collection must be timed with the seed fall.

3.1 It is necessary to clear the ground under the trees from vegetation layer and debris. Vitex seeds are collected after this preparation. Spread canvas, plastic sheeting or similar things for catching the seeds makes the work easier. Other types of catchments cannot be recommended (Turnbull 1975).

Seeds should be collected immediately when mature and fallen to avoid losses by rodents, birds, insects and fungi.

Some species hold their seeds only awhile after reaching maturity (e.g. Eucalyptus, Pinus elliotti, P. taeda). Cutting tests on the spot can prevent collecting seeds from sources with unsound or empty seeds.

For fruits which are easily detached but not in a concentrated time, this process can be influenced by manual shaking either by hand or by long poles with or without hooks and ropes. Poles with shears or saws are used to detach the fruits directly or fruit - or - seed-bearing branches. Bamboo, alumminium or plastic poles (4 - 6 m) are usual, but with telescopic poles, one can reach higher parts of the crown. It is important to know that collection is more recommended in the upper half of the crown

because fruits or cones on the lowest branches may yield little seeds as a result of lack of pollination.

Besides this fruits can be picked easily from the ground provided the trees are small and branches low. In Australia seeds of smaller Acacias may be collected by this method (Turnbull 1975).

3.2 Collection from trees on the ground

Seeds can be collected either following normal logging or trees are felled especially for seed collection. The first method must be timed with logging, ripeness and collection and subsequently the stand is felled (Turnbull 1975).

Special felling has the advantage of a high collection method for large good phenotypes, but the tree is lost as a future seed source.

3.3 Collection from standing trees

Climbing into the crown is often the only collection method for large quantities. According to Willan (1985) this method can be divided into:

(a) climbing into the crown by way of the bole

(b) climbing into the crown directly

(c) climbing and picking of fruits within the crown

In some countries collectors climb without supporting devices or with an axe successive notiches are cut into the bole. These methods are dangerous and make the collector choose trees for their ease rather than for their quality (Turnbull 1975). Mechanical aids like climbing irons, bicycles and ladders are recommended.

Climbing irons have the advantage of cheapness, simplicity and portability but on the other hand, they can cause damage to trees and require skilled climbers.

Basically they consist of a strirrup to support the foot, a shank with straps for attaching to the leg and a gaff or spike.

The length of the gaff varies, depending on the bark type and ranges from 5 cm (thin barked trees) to 9 cm 8thick barked trees).

The equipment also consists of saftey straps and belts, which support the torso of the climber and are attached to both sides of the climber's waist. In the tropics, they should be made of canvas, because leather would quickly rot.

As a safety precaution the climber should wear tough clothing which cannot catch in branches, boots with rubber soles and probably safety helmet.

The following advice is given by Issleib 196 (quoted in Seeber and Agpaoa 1976):

- Checking of equipment: spikes of the climbing irons, safety rope;
- Decide on the climbing route when still on the ground, especially for the branchy crown region;
- Climb calmly with regular movements, make short steps;
- Hit the trunk with the spikes of the climbing iron in a slanting direction from above;
- Always see three pints for a hold (two feet and one hand or one foot and two hands);
- Do not press the upper part of the body and the knees against the trunk of the tree;
- In ascending the tree avoid dead branches and resin spots, break dry branches;
- When detaching fruits, have a safe stand by fastening the safety belt;
- Do not climb when it rains, when it is windy or in darkness; also not when you are exhausted or tired.

Ladders must be light to be easily pulled by the climber. They can be made of aluminium, wood or magnesium alloy. A ladder consists of several sections, each section is between 1.8 and 3 m long and weighs not more than 3 - 6 kg. For example, the Swedish cone picking ladder is made of 3 m sections of 5.5 kg each. The sections have a stem support and a safety chain with a quick-release buckle. The legs of the ladder should be placed on adjustable platforms for stability. Each section is carried up the tree and fitted into the lower one and after it the section is fastened to the trunk by a chain or belt.

3.4 Seed handling after collection

The stage after collection can be very delicate to the seeds since they are not transported to a seed processing place in due course (Willan 1985). Seeds may loose their viability and identity, especially when transport problems occur. All the collected seedlots have to be provided immediately with a label indicating the details of collection. All the seeds or fruits are transported in gunny bags (hessian sacks) to the processing place to avoid deterioration through mould and overheating (except smallest seeds like Eucalyptus), polythene bags for transport operations are no longer in use.

Seeds are dried and extracted by using covered sun-drying beds or in case of high temperatures, under a shelter. It is tried to ensure a slow and gradual decrease in moisture content of fruits and seeds. The cones, fruits or pods are placed on top of a wire-mesh to promote free-air-circulation, which is of great importance.

Fleshy fruits are usually depulped by soaking in water and gentle abrasion, if necessary. Fruits of Vitex keniensis are dried first, and then pulp is removed by a concrete mixer, others by hand maceration. Another method of depulping or extracting seeds is the use of a mortar or in future of a coffee-depulper. A new drying unit allows the drying of fruits more gradually, which will especially be suited to indigenous species from the highland forests.

4. SEED STORAGE AND TESTING

Seed storage is an integral part within the process of seed procurement. The need for storing seeds is to provide a viable supply whenever it is required (Stein et al 1974). According to Willan (1985), storage period will vary, this depends on seed longevity of the species and the storage conditions

In order to supply seeds of a known quality to users,

monitoring and regulation of seed conditions from collection through handling to storage is a pre-requisite. This involves seed testing. To access the value of the seedlot, both physical and biological characteristics are measured(Bonner 1974). Tests carried out at KFSC include: purity analysis, weight determination, germination, occasional indirect testing of viability (Tatrozolium salt test) and moisture content determination.

4.1 Storage

Storage involves maintaining the viability of a seedlot from collection time to the time when the lot is required for sowing. Since longevity of seeds in storage is affected by their storage condition, Willan (1985) has stressed that even under ideal conditions, seed will soon lose viability, if it is defective from the start. Therefore, factors to be considered before storage are:

(a) Seed maturity. Fully ripened seeds retain viability longer than immature seeds.

(b) Parental and annual effects. In seed harvest, quantity and quality often go together. When there is a good yield, the seed quality is also high and vice versa.

(c) Freedom from mechanical damage. Seeds damaged mechanically during extraction, cleaning, dewing, etc, rapidly lose viability.

(d) Freedom from physiological deterioration. Poor handling in the forest, during transit or processing cause physiological deterioration of seeds even when mechanical and fungal damage are absent.

(e) Freedom from fungi and insects. Collection of crops showing a high incidence of fungal or insect attack should be avoided. All operations of collection, transport processing, etc have to be carried out as quickly as possible to ensure seed is not already damaged before it goes into storage.

(f) Initial viability. Seedlots with high initial viability and germinative capacity have a higher longevity in storage than those with low initial viability.

In most cases it is necessary to store the seed for varying periods. It is generally agreed that storage conditions and longevity of seeds vary from species

to species (Willan 1985); Stein et al 1974); Harrington 1972). The storage periods are generally:

(a) Upto one year. When both seed production and afforestation are regular annual events.

(b) One to five years or more. When a species bears an abudant seed crop at intervals of seveal years and enough seed must be collected in a good year to cover annual afforestation needs in intermediate years of poor seed production.

(c) Long-term storage. For purposes of conserving genetic resources and also for research work.

The KFSC is in a position to store seeds at room temperature (+24°C to +28°C), cool room (+3°C) and freezing (-18°C), due to modern and improved storage conditions. This also facilitates investigations on different storage methods to match with the increase in species diversity required. Most of the species apparently store well at +3°C, and in storage for approximately to zero to five years only.

Some species require to be sown when fresh due to rapid loss of viability. These include:

Warburgia ugandensis, Vitex keniensis, Azadirachta indica, Olea spps., etc. These species require further investigations. The other groups of species can be stored for three to fifteen years; and for more than fifteen years, for example, the Acacia spps.

There are different methods of storage depending on the availability of equipment. Where equipment is available the most important factors to be considered for seed storage are moisture content and temperature. There are seeds that are killed by excessive drying. Moisture content should be above 15% and temperature above 0°C. Most of these seeds cannot be stored for long durations and require aeration.

The other group of seeds are those that can be dried between 5 to 10% moisture content and are stored for long durations in sealed containers under low temperatures (freezing).

The KFSC is in the process of categorising species into their appropriate storage conditions.

4.2 Seed Testing

Seed tests are important after extraction and cleaning

of seeds in order to store seeds of a high quality and viability. Before planting, it is necessary to know the viability of the seeds.

At KFSC, all the incoming seeds are tested before storage or dispatch for purity percent, seed weight, moisture content and germination.

4.2 Tree seed samples often contain impurities, for example, detached seed structure, leaf particles and other objects. Purity analysis is conducted in order to determine to composition by weight of the sample being tested. Two samples are divided into eight replicates each. The replicates are weighed separately (Appendix 2). Seeds of some species cannot be separated from their impurities, for example, some Eucalyptus. spp.

Weight is determined by use of the pure seed component seperated by the purity analysis. At the KFSC the weight of 10 replicates of 100 seeds each, from which the standard deviation and co-efficient of variation may be calculated, as well as the final mean of the sample (Appendix 3).

Moisture content is determined by drying seeds in an oven for seventeen hours (slow method) at 103°C. The weight loss of the original material is used

as a measure of moisture content (Appendix 4). Moisterial is used as a measure of moisture content. (Appendix 4). Moisterial content can also be determined by use of the fast method. The seeds are heated for 2½ hours at 130°C in an electric moisture meter, which is not as acurate as the slow method. Potential germination of seeds is the most important factor in the measure of quality (Bonner 1974). The Germination test is used as an estimate of the number of seeds which can germinate at a given time. At the KFSC, seeds are germinated in the laboratory, nursery and glasshouse. In the laboratory the seeds are either germinated in germination boxes under controlled temperatures in a Rodwald apparatus, germination tank or germination cabinets. The germination media used in the nursery and glasshouse is sand. These different conditions give varying result, which aid in better approximation of seeds sown in different nurseries. In general, the results from the laboratory are higher compared to the other two locations, due to conditions being more controlled in the laboratory.

A sample of 4 replicates of 100 seeds each is normally used for germination tests (Appendix 5 and 6), except for small seeds mixed with impurities, for example, Eucalyptus spp. whereby, 4 replicates of equal weights are used.

Some species have been found to have germination problems. Hence the KFSC has an on-going research programme on these species. Recommendations are listed whenever a/some pretreatment/s is/are successful. Some papers have been written on some preliminary germination results (e.g. Rode 1986; Kariuki 1987; Kariuki and Rode 1988).

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TABLE 1: SUITED SEED STANDS

Species	District	Forest Station	Compart.	Area Ha	Year Planted
Acrocarpus fraxinifolius	Nyeri	Muringato	1 (L)	0.5	1953
Araucaria angustifolia	Murang'a	Gatare	8 (A)	2.5	1958/9
Araucaria angustifolia	Kiambu	Kerita	1 (G)	2.0	1955
Araucaria angustifolia	Kiambu	Kerita	5 (M)	3.5	1958
Araucaria angustifolia	Kiambu	Kerita	6 (B)	14.1	1956
Araucaria angustifolia	Kiambu	Uplands	4 (B)	2.0	1938
Araucaria angustifolia	Kiambu	Uplands	5 (J)	2.0	1956
Araucaria cunninghamii	Kilifi	Jilore	1 (A)	8.5	1959
Araucaria cunninghamii	Nyeri	Muringato	1 (B)	0.7	1935
Bischoffia javanica	Kakamega	Kakamega	12 (B)	26.1	1976
Brachylaena hutchinsii	Nairobi	Karura	2 (C)	3.2	1941
Brachylaena hutchinsii	Nairobi	Karura	2 (B)	4.8	1938
Cupressus lusitanica	Nakaru	Elburgon (Daraja)	2 (G)	14.0	1927
Cupressus lusitanica	Nakuru	Elburgon (Sokoro)	2 (D)	8.0	1927
Cupressus lusitanica	Nyeri	Ragati	8 (B)	14.6	1968
Eucalyptus paniculata	**Nairobi**	**Ngong Road**	2 (A)	4.0	1954
Eucalyptus regnans	Nyandarua	S. Kinangop	5 (F)	1.5	1933
Eucalyptus saligna	Embu	Njukiini	1 (N)	2.0	1978
Gmelina arborea	Kilifi	Gede	2 (B)	1.2	1973
Gmelina arborea	Kilifi	Gede	3 (E)	1.7	1972
Grevillea robusta	Embu	Njukiini	1(R), 1(S)	15.2	1980
Grevillea robusta	Machakos	Mbooni	4 (H)	27.2	1943
Grevillea robusta	Machakos	Mbooni	5 (B)	22.3	1945
Juniperus procera	Nairobi	Karura	2 (C)	2.7	1940
Juniperus procera	Kiambu	Kinale	3 (A)	8.1	1923-7
Juniperus procera	Nyandarua	N. Kinangop	9 (E)	32.0	1926-9
Maesopsis eminii	Kakamega	Kakamega	4	8.9	1938/9
Maesopsis eminii	Kakamega	Kakamega	5 (B)	10.5	1964
Ocotea usambarensis	Embu	Irangi	1 (B)	11.3	1952/3

Species	District	Forest Station	Compart.	Area Ha	Year Planted
Pinus caribaea	Kwale	Kwale	2 (C)	13.4	1970
Pinus caribaea	Kwale	Kwale	2 (D)	43.8	1971
Pinus patula	Kiambu	Kinale	4 (U)	10.0	1966
Pinus patula	Kiambu	Kinale	2 (C)	52.7	1969
Pinus patula	Nyandarua	S. Kinangop	1 (A)	12.9	1971
Pinus patula	Nyandarua	S. Kinangop	2 (D)	12.6	1972
Pinus patula	Nyandarua	S. Kinangop	2 (F)	8.8	1973
Pinus patula	Nyandarua	s. Kinangop	9 (b)	18.0	1959
Pinus patula	Nyandarua	S. Kinangop	9 (G)	13.0	1959
Pinus patula	Nyandarua	S. Kinangop	1 (C)	14.0	-
Pinus patula	Nyandarua	S. Kinangop	4 (L)	8.1	1952
Pinus patula	Baringo	Maji Mazuri	2 (T)	7.0	1949
Pinus patula	Baringo	Narasha	2 (C)	6.1	1972
Pinus patula	Baringo	Narasha	2 (D)	8.9	1972
Pinus patula	Baringo	Narasha	2 (G)	7.3	1972
Pinus patula	Nakuru	Dundori	1 (D)	37.0	1951
Pinus patula	Nakuru	Nessuit	2 (B)	11.0	1951
Pinus patula	Nakuru	Nessuit	2 (G)	24.0	1950
Pinus patula	Uasin Gishu	Nabkoi	2 (B)		
Pinus pinaster	Machakos	Makuli	10 (N)	15.1	
Pinus radiata	Nyandarua	N. Kinangop	12 (A)	11.0	1949
Polyscias kikuyuensis	Nyeri	Ragati			
Polyscias kikuyuensis	Nyeri	Kabage	10(B), 9(K)	2.0	1931/33
Polyscias kikuyuensis	Nyandarua	N. Kinangop	9 (J)	4.0	1933
Pinus africana	Nyeri	kabage	7 (E)	11.0	1923/27
Prunus africana/ Ocotea usambarensis	Nyeri	Ragati	2 (A)	1.0	1941
Prunus africana/ Ocotea usambarensis	Nyeri	Ragati	2 (I)	3.0	1940/41
Prunus africana Ocotea usambarensis	Nyeri	Ragati	2 (K)	3.0	1941/42

Species	District	Forest Station	Compart.	Area Ha	Year Planted
Vitex keniensis	Nyeri	Ragati	1 (A)	8.9	1933/36
Vitex keniensis	Nyeri	Ragati	2 (A)	6.5	1933/36
Vitex keniensis	Nyeri	Ragati	2 (C)	3.0	1932
Vitex keniensis	Nyeri	Chehe	1 (C)	13.0	1963
Vitex keniensis	Nyeri	Chehe	2 (A)	14.0	1968
Vitex keniensis	Nyeri	Chehe	2 (B)	16.6	1971
Vitex keniensis	Nyeri	Chehe	2 (C)	17.8	1972
Vitex keniensis	Nyeri	Chehe	2 (E)	12.1	1969
Vitex keniensis	Nyeri	Chehe	3 (B)	5.3	1948
Vitex keniensis	Nyeri	Chehe	3 (C)	2.0	1958
Vitex keniensis	Nyeri	Chehe	3 (H)	0.4	1948/9
Vitex keniensis	Meru	Meru	2 (D)	22.4	1966
Vitex keniensis	Meru	Meru	2 (F)	30.4	1969
Vitex keniensis	Meru	Meru	5 (A)	20.0	1968
Vitex keniensis	Meru	Meru	6 (F)	12.1	1973
Vitex keniensis	Meru	Meru	6 (G)	18.6	1973
Vitex keniensis	Meru	Meru	6 (H)	13.1	1974
Vitex keniensis	Meru	Meru	6 (I)	14.5	1974
Vitex keniensis	Meru	Meru	1 (A)	17.4	1976

Total: 76 Stands 861.9 ha

APPENDIX 1

KENYA FORESTRY SEED CENTRE

Seed Purity Analysis

Test No. ..... Date of test .....

Species ..... Variety .....

Batch No. ..... Origin .....

Date and Method of Collection .....

.....

Weight of seed of which the sample below are represetatives ..... Kg

Weight of sample used ..... grams.

	Sample I								Sample II							
	Weight in grams				%				Sample in grams				%			
Replication	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Seed with inert matter																
Pure seed																
Inert matter																

Pure seed	Weight	%
Mean of Sample II		
Mean of Sample I II & III		

Variation between samples .....

Character of inert matter .....

.....

Purity .....%. Tolerance .....

Utilization value : $\frac{\text{Purity x Germination Capacity}}{100}$

Remark: .....

.....

Analysed by: .....

NB: Secure samples that represent the bulk from where the samples are drawn.

APPENDIX 2

KENYA FORESTRY SEED CENTRE

Weight Determination Form

Test Number ..... Batch Number .....

Seed Species ..... Variety .....

Origin ..... Method of extraction .....

Date of test .....

Storage: Temperature .....°C Duration of storage .....

P. H. .....% Purity .....%

Working sample: Number of seeds read on indicator .....

Weight of sample used ..... grams

Replicate	1	2	3	4	5	6	7	8	9	10	Total sum	Mean wt. replicate(X)	
x (in gms)													
x^2													
Difference from mean (X-)											Total (-)	Total (+)	Net

Calculate, variance (V), standard deviation (S) and coefficient of variant (C) using:

$$V = \frac{n(\Sigma x^2) - (\Sigma x)^2}{n(n-1)}$$

Where x = wt. of each replicate
n = no. of replicate used
Σ = sum of

$$S = \sqrt{V}$$

$$V = \frac{S}{\bar{X}} \times 1000$$

Where $\bar{X}$ = Mean weight of x

NB

(a) Accuracy used in purity analysis must be mainatained
(b) Where coefficient of variance exceed 6.0, e.g., in grass seeds or 4.0 for other seeds use 16 replicates instead of 8 to calculate standard deviation.

Results

Variance ..... Standard deviation .....

Coefficient of variance .....

Mean weight of seed replicate ..... grams

Weight of 1 000 seeds (X-.10) ..... grams

No. of seeds/kg $\frac{\text{No. in replicates x 1 000}}{\text{Total } \Sigma x}$

Compiled by .....

.....

.....

APPENDIX 3

KENYA FORESTRY SEED CENTRE

SEED MOISTURE CONTENT DETERMINATION

Test number ..... Species .....
Variety ..... Origin .....
Batch No. ..... Date and method of collection ..
.....

Date of receipt of seeds .....
Storage: Storage place .....
Temperature .....°C
Relative humidity .....%
Wt. of seed tested ..... Test method .....
..... Date tested .....

Samples	A				B				
	Weights in gms					Weights in gms			
Replicates	m_1	m_2	m_3	Moisture %	Replicates	m_1	m_2	m_3	Moisture %
1									
2									
3									
4									
5									
Result average of A and B	%				%				
	%								

Note

m_1 = wt. of dish + lid $m_2 - m_3 = w$
m_2 = wt. of dish + lid + seed $m_2 - m$ = original wt. (x)
m_3 = wt. of dish + lid + dehydrated seed.

$$\text{Moisture \%} = \frac{W}{(X)} \times 100$$

Remarks: .....
.....
.....

Compiled by .....
.....

APPENDIX 4

KENYA FORESTRY SEED CENTRE

GERMINATION TEST FORM

Test No. ..... Seed species .....
Variety ..... Origin .....
Batch No. ..... Locality of experiment .....
Altitude .....m Aspect ..... mm p. m.
Date and method of collection .....
Date and method of extraction .....
Storage: Type .....
Av. storage Temp.....°C Av. storage
Humidity .....%
Seeds stored for .... years .... months .... days ... hours
Purity .....% Seed quality .....
Seed weight: Weight of the seeds used ..... gm wt. of 1 000
seeds ..... kg ..... No. of seeds per kg.....
Cutting test ..... Seeds sound out of percent .....%
Pretreatment .....
Germination: Method ..... Medium ..... Ph .....
Av. ..... Temp. of medium of room....°C Hum. .....%
No. of seeds used ..... Moisture content .....%
Tetrozolium test ..... Seeds viable out of ..... Percent .....%
Date of commencement of test ..... Date closed .....
Germination capacity .....% Value .....
Standard error ..... No. rejected for rot .....

Remarks .....
.....
.....

Key: Nursery soil - N. S.; Top of Paper - T.P.: Germinator Tank = G. T.; Glasshouse Soil - G. S.: Between Paper - B. P.; 'in sand' - S.; Tetrazolium Test - T. T.

APPENDIX 4 (B)

SEEDS GERMINATION REPORT FORM

EXPERIMENT LOCATION ..... DATE WRITTEN .....

TECHNICIAN .....

NOTE: A Cutting Test should be conducted in germination % is less than 50% (Note in remarks)

SPECIES	ORIGIN	BATCH NO.	TEST NO.	DURATION BEFORE GERMINA-TION	DURATION OF TEST	NO OF SEEDS USED	NO OF GERMI-NATED SEEDS	GERMINATION %	PRETREATMENT	REMARKS

Date	No. of days since start of test	Nursery (Open air)	Glasshouse	Germinator Tank	Plate Test

APPENDIX 5

PRELIMINARY RESULTS OF PRETREATMENT AND GERMINATION TESTS OF CUPRESSUS LUSITANICA, JUNIPERUS PROCERA AND VITEX KENIENSIS

1. INTRODUCTION

One of the essential objectives of a forestry seed centre is the execution of seed testing under controlled conditions. Seed testing includes purity tests, health tests, moisture content tests, viability tests and germination tests. This field of duty is based on the fact that forest productivity and nursery efficiency depends on the quality of the seeds used. The purpose of seed testing is to provide factual information relating to the sample (Justice 1972) to involved persons (researchers, foresters, nurserymen, seed dealers etc). Of special interest to forestry practice are the results of germination tests, which explain the planting value of the purchased seeds and form the basis for the respective stand establishment project.

Thus germination may be defined as "the sequential series of morphogenetic events that result in the transformation of an embryo into a seedling" (Barner 1975).

The International Seed Testing Association (ISTA) - rules (1985) say that germination tests have to be carried out under controlled, standardized conditions so as to achieve comparable results. However, under the prevailing circumstances the necessary requirements are frequently lacking and as a result germination tests have to take place in the nursery or greenhouse or under problematic laboratory conditions. Hence, Willan (1984) emphasizes that "lack of equipment is no reason to omit seed testing altogether" as long as all the details of the methods are pointed out. Under favourable conditions of moisture and temperature, seeds of many species germinate readily. Others require some form of pretreatment if seed dormancy is distinct, to obtain a reasonably high germination percentage in a short time. The different types of dormancy can be grouped into (a) seedcoat/exogenous dormancy which includes impermeability, inhibitors, mechanical resistance, (b) embryo/endogenous dormancy, related to inhibitors, under-development of embryo and (c) combined dormancy (Barner 1975; Baertels 1982; Willan 1984).

To break the resistance to germination and to hasten germination, different methods can be applied: (a) mechanical scarification; (b) soaking in water; (c) acid treatment; (d) dry heat and fire; (e) cold/warm stratification - prechilling; (f) chemical treatment; (g) combined treatment (Kemp 1975).

As many tropical species are grown widely in the world, information about pretreatment and storage of seeds is readily available. However, species and even provenances can vary in their response to such treatment and the locally appropriate methods of pretreatment have to be determined (Kemp 1975).

In the drier areas of the tropics the resistant seedcoat is very common and this form of dormancy can mainly be overcome by methods mentioned above under (a) - (c). According to Willan (1984), cold/warm stratification/ prechilling may only be applicable to species planted in the sub-tropics and tropical highlands. The term "stratification" is now commonly applied to any technique which keeps seeds in a cold and moist environment (Bonner 1984). For most of the indigenous and some of the exotic species in Kenya, information of the necessity and form of seed treatment is lacking or not available, which is also applicable for the stratification of seeds. In these cases extensive experiments are necessary, including storage tests under different moisture conditions so as to minimize the costs for seed collection and handling, seed consumption and to shorten the nursey period.

The following will show some results of germination experiments of the highland species Cupressus lusitanica, Juniperus procera and Vitex keniensis after different stratification methods.

2. MATERIALS AND METHODS

2.1 Cupressus lusitanica

Cupressus lusitanica is one of the twenty important tropical species which is not included in the ISTA lists (1985) which relects the lack of research information on seed testing in the tropics (Willan 1984). Cupressus lusitanica is and most likely will be the most important species for plantation activities in Kenya in the foreseable future. At present about 60% of the annual plantation area is established with this species resulting in large requirements of seedlings (Odera 1984). The seed indents by which the forest stations in Kenya request the seeds at the Seed Centre at Muguga have to indicate the expected number of seedlings per kilogram for the required species. For Cupressus lusitanica the figures range between 30 000 - 50 000 seedlings per kilogramme. Since the number of seeds per kilogramme is between 170 000 - 320 000 (Webb et al 1984), the average germination rate is less than 20%. This is equivalent to the achieved germination results at the Muguga Research Nursery until 1985. Even under favourable laboratory conditions germination results did not exceed the mean of 29%. Usually the seeds were sown without any pretreatment in the forest stations and likewise in Muguga as Cupressus lusitanica can be expected to flower and fruit profusely every year. However,

stratification is recommended for Cupressus lusitanica as well as for a number of other Cupressus species (FAO 1975; Johnson 1974; Webb et al 1984).

For this reason an experiment was launched to scrutinize the effect of cold stratification of germination percentage and the speed of germination of Cupressus lusitanica.

The seeds used in this experiment had been collected in 1984 since then kept in the cold room at 3°C. Seed origin was as follows:

(a)	Sokoro 2 (D)	-	selected seed stand
(b)	Daraja 2 (G)	-	selected seed stand
(c)	Muguga	-	seed orchard
(d)	Londiani (Masaita)	-	seed orchard R. E. 262/70

About twenty grams of each seed source were mixed with a layer of damp sand (7 cm), which was treated with a solution of Captan (4 tablespoons/3.78 l) for fungal control. These seeds were then kept in separate trays in the cold room at 3°C for twenty one days. After this period nine hundred pretreated and nine hundred subsequently sown in three replicates in three different sites with one hundred seeds in each case (3 x 3 x 100 = 900). In the laboratory the seeds were placed on filter paper on the Copenhagen apparatus while the

the nursery and glasshouse medium was kept moist continuously. Observation period was sixty days for nursery and glasshouse and forty six days in the laboratory. Counting was done regularly every 3 - 4 days, later on, this period was extended to about ten days due to a low germination rate.

2.2 Juniperus procera

Juniperus procera is the dominant indigenous tree in the drier highlands in Kenya (Dale and Greenway 1961). Due to its wide use for timber and environment protection and increasing demand (Kigomo 1980), this species may be planted more extensively in future. Results of germination tests mostly in the Muguga nursery, from the sixties until 1985, failed almost completely with no pretreatment being applied.

Germination in most Juniperus species of the northern hemisphere is delayed because of embryo dormancy, impermeable seed coat or inhibitors (Johnsen et al 1974). Cold/warm stratification for thirty to one twenty days is a recommended pretreatment combined with an acid for some species. Thus it was obvious to find out the ffect of any stratification on the germination and speed.

The seeds of Juniperus procera originated from South Kinangop and were collected 1986. The following were applied:

(a) stratification for sixty days in damp sand

(b) soaking in 1% citric acid for four days followed by stratification for sixty days in damp sand

(c) control

About nine hundred seeds of pretreatment were counted and stratified as described under 2.1. After sixty days an additional nine hundred seeds for the control were counted and the whole amount sown in three replicates in the nursery, glasshouse and the laboratory with one hundred seeds in each case (3 x 3 x 100 = 900). The germination medium in the nursery was forest soil covered with a thin layer of sand, in the glasshouse sand was used while the experiment in the laboratory was carried out on filter paper in petridishes.

The observation period was ninety days, counting was done likewise as mentioned in 2.1.

2.3 Vitex keniensis

Vitex keniensis, an indigenous timber species in Kenya, is planted fairly extensively within its natural distribution, although trials of this species can also be found elsewhere in Kenya (Kigomo 1981).

Seeds of Vitex keniensis are said to loose their viability soon after three months. Teel (1984) emphasizes that seeds can be stored well under dry and cool conditions, although the duration of their viability is not known. Therefore a storage experiment was set up with the objective of testing the germination rate of Vitex keniensis seeds after different storage methods and periods.

The seeds used in the experiment originated from Meru Forest Station and were collected in August 1985. All the seeds were dried in seed drying beds to a moisture content of 1.6%. The seeds were then divided into five equal amounts and stored as follows in the cold room:

(a) storage in a plastic container
(b) storage in damp sand in a plastic container
(c) storage in damp vermiculite in a plastic container
(d) storage in damp sand in a tray
(e) storage in damp vermiculite in a tray

Storage method (e) had to be excluded due to some seed loss in the cold room during the experiment period.

After an initial germination test, the stored seeds were tested after two months (Phase I), five months

(Phase II and seven months (Phase III) of storage respectively. Each sowing date comprised of one pretreatment variant (soaking in cold water for 24 hours) and the control. The number of seeds sown in the glasshouse in sand was 4 x 50 for the initial germination test, one hundredd for phase I and II, 3 x 100 for Phase III. The observation period was sixty days in each case, counting took place as mentioned above.

2.4 Statistical Analysis

The statistical analysis of data was conducted according to the respective problem by application of the analysis of variance and the modified LSD - test or the t- test (Sachs 1978).

3. RESULTS

Cupressus lusitanica

Table 1 shows the results of the germination test of Cupressus lusitanica seeds after forty six or sixty days in the laboratory, greenhouse and nursery, differentiated into stratisfication and control. The hypothesis, whether the cold stratification results had a higher germination rate has to be accepted according to the achieved percentage of germinated seeds. It appears that the stratification with a mean of all sites of 31.0% resulted in a

significantly (significance level - 0.001) better germination than the control with 17.21%. This great difference is essentially explained by the higher results of the stratified seeds in the laboratory and the nursery, where 37.6% or 23.8% were achieved compared to 16.0% for the control. However, the slightly better performance of the stratified seeds in the greenhouse was not significant. The results of the control correspond to those usually obtained at routine tests in Muguga and when raising seedlings in the forest nurseries. The experiment also reveals a relatively great difference between the results of the control in the three sites, which are partly contradictory to those of the stratified seeds.

With the control the higher germination rate was reached in the greenhouse, with favourable conditions of moisture and temperature followed by the results in the laboratory while the germination percentage in the nursery was very low with 6.9%. After stratification, however, the laboratory test provided the highest germination, again the results in the nursery were lowest.

A significant difference between the four seed sources was not acertainable although it might be speculated that seeds from Sokoro 2 (D) are superior to the other

seed sources since seeds from this famous seed stand brought in most cases a higher germination percentage. Moreover of interest was the influence of stratification on hastening seed germination. Figure 1 shows the effect of cold stratification on accelerating the germination of Cupressus lusitanica seeds in all sites. This certain days to the ultimately results. In the laboratory (Figure 1 above), the ratio of pretreated seeds after fourteen days was 72%. At the same time the control shows a ratio of 33%. The corresponding figures after thirty one days are nine hundred and sixty five for the stratification and 73% for the control. After thirty six days, the percentage figures of the then germinated seeds out of the total became identical.

In the greenhouse (Figure 1, centre), no substantial speeding up to germination was observed. Apparently the effect of stratification was concealed by the good conditions.

In the nursery, however, the germination rate was generally delayed. Fourteen days after sowing no observations were made neither for the stratified seeds germinated (ratio = 71%) compared to 0% of the control. Unitl the thirty fifth day more than 90% of the germinable seeds of both the pretreated and the control had germinated.

3.2 Juniperus procera

The germination results of Juniperus procera seeds are shown on Table 2. A comparison of the means of the different pretreatments (all sites) shows a higher germination value for pretreatment "stratification for sixty days" with 30.0% followed by "soaking in citric acid/stratification for sixty days" with 24.6% and the control, where 21.1% germinated. However, the differences are not significant. This fact is explained by the high results of the control in the laboratory of 38.6% which is significantly higher than the obtained laboratory results for the pretreated seeds. This result cannot be explained since both in the greenhouse and the nursery, the effect of the stratification is distinct. Stratification for sixty days gave 47% germination, soaking the seeds in citric acid and stratification for sixty days resulted in 45.0% in the greenhouse. This is significantly higher than the germination rate of 23.3% for the control. Similar to the greenhouse are the results in the nursery, although the absolute figures again indicate the poor conditions of this site. Generally the germination in the nursery was much lower at which both pretreatment methods gave a significantly higher germination with 15.3% and 8.3% compared to only 1.3% of the contro. There is no statistical difference between

the two stratification methods in any of the three sites although the stratification for sixty days gave slightly better results.

Figure 2 shows the development of the germination (all sites) for the applied treatments which is fairly uniform. Stratification has obviously accelerated the germination considerably. The stratified seeds started to germinate earlier than those of the control. After twenty eight days the ratio (germination rate after certain days/ultimately obtained results) was 47% for stratification for sixty days, 43% for citric acid treatment and stratification and only 14% for the control. Forty eight days after sowing, the ratio was 67%, 66% and 40% respectively. Figure 2 also shows a germination rate increasing fairly steadily up to forty eight days after sowing which then levels off especially for the stratified seeds. At this time more than 80% of the germinable stratified seeds had germinated compared to only 61% of the control. The effect of stratification on germination acceleration is also underlined by the number of days needed to obtain at least 20% germination. This is the case after forty two days for "stratification for sixty days", forty eight days for "soaking in citric acid and sixty days stratification" and after ninety one days for the control.

3.3 Vitex Keniensis

The results of the storage experiment of Vitex keniensis are shown in Table 3. Storage method 1, which was storage in a plastic container resulted in the highest germination rate of 18.31% which is significantly higher than the obtained results for the other storage methods. A general influence of the applied pretreatment (soaking in water for twenty four hours) for all storage methods was not ascertainable. However, considering only the storage in a plastic container the comparison of the results between the untreated and treated seeds reveals a significant difference. A steady reduction fo the germination rate of all storage methods and treatments since the Phase I test (after two months) could be observed except for the seeds which were stored in a plastic container and treated in cold water (1/B).

Nevertheless the general germination of Vitex keniensis after seven months appears to be low compared to the initial germination rate of 71% of the fresh seeds.

4. DISCUSSION

The germination tests with Cupressus lusitanica seeds proved that cold stratification resulted in

a higher and faster germination rate. The average result of stratified seed is 31%, hence an essential rise was achieved compared to previous tests. Usually the germination rate in the Muguga Nursery was 15% since about 1970 without any pretreatment being applied.

Seed germination results without applied pretreatment from the thirties show almost the same figure. The average germination as reported from district nurseries in Kenya was 6.4% (7,783 seeds out of 121, 600), the highest germination in the nurseries was about 18% (Forest Department Kenya Colony, 1939).

Data experiments in the glasshouse with stratified seeds are not available, their existence is unlikely. Lamprecht (1985) mentions the average germination of Cupressus lusitanica being about 75%, which might be the case in Central or Latin America. It is possible that maximum and minimum temperature influence the germination rate essentially. According to the Forest DEpartment Kenya Colony (1939), the highest germination of Cupressus lusitanica was recorded at Mt. Elgon with an altitude of 2 500 m the highest average germination at Bahati Forest Station (altitude 2 300 m) while the lowest were reported from Karura (1 800 m) and Ngong Forest Station (1 900 m). This may be an indication of the necessity of a pretreatment

under cold conditions in whatever manner. Stratified seeds of other cypress species readily germinated at a constant temperature of 22°C but the germination test results ranged between 1% and 31% only (Johnson 1974).

These low germination capacities are obviously explainable because of low percentage of sound seeds which are common among cypress seedlots (Johnson 1974). Whether these details are also true for Cupressus lusitanica and no essential rise of the germination percentage might be possible, should be analysed by health-tests.

Analysis on the germination capacities of various seed sizes of Cupressus lusitanica did show that the large the seed size the larger the percentage of germination (Forest Department, Kenya 1952) and the assumption that the germination is related to the seed size was frequently concluded. But these differences are only explained by the fact that smaller seeds generally contain a large portion of hollow, unsound seeds (Rohmeder 1972).

The ISTA - rules (1985) prescribe for some cypress species (Cupressus arizonica, Cupressus macrocarpa, Cupressus sempervitens) the first count to be conducted after twenty eight or thirty five days.

The achieved results confirm that the germination commences at the earliest after seven days and is completed largely after thirty five days. Webb et al (1984) also started a germination within a period of thirty five days. Future tests in Muguga should not last longer than thirty five days, counting will start seven days after sowing.

The establishment of a greenhouse effect in the nursery with foil or polythene combined with seed stratification might also increase the germination rate in the nursery.

The germination rate of Juniperus procera seeds in the greenhouse and the nursery was considerably improved by the applied stratification methods. However, the achieved results in the Muguga nursery are still unsatisfactory and efforts should be made to increase the germination. Comparable results of this species are scarce with very little information on germination methods being applied. The Kenya Forest Department (1972) shows an expected average number of seedlings per kilogram of 2 876 which is equivalent to a germination rate of about 8%.

Other figures from various district nurseries in Kenya give an average germination in the nursery of 7% while the highest germination was 64%. It is said that low germination may be due to seed being sown in the berry and that the seed requires cooler conditions for germination (Forest Department Kenya Colony, 1939. The comparatively high germination results

in the greenhouse might be an indication to include a warm pretreatment to overcome the seed dormancy. This combined warm/cold stratification is recommended for North American Juniperus, e.g. Juniperus communis, Juniperus osteosperma and Juniperus scopulorum. A warm stratification (at 20° - 30°C) for sixty to ninety days followed by ninety days of cold stratification at 3°C for another ninety days gave upto 75% germination for Juniperus communis (Johnsen 1974). An acid treatment using concentrated sulphuric acid might also be useful to soften the seedcoat.

The storage of Vitex keniensis seems to be possible for a longer period than three months although rather heavy reductions of the germination rate occurred. Thus, the results are still unsatisfactory and storage appears to be uneconomical because of a fairly regular fructification of Vitex keniensis. Nevertheless, as long as no further findings are acquired seeds of Vitex keniensis will be stored in airtight plastic containers and soaked in cold water for twenty four hours before sowing.

The main reason for conducting this experiment in the greenhouse was the higher temperature since it can be assumed that the conditions in the Muguga nursery are already too cool for Vitex keniensis, a species which has its natural distribution between 1 700 and 2 000 m above sea level. (Dale and Greenway 1961). Previous germination results in the Muguga nursery did not exceed a germination rate of

10% regardless of whether a pretreatment was applied or not. These results are confirmed by reports for nurseries in Kenya (Forest Department Kenya Colony 1939; Kenya Forest Department 1972).

The optimal moisture content (MC) for a long term storage of Vitex keniensis seeds has still to be determined. In Meru the forest seeds are stored under conditions allowing fermentation but the storage period is reduced (RAES, Meru 1985). A storage experiment with Vitex keniensis seeds comprising different moisture content is being observed in the Muguga cold storage at present.

5. SUMMARY

The present paper deals with preliminary results of pretreatment of Cupressus lusitanica, Juniperus procera and Vitex keniensis seeds carried out in Muguga, Kenya.

Seeds of Cupressus lusitanica from four seed sources was stratified in moist sand at 3°C for twenty one days. Subsequently these seeds and the control were sown in the laboratory, greenhouse and nursery. After a test period of forty six days (laboratory), sixty days (greenhous and nursery) respectively, the germination rate of 31% for the stratified seeds was

significantly higher than for the control with 17.2%. The effect of stratification was significant in the laboratory and the nursery while there was no difference in the greenhouse. Stratification also resulted in an earlier germination.

Seeds of Juniperus procera were stratified for sixty days in moist sand or soaked in a solution of 1% citric acid and stratified for sixty days in moist sand respectively. Including the control the seed was sown in the laboratory, greenhouse and nursery. The result after ninety days was significant for the stratified seeds in the nursery and the greenhouse, while in the laboratory the control performed best. Germination rate in the nursery and the greenhouse was accelerated by the stratification.

Seeds of Vitex keniensis were stored in different environments for two, five or seven months at 3°C. Storage in a plastic container for seven months and soaking the seeds in cold water for twenty four hours gave a germination rate of 25% in the greenhouse, which was significantly higher than any other storage method.

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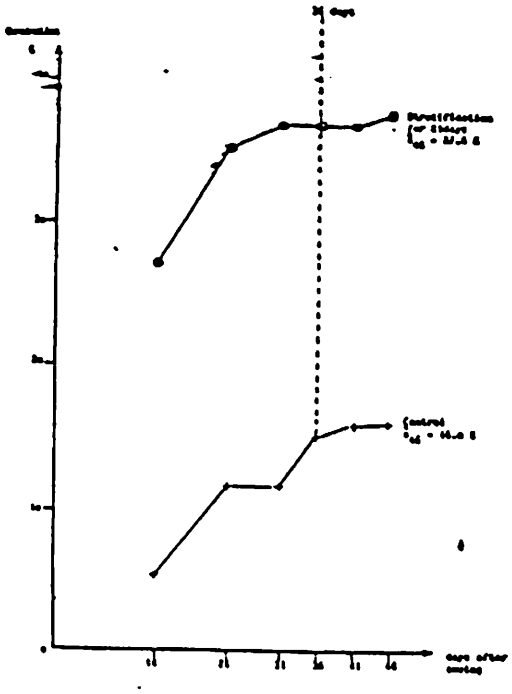
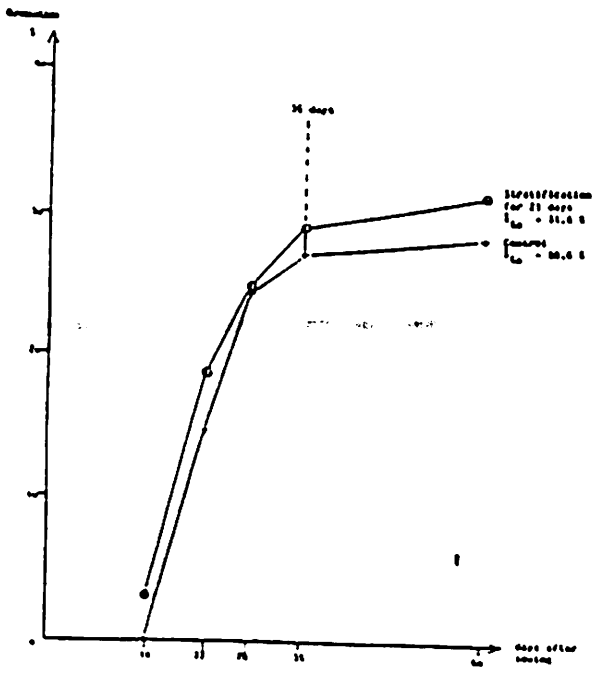
Table 1

Germination test results of Cupressus lusitanica seeds in laboratory, greenhouse and nursery after stratification in moist sand for twenty one days (in %).

Site	Seed Origin	Pretreatment	
		Stratification	Control
Laboratory	Sokoro 2 (D)	56.3	25.0
	Daraja 2 (G)	31.0	14.0
	Muguga Seed Orchard	32.0	8.6
	Londiani Seed Orchard	31.3	16.6
		x_1 = 37.6***	y_1=16.0
Greenhouse	Sokoro 2 (D)	34.3	37.6
	Daraja 2 (G)	30.6	24.6
	Muguga Seed Orchard	30.3	22.3
	Londiani Seed Orchard	31.3	29.6
		x_2= 31.6	y_2= 28.6
Nursery	Sokoro 2 (D)	35.3	5.0
	Daraja 2 (G)	18.7	4.3
	Muguga Seed Orchard	26.0	11.3
	Londiani Seed Orchard	15.3	7.0
		x_3= 23.8***	y_3= 6.9
		$\bar{x}$ = 31.0***	$\bar{y}$ = 17.21

*** = Significant at α = 0.001





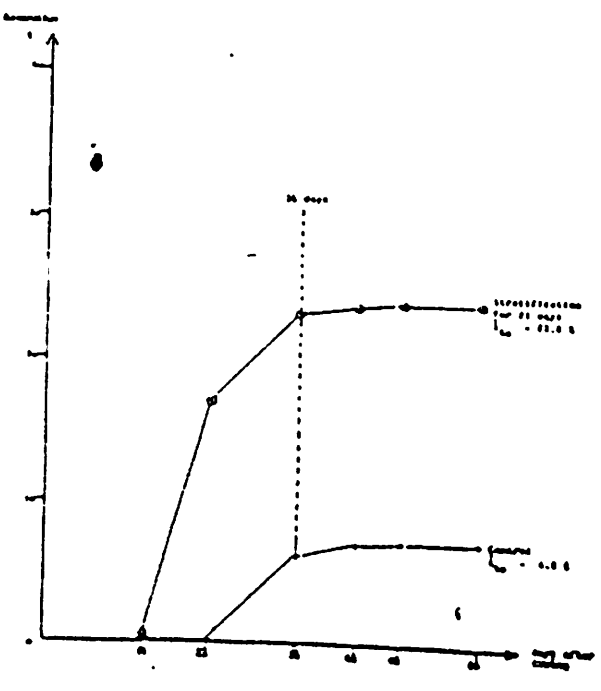


Figure 1: Germination to
period and effect of col
stratification on germi-
nation of Cupressus lusi-
tanica seed in laborator
(above), green-house (cent
and nursery (bottom)

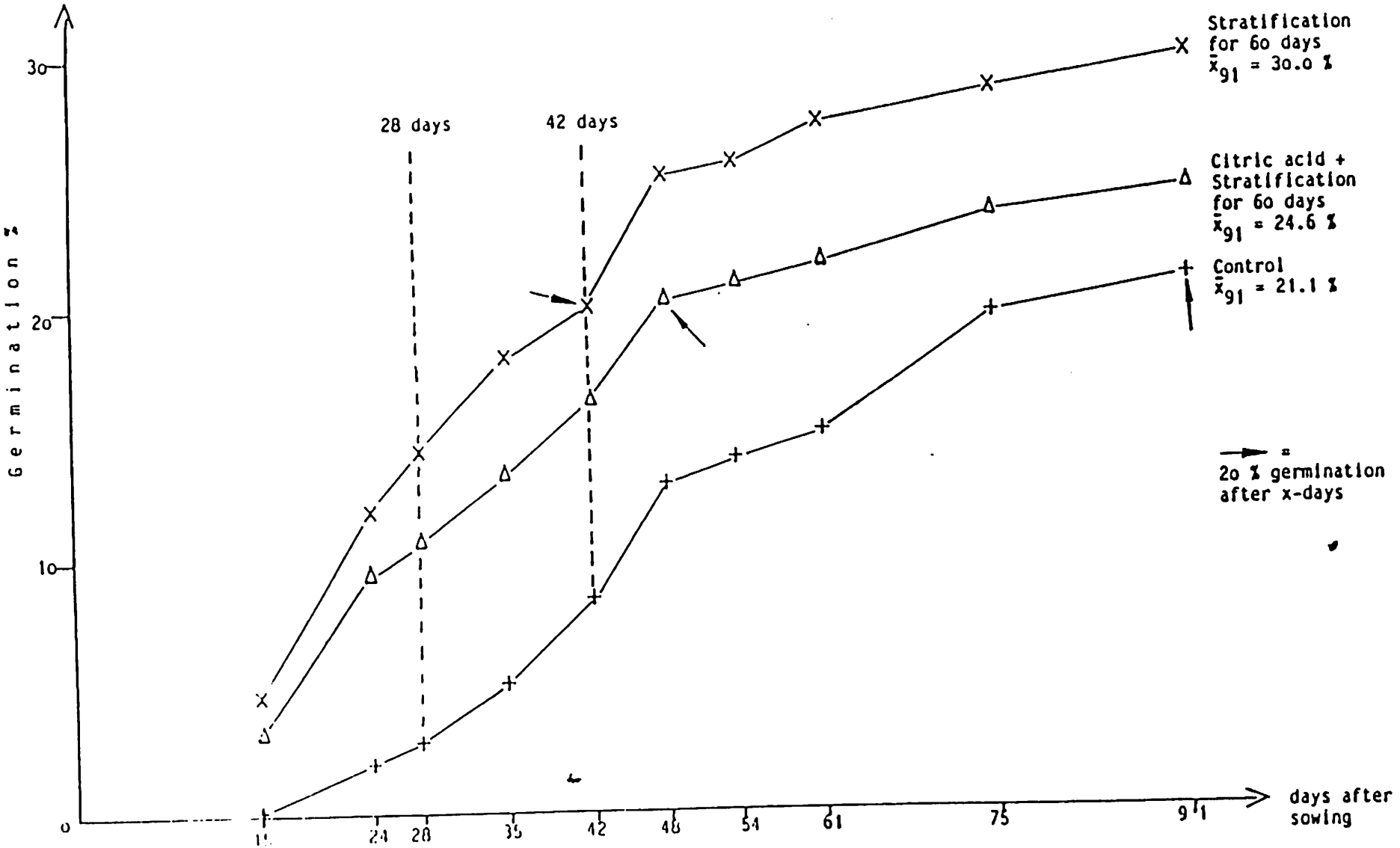


Figure 2: Effect of cold stratification for accelerating germination of Juniperus procera seed.

Table 3

Germination test results of Vitex keniensis seeds after different storage methods and storage duration (%).

(I= Storage in plastic container; II = Storage in damp sand in plastic container; III = Storage in damp vermiculite in plastic container; IV = Storage in damp sand in tray. A = No treatment; B = Soaking in cold water for twenty four hours).

Storage period	Storage method I A	I B	II A	II B	III A	III B	IV A	IV B
2 months	28.0	24.0	20.0	17.0	21.0	12.0	13.0	11.0
5 months	23.0	29.0	18.0	8.0	9.0	16.0	9.0	7.0
7 months	11.7	25.0*	5.3	4.7	10.7	7.0	2.3	5.0
$\bar{x}$ A + B = (7 months)	18.3*		5		8.8		3.7	

* = Significant at α = 0.05

APPENDIX 6

Number of Seeds Per Kilogramme

Milka Gaitho[1] and Gert Rode[2]

The determination of the number of seeds/kilogrammes was conducted according to the rules of the International Seed Testing Association (ISTA), which prescribe eight replicates of one hundred seeds each, from which the standard deviation and co-efficient of variation is calculated.

The figures below shall assist in calculating the sowing rates in the nursery. Although the number of the samples is still small, the report covers details of one hundred and fifty species, which is a considerable extension compared to the first issue.

We would like to ask the responsible Foresters or other users to use there figures as a rough guide when calculating the number of seedlings to be raised in their nurseries, which improve the current situation of seed supply.

1 Second issue

2 Kenya Forestry Seed Centre

Species	No. of Seeds/Kilogramme		
Aberia caffra	33,126	-	38,295
Acacia albida	7,514	-	8,341
Acacia aneura	58,182		
Acacia ataxantha	6,430		
Acacia brevispica	3,651	-	7,373
Acacia depanolobium	17,790	-	21,091
Acacia gerrardii	9,563	-	10,055
Acacia horrida	24,510		
Acacia lahai	4,231		
Acacia mangium	80,727		
Acacia mearnsii	68,788	-	73,665
Acacia melanoxylon	63,745		
Acacia mellifera	15,751	-	18,244
Acacia nilotica	7,291	-	7,955
Acacia nubica	4,670	-	9,563
Acacia senegal	8,406	-	15,334
Acacia seyal	19,945		
Acacia tortolis	15,567	-	31,141
Acacia xanthophloea	24,089	-	26,212
Acacia zanzibarica	44,395		
Acrocarpus fraxinifolia	24,220	-	28,860
Adansonia digitata	1,663	-	1,943
Adenanthere pavonina	4,439	-	3,488
Afzelia quanzensis	253	-	269
Albizia gummifera	10,519		
Albizia lebbeck	7,907	-	10,313

Species	No. of Seeds/Kilogramme
Albizia lophantha	10,613
Albizia procera	23,385
Allophyllus abyssinica	17,312
Aningeria adolfi-friederici	497
Atriplex wummularia	96,270
Antiaris toxicaria	1,767 - 2, 154
Araucaria angustfolia	146
Araucaria cunninghamii	2,669 - 6,709
Azadirachta indica	2,886 - 6,073
Balanites aegyptica	329 - 425
Balanites wilsoniana	50
Bischofia javanica	74,212 - 90,600
Bombax rhadognaphalon	15,901
Boscia coriaria	2,448
Brachychiton acerifolium	4,403
Brachylaena hutchinsii	851,064
Brachystegia spiciformis	2,651
Caesalpinia spinosa	3,433 - 4,578
Calliandra calothyrsus	19,034
Callitris robusta	115,108 - 138,169
Calodendrum capense	615 - 991
Cassis siamea	34,130 - 46,350
Cassis spectabilis	31,250 - 92,060
Casuarina equisetifolia	672,269 - 860,215
Casuarina junghuhniana	2,352,941
Chlorophora excelsa	430,108 - 528,751

Species	No. of Seeds/Kilogramme
Cordia abyssinica	2,878 - 3,568
Cordia sesbatana	1,167 - 1,268
Craibia ellioti	2,555
Craibia laurentii	878
Croton macrostachyus	27,100
Croton magalocarpus	860 - 2,178
Cryptomeria japonica	579,710
Cupressus lusitanica	171,674 - 187,356
Cupressus pyramidalia	139,373
Delonix elata	6,171
Delonix regia	1,887 - 2,265
Diospyros abyssinica	7,587 - 8,741
Diospyros mespiliformis	2,475
Dodonea viscosa	104,987 - 106,101
Dombeya goetzenii	235,294
Ehretia cymosa	132,960
Ekebergia rueppeliana	2,947 - 8,634
Entada abyssinica	3,622 - 4,156
Erythrina abyssinica	7,993
Erythrophlean guineense	1,097 - 1,400
Eucalyptus camaldulensis	2,162,162
Eucalyptus ficifolia	34,261 - 35,635
Eucalyptus maculata	154,440 - 185,185
Eucalyptus saligna	1,739,130 - 2,000,000
Eucalyptus tereticornis	2,332,362 - 2,777,778
Fraxinus berlanderiana	37,031 - 81,967

Species	No. of Seeds/Kilogramme
Ficus religiosa	33,347
Funtumia latifolia	39,196
Garcinia livingstonii	2,121
Gmelina arborea	1,423 (fruits
Grevillea robusta	70,609 - 112,609
Grewia viliosa	17,327
Gyrocarpus jacquinii	2,947 - 3,095
Harungana madascariensis	121,766
Jacaranda mimosifolia	65,413 - 80,080
Juniperus procera	37,960 - 46,948
Kigelia ethiopium	3,452
Lawsonia inermis	473,373 - 655,738
Leucaena diversifolia	25,543
Leucaena leucocephala	16,750 - 30,781
Macharium tipus	2,371
Maerua endlichii	14,662
Maesopsis eminii	616 - 784
Monilkara zanzibarensis	11,868
Markhamia lutea	63,442 - 84,477
Melia azedarach	1,101 - 2,710 (fruits
Moringa oleifera	4,172 - 4,412
Moringa stenoperala	2,018 - 2,028
Newtonia buchananii	5,200 - 5,595
Newtonia hildebrandtii	6,549 - 7,260
Olea africana	13,117 - 16,103
Olea hochstetteri	1,718
Olea welwitschii	3,110 - 3,560

Species	No. of Seeds/Kilogramme
Paramacrobium calsruloum	950
Parkinsonia aculeata	11,100 - 14,728
Pelthopharum ferrugineum	14,451
Phoenix reclinata	3,806
Phyllogeiton discolor	1,925
Piliostigma thonningii	7,024 - 7,546
Pinus caribaea	51,282 - 61,115
Pinus patula	127,796 - 158,103
Pinus radiata	48,780
Pithecellobium dulce	7,172
Podocarpus gracilior	535 - 993
Podocarpus milanjianus	2,228
Polyscias kikuyuensis	67,340 - 135,593 (unex-
" "	304,183 - 317,460 tracted
Prema maxima	9,453
Prosopis juliflora	34,291
Prunus africana	3,434 - 5,750
Salvadora persica	31,165
Schinus molle	32,362 - 34,247
Schrebera elata	56,457
Sesbania grandiflora	18,014 - 20,014
Sesbania sesban	87,719 - 145,455
Sorindeia madagascarensis	653
Spathodea nilotica	134,964 - 169,851
Syzygium guineense	3,723
Tamarindus indica	1,324 - 1,575

Species	No. of Seeds/Kilogramme
Tecoma stans	157,791
Tectona grandis	1,182 - 1,185
Terminalia brownii	3,188
Terminalia catappa	1,693
Terminalia mentalis	2,034 - 2,874
Terminalia prunoides	7,824 - 9,516
Terminalia spinosa	27,239
Thevetia peruviana	277 - 278
Tipuana tipus	1,982 - 2,163
Trachylobium verrucosum	944 - 1,000
Trichilia roka	807
Vitex doniana	1,073
Vitex keniensis	755 - 1,229
Warbulgia ugadensis	10,751
Ximenia american	667
Zizyphus abyssinica	127
Zizyphus mauritiana	433
Zizyphus jujuba	1,870
Zizyphus mucronata	1,648 (fruits)

(ii) TRAINING AND SAFETY WHEN COLLECTING SEEDS

Kenya Forestry Research Institute

Seed collection, especially by climbing is arduous work and it is essential that climbers should have the following qualifications and stick to the rules below. They need to be physically and mentally fit, with natural aptitude for climbing and a combination of self confidence and common sense.

SAFETY PRECAUTIONS

Safety precautions will vary according to local conditions and particularly the species of tree and the equipment and methods of collection used. All staff taking part in collecting operations should be fully conversant with local safety rules. The selection of safety hints reproduced below is based on those of Yeatman and Nieman (1978), Dobbs et al (1976) and Seal at el (1965) Isslieb (1964) [cited in Seeber and Afpaoa 1976].

(a) All equipment should be carefully stored, both during transportation in the field and while in store between collecting seasons.

(b) Clothing should be strong, well fitting and suited to the weather expected.

(c) All equipment should be checked before it is used and if there is doubt about its conditions, it must not be used until repaired or replaced.

(d) Do not climb in wet or very windy weather, or in poor light as dusk or even when overtired.

(e) Do not climb trees with obvious signs of seen rot, severe canker or galls, split stems, double leaders, or other abnormalities indicative of mechanical weakness.

(f) The safety line should be coiled on the ground before the climber ascends to avoid tangling or gagging the rope in the underbrush.

(g) The anchorman should hold the safety line under one arm and over the other shoulder. It is wise to make a half turn around a neighbouring tree. This gives control and prevents the safety line from being pulled from his hands. Pull in and payout the safety line by alternate hand grips. A sliding rope is difficult to control and can cause painful friction burns.

(h) Never climb with anything tied or looped around the neck.

(i) Safety helmets and gogles should be worn to prevent injury to take the head and eyes in climbing rough, densely branched trees.

(j) Stand on and grip branches close to the point of attachment to the main stem.

(k) Watch for the brittle branches; test doubtful branches before putting weight on them. Avoid branches with bark peeling from them - they are slipery. As far as possible, decide on the climbing route while still on the ground, especially for the branchy crown region.

(l) The climbers should have three points of support at all times, (one hand and two feet or two hands and one foot), moving one limb at a time, except when attached to the tree by safety strap or rope when suspended on safety line, climb calmly with regular movements, taking short steps at a time.

(m) Do not carry tools while climbing the crown. If there is need for a pole pruner or cone rake, etc, use a light tool line to hoist the equipment to the working level. Leave the line attached to large tools as a landyard while working. Return tools to the ground on the line, do not drop or throw them down.

(n) Beware of sharp branch stubs; they can snug clothing and may cause painful cuts and bruises.

(o) Climb spirally or in a zig zag manner, or fasten safety straps to the stem so that you cannot fall more than 2 m before your weight comes on to the safety line.

(p) The diameter of the main stem should not be less than 8 cm at waist level during climbing. If in doubt concerning security, do not hesitate to tie a safety strap to the stem at a safe level before climbing within reach of the seed bearing crown.

(q) While attaching safety rope, keep one arm securely around the tree until the rope is fastened to safety rope and belt.

(r) Before letting go off the tree with your hands, test your weight against the safety rope and footholds.

(s) When picking near to the top of a tree, keep your body close to the stem so that your weight bears down not upward.

(t) The safety strap should always be attached around the tree stem except while climbing or changing

position in the crown or are suspended on the safety line.

(u) Before dropping bags, cones or other materials, be sure that the personnel on the ground are notified and are well clear.

(v) When collection fruits from a ladder, make fast the top of the ladder to the tree with a nylon strap. The ladder must be further steadied with two guylines.

(w) Have a well-stocked first aid kit handy at the climbing site at all time.

CONCEPT AND APPLICATION OF AGROFORESTRY FOR THE PROMOTION OF SOCIAL FORESTRY IN KENYA

Prof. F. Owino
International Council for Research in Agroforestry (ICRAF), Nairobi, Kenya

1. THE CONCEPT OF AGROFORESTRY

As a concept, agroforestry refers to sustainable land management systems which combine crops, woody perrenials and/or animals simultaneously or sequentially on the same unit of land (King and Chandler 1978). In modern thinking an agroforestry system is an intergrated land management system which involves any combination of three components (crops, wood perennials and animals) and which is specifically designed in full articulation of the components interactions and the benefits over and above that obtainable from the constitutent componets separately (Lundgren 1982). Agroforestry systems are classified according to constituent components. Thus agrisilvicultural systems are those which involve combinations of woody perennials and crops.

Silvo-pastoral systems involve trees and animals and agri-silvo-pastoral systems involve all the three components. So defined, the science and practice of agroforestry calls for effective interfacing of agricultural and forestry land production systems far beyond what most agriculturists and foresters are prepared to appreciate. Suffice it to stress the dominant characteristics of well designed agroforestry systems as follws:-

(i) agroforestry systems provide greater benefits than agriculture or forestry alone

(ii) agroforestry systems are designed in such a way as to enhance and sustain land productive capacity

(iii) the woody perennial is fully intergrated to the farming system. This is in contrast to growing trees independently in farm woodlots and on boundaries

(iv) the trees and shrubs which form part of agroforestry systems are those with the potential to provide a diversity of goods and services i.e. multipurpose trees and shrubs.

2. THE PRACTICE OF AGROFORESTRY

While the concept of agroforestry is new, the practice of agroforestry is very old and probably dates back to the earliest agricultural intervention by man. Nair (1984) has mentioned many examples of agroforestry practices which have been evolved in different parts of the tropics. Shifting cultivation, taungya system, home gardens, trees in pastures and trees lopped for fodder are but a few examples of such traditional agroforestry practices. In some cases these traditional agroforestry practices continue to be viable and are worthy of refinement. In many developing countries (Kenya included), however, the rapid rates of population increase and land productivity decline are such that radically different approaches to agroforestry development are called for.

The International Council for Research in Agroforestry (ICRAF) has proposed a methodology for agroforestry systems diagnosis and design (Steppler, 1987). The basic steps in this methodology are (i) identification of forestry and agricultural production needs of the population (this could be a village, location or larger units) (ii) identification of constraints to the realization of these needs (iii) design of

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appropriate agroforestry system which overcomes the constraints in providing the needs (iv) promotion of the designed system at the farm level through extension (v) agroforestry research towards the refinement of the proposed agroforestry system. Two characteristics of this methodology should be stressed. Firstly, the methodology is circular in nature continuously responding to changing society needs and research findings towards more focused and refined forms. Secondly, the methodology calls for multidisciplinary approach in all its stages. It is critical to the sucess of this methodology that the diversity of professionals engaged in designing and refining agroforestry systems have professional committment to the development of systems rather than their respective disciplines.

Focusing on Kenya, a few ongoing agroforestry practices are worthy of mention. Mixed home gardens are found in many parts of the country where trees are grown around homesteads for their cultural, productive and protective values. Shifting cultivation is still practised in medium and low potential agricultural lands. Shifting grazing has been the traditional land use in semi-arid and arid zones of the country. In either case, the fallow period has been reduced far below that

required for full restoration of soil fertility and stability. Such practices have resulted in land degradation and desertification processes so common in most parts of the country. Shade trees have been planted in tea and coffee plantations for a long time with Grevillea robusta, Calpurnia aurea and Cordia abyssinica being the most popular shade trees in the earlier period. The recent increased infestation of tea by Armilaria mellea root disease from Grevillea robusta has resulted in the elimination of the latter from tea plantations and its replacement by Millettia dura as the tea shade tree.

Semlages of silvo-pastoral systems are practised in many parts of arid and semi-arid zones. In these areas valuable fodder trees like Platycelyphium voense, Balanites obicularis et. are specifically managed by local populations for fodder. Very commonly found in high and medium potentials agricultural zones are the trees in annual crop systems. Trees grown in such systems include Grevillea robusta, Markhamia lutea, Sesbania sesban, Cocos nucifera. The national forest service has heavily relied on the taungya system in establishing populations of Cupressus lusitanica, Pinus patula, Pinus radiata and Eucalyptus saligna. More recently it has become apparent that the forest workers who operate the

taungya system often resort to land management practices and settlement patterns which are incompatible with the long term management goals of the forest estate. Indeed the future of taungya system in tree plantation establishment is uncertain.

Finally, a mention should be made of the more recent and rather experimental agroforestry practices in Kenya. One such system which is gaining popularity in some parts of the Indian Ocean Coast is the Anacardium occidentale (Cashew nut/maize/beans/ combination). More widespread are trees in annual crops and alley cropping systems which have been promoted by the Ministry of Energy from its six Agroforestry/Energy Centres located in various agro-ecological zones of the country. Through this programme of the Ministry of Energy, farmers have been exposed to agroforestry demonstration plots. In addition, farmers have been supplied with appropriate tree species for planting on farms. Outstanding among such recent agroforestry innovations in Kenya are (i) trees in annual crops system with Sesbania sesban, Leucaena leucocephala, Flemingia conjesta, Grevillea robusta, Bixa orellana, Psidium guajava and Prosopis chilensis, (ii) alley cropping systems with Calliandra calothyrsus, Sesbania sesban, Gliricidia sepium.

In direct support to the encouraging development trends above, a firm base for agroforestry research has recently been established in Kenya as a collaborative venture between the Kenya Forestry research Institue, the Kenya Agricultural Research Institute and ICRAF. Such research initiatives as has recently been started at Maseno (and soon expected to spread to other parts of Kenya) will benefit from and be part of a regional programme - Agroforestry Research Networks for Africa (AFRENA).

Agroforestry in social forestry context

Social forestry, community forestry and agroforestry are all recent development thrusts in forestry thinking and practice. They have four common characteristics (i) they are people-oriented both in terms of participation and benefits (ii) they constitute small scale operations by individuals or communities relative to traditional industrial forestry, (iii) they have the potential to offer high social benefits particularly to the rural poor and (iv) they are often more environmentally stabilizing than industrial plantation forestry.

The jutisfication and appropriate strategies for social forestry development in Kenya have been discussed elsewhere (Owino, 1988). The growing by the masses has been accorded very high priority nationally and is being actively

promoted by several governmental and non-governmental agencies. However, past experience has shown that the result at the farm level is not commensurate with the efforts put in by these agencies. Tree survival is very poor even in high potential areas. Farmers generally neglect their woodlots except in few cases where farmers become convinced that they can get good prices for poles. Three factors could account for this undesirable state of affairs in social forestry development (i) the economic value of trees grown on farms and homesteads is not rationalized vis a visa other farm produce (ii) ease of access to alternative "free" sources of wood and (iii) inadequater appreciation of the potential role of trees on farms in improving land productivity.

Properly designed agroforestry systems are clear interventions for (i) and (iii) above. Through agroforestry, farmers will no longer view tree growing as an extra burden in their already crowded farm activities but will adapt trees as an intregral part of farm production. Given woody pernnials with proven potential to improve farm land productivity farmers will be more willing to grow trees for increased agricultural production.

Some suggested strategies for social forestry/agroforestry programmes

It has been advocated elsewhere that the appropriate social forestry development model for Kenya would be the partnership model incorporating sustainable incentives schemes (Owino 1988)

The Rural Afforestation and Extension Service (RAES) of the Kenya Forest Department should address itself fully to this important national development issue. RAES should be expanded and restructured in such a way as to maintain more effective contacts with farmers. In support of social forestry and agroforestry, RAES should strive to accomplish the following in the immediate time-frame:-

(i) Identify and strengthen rural based contact groups engaged in tree planting (women groups, self-help groups, co-operative societies, etc)

(ii) Develop an effective extension service to the farm level

(iii) Develop agroforestry model farms at the location and sub-location levels

(iv) Participate in the development of national mechanism for efficient delivery of forestry inputs (seeds, seedlings, containers, etc) for marketing of tree products.

The tasks above are rather daunting but must be in place for effective social forestry/agroforestry development.

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LAND TENURE AND LAND USE LEGISLATION ISSUES IN AGROFORESTRY DEVELOPMENT

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ABSTRACT

In this paper, land tenure, land use and land use legislation are defined. Their place in a system of laws is also considered. They are then discussed as issues in agroforestry. The discussion identifies the problem areas posed by each, and suggests the appropriate response within a context of legislative arrangements.

The major conclusion reached is that there are more problems posed by enforcement issues than by either tenure or land-use in agroforestry development in Kenya.

INTRODUCTION

The purpose of this presentation is to discuss the role of land tenure and use legislation in agroforestry development in Kenya. This is done by:

(i) Conceptualising land tenure and land-use in the context of Kenya's legal system, and

(ii) Raising and discussing issues of land tenure and land use that are relevant for agroforestry development in Kenya.

1. SOME ISSUES OF THEORY

1.1 LAND TENURE

Land tenure, together with the doctrine of estate, are the proper starting points for a full understanding of the idea of property in land as it evolved in Western jurisprudence (Gray, 1987). Land tenure refers to the possession or holding of the many rights associated with each parcel of land (Rindell 1987). These rights are commonly referred to as a "bundle" which, in accordance with property theory, can be broken up, redivided, transferred or transmitted to the absolute discretion of the holder (s). Not all the rights comprising the bundle be held by the same, single legal person at any give time: on the contrary, they have never been held by a single legal person at any given point in time. This is because the society ("community", "state" or "collectivity") has always retained some interest in the same parcel of land over which the individual legal entity ("family", "clan" or individual") also holds some exclusive rights.

An alternative modern way of rendering the same proposition is to suggest that as part of the tenurial

arrangements in society, the state holds superior rights of ownership and control over all land within its jurisdiction. This is the juridical basis for the exercise of police power and eminent domain. (Mann 1959).

The practical operation of any system of land tenure is dependent upon the historical and cultural circumstances within which the given community has evolved, and the legal and philosophical content of that community's conception of land. There are societies in which land is taken to mean not only the physical solum, but all the things that are attached to it as well. In others, various natural objects, e.g. trees, and artificial structures, e.g. buildings, are legally servered from the conception of what land means (Fortmann 1987). But to whichever society one is referring, the fact of possession of rights over land means that the possessor (or holder) is able to participate in determining the use to which the given parcel of land is to be put. And this is the critical link between tenure and land-use.

1.2 LAND-USE

Land-use, in a very broad sense, is the function of land as determined by natural conditions and human settlement (FAO 1975). When natural conditions determine land-use, the same may still be protected

by the legal entity which possesses relevant rights over the land. For example, the state may declare an area of land to be a forest area or a nature reserve, in the same manner in which an individual landholder may reserve part of his land for grazing. In this sense, natural conditions and human settlement interact in determing land-use. Nor can human settlement be said to have an inherent capacity to dictate land-use. But at least it can be said that human settlement necessarily brings with it certain rights of access and of use which in turn entitles the holder of these rights to the freedom of determining land-use.

The point to stress here is that the interaction between tenure and land-use is the central problematique. Land tenure rules emphasize man versus man issues; the regulation of competing interests in the use of land. On the other hand, land-use emphasizes man versus environment issues; the regulation of the use of land so as to conform with acceptable methods of husbandry and conservation. It is the holder of tenurial rights who can ensure that the objectives of land-use are realized. This is the same as saying that the determination of the function to which land is put is an exercise of legal rights over the given parcel of land; land-use decision-making is a tenure issue. Legislation can be used to ensure that defined objectives of land-use are respected by holders of tenurial rights.

1.3 LAND-USE LEGISLATION

Land-use legislation is legislation that is designed to provide a framework for determining the functions) of land. Land-use legislation, like other laws, must be constructed on a foundation of certain jurisprudential assumptions, which in many modern societies, will already have found articulation in some constitutional document. By the time land-use legislation is being considered, such issures, as the legal character of state power, the place of personal choice and freedom in society, the role of rights in the process of production,, and the ideological content of political organization will usually have been thrashed out and articulated in law. A complete picture of the role of land-use legislation can only emerge if the jurisprudential foundation is understood.

Whenever legislation is introduced with the intention of using it to implement policy, such legislation must be well-suited for the task it is intended to fulfil. Expressed diffently, such legislation must be appropriate. Two sets of considerations determine the appropriateness. First, the legistation must be suited to the particular circumstances of the country. Here, the relevant considerations are levels of sophistication of the population and the decision-making organs of the society, the ruling political

ideology, the historical context within which laws and institutions were nurtured, etc. For example, if legislation is introduced on the premise of popular participation in decision-making in a society in which the population is accustomed to authoritarianism, they are not likely to benefit fully from such law. Similarly, if legislation is premised on information and contribution of a literate public, then a largely illiterate population cannot operationalise it.

Secondly, the drafting of the legislation must reflect a scientific use of the law. Decisions have to be made between substantive legislation (i.e. one in which the policy principles, standards and procedures are all written in law) and enabling legislation (i.e. one in which only a legitimate framework by decision-making is provided). Similarly, choices have to be made regarding the "sanction element" of the law. The law provides a great variety of methods for achieving the ends of legistation. These include punishment, civil remedy, licence, incentives and publicity (Swan 1976) which method best suits the requirements of a particular piece of legislation is a scientific question which if answered irrationally, could hinder the attainment of proper ends of the law.

If land-use legislation is to be considered specifically, an appropriate scheme of such legislation ought to

facilitate at least four things:

(i) Rational choice of land-use in situations of competing interests;

(ii) Combination of more than one uses whenever necessary;

(iii) Public participation in the decision-making process; and

(iv) State supervision of the process of choice and process of use to which the land is put.

As one form of lan-use, agroforestry development should then be implementable within the framework of an appropriate scheme of land-use legislation.

1.4 AGROFORESTRY DEVELOPMENT

Agroforestry has been defined as any land-use system that combines trees, crops and/or animals in an interactive manner either simultaneously or sequentially in the same unit of land (UNEP 1986). Its development requires, and involves some adjustment in existing land-use practices. This process of adjustment may be voluntary changed on the part of land owners, or a requirement of policy at a national or regional level. In either event, there is a possiblility that existing tenure arrangements could hamper the successful realization of agroforestry

development objectives. In an appropriate scheme of land-use is already in place, then agroforestry development ought to be implementable without any drastic changes as soon as a policy decision to that effect is reached, and subject to any problems of a tenurial character.

But in the event of an appropriate scheme of land-use legislation not having been developed, then in addition to problems posed by existing systems of tenure, acceptable methods have to be found of incorporating agroforestry development objectives into land-use legislation. How this is to be done depends on what already exists on the ground. In the case of Kenya, the rest of this paper will now turn to examine the tenure systems that exist, the land-use laws that have been promulgated, and how well-suited these are for purposes of agroforestry development.

2. LAND TENURE ISSUES

2.1 SYSTEMS OF LAND TENURE

There are two systems of land tenure in operation in Kenya (Kibwana 1988; Okoth-Ogendo 1976). One is based on English property law, and its statutory embodiment is the Registered Land Act as supplemented by the Indian Transfer of Property Act and the Registration of Titles Act. The essential characteristic of this system of tenure is that it confers titles and rights

on individuals. Legal persons own land as individuals, and subject to superior rights inhering in the state, they regard their parcels as any other commodity that can be bought, soild, leased or transmitted.

Individual title, and the freedom of transaction and disposition of land that goes with it, can, and does lead to over-parcellation, over-exploitation of the land, and landlessness, (James 1971; Swynnerton 1955). Moreover, to the extent that English law conceives of land as including things that are attached to it, individual tenure means that the owner also acquires the legal right to do as he pleases with the things growing on the land - including trees.

The other system of tenure is based on pre-colonial, indigenous property arrangements in Kenya. It is regularly referred to as the customary or communal land tenure. This system of tenure operates in two categories of land areas. The first are trust lands which are former "Native Reserves" where land has not yet been adjudicated and consolidated. The second are those areas in which the Land (Group Representatives) Act is in operation. These are areas in which individual title is an unsuitable arrangement owing to prevailing land-use practices and cultural considerations (Godana 1976). The full legal content of communal land tenure is very complex.

(i) Tenure can obstruct tree planting.
As a proposition, this ought to happen when there is insecurity (Okoth-Ogendo 1987), when there is pressure on the land, when there is communal tenure, and when ownership does not carry a duty to develop the land.

All these situations obtain in Kenya today. Solutions must be found for them before meaningful agroforestry programmes can succeed.

(ii) Tenure inhibits the fixing of responsibilities for the planting of trees and other things growing on the land. This situation obtains because, even though the formal legal position is that two systems of tenure exist in Kenya, at a practical level there is a great deal of confusion as to which one to apply, and greater confusion still as to the legal responsibilities that go with tenurial rights. Those with individual title do not necessarily assume responsibility for fixtures on land: those under communal tenure assume that these are outside their scope of duty in enjoying access.

This situation can be resolved by separating access rights from control rights over land (Okoth-Ogendo 1987) and consequently treating

the latter as incidents of sovereignity. In practice, this would be attempting to erect a separate system of tenure for trees, which has not been done yet in Kenya.

(iii) Although tenurial rights can be qualified, and are subject to overriding state rights over land, it is not always clear how much of that qualification can be introduced with the object of requiring landowners to practice agroforestry.

Here is a tenurial issue that in practice poses itself as either a role of the state in land matters question, or a land use legislation issue. It is easiest to resolve the problem by positing theory that the state can compel landowners to practice agroforestry as an incidence of control of land, and then examine the practical circumstances of a given locality with a view to deciding how this is to be done. Apart from it not having been done so clearly in Kenya, there is the related issue of how well aware the landowners are that the state can do any of these things.

3. LAND-USE LEGISLATION ISSUES

3.1 BACKGROUND

Land-use legislation in both colonial and post-colonial Kenya has been enacted on the unarticulated premise that aspects of land-use are independent on one another

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(Okoth-Owiro 1986). Hence aspects of land-use in Kenya re today regulated by separate legal frameworks, e.g. Agriculture Act for Agriculture, Forests Act for Forestry, Mines Act for Minerals, Water Act for Water Resources. This legislative scenario is a reflection of policy on land-use which started by emphasizing resource exploitation, and then moved gradually to reflect resource management. Neither strategy required an inter-land use linkage in management, and so allowed for separate regulation. It was only after 1970 that conservation of resources - the thesis of "sustainable use" - was articulated in policy (Kenya 1974), and by this time the majority of the legal frameworks were firmly in place.

Conservation is the basis upon which notions of wholistic management and interrelationships in land-use are developed. If it was a post-1970 development in Kenya, pre-1970 legislation could not seriously reflect it.

3.2 CURRENT LAND-USE LEGISLATION

Four characteristics typify existing land-use legislation in Kenya (Okoth-Owiro 1988).

First, the legislation, as a rule is enabling legislation which confers legitimate authority on public servants to make binding legal decisions on the basis of broad, discretionary power e.g. Land Planning Act, Local Government Act, Agriculture Act e.t.c.

Secondly, every piece of legislation is, as a general rule, independent of every other piece, and with the exception of the Agriculture Act, no provision has been made for inter-sectoral co-ordination, or cross-application. This is the case even though the Land Planning act purports to be an umbrella planning statute (Menezes) 1968).

Thirdly, responsibility for land-use decision-making is fragmented, and is currently exercised by more than twenty government departments and related public institutions. Finally, all legislation without exception, rely on punishment and the licence as the primary methods for securing compliance with the requirements of the law.

These characteristics are largely negative. But there is the positive side - that the legislation is enabling in character. This makes most laws adaptable to changing situations.

3.3 THE ISSUES

The real question to be posed here is this: to what extent can Kenya's current land-use legislation be used to implement an agroforestry development strategy? There are two basic ways of arriving at agroforestry: integrating trees into farming systems or farmers into forests (Raintree 1987). Another way of posing the issue thus is: can Kenya's land-use legislation deal with problems and difficultures that are bound to arise?

To answer these questions, it is useful to explain that the outset that the Agriculture Act holds the greatest promise as an agroforestry legal framework. This is because the Act contains an exhaustive range of enabling powers for supervising land-use for purposes of agricultural production (section 64 - 74) while at the same time providing a framework for the development of forests in agricultural land (section 48 - 62). Thus, if agroforestry development is interpreted purely as a land-use conservation requirement, the Act can be used to facilitate the integration of trees into farming systems in Kenya. An attempt to integrate farmers into forests is, however, not easy under the present scheme of legislation because the Agriculture Act cannot facilitate it, and the Forests Act defines forests in a manner that excludes other forms of land-use, including agriculture. An alternative legal framework needs to be developed for this purpose.

Even assuming that the Agriculture Act can provide a legitimate starting point, it must be realized that the potential for generating problems is not marched by a provision for possible solutions in the current scheme of legislation. Three problem areas may be identified.

(i) the current scheme of legislation does not provide for rational selection of land-use priorities, or conflict resolution in cases

of competing demands on the same parcel of land. And partly because of this,

(ii) the legislation does not provide for a systematic curb on encroachment of agricultural land, or forest land through expandison of other land-use activities. The best illustration is the continued expansion of urban settlement areas at the expense of forest and agricultural land; and

(iii) the legislation does not provide a clear framework for compelling or persuading occupiers to practcie agroforestry. The Agriculture Act could be used to force occupiers to practice it, but since this is not the best way of converting populations to superior land-use techniques, a more culturally acceptable method of integration is required.

4. COMMENTS AND CONCLUSIONS

It is not easy to separate land-use legislation issues from tenure issues in agroforestry development. Indeed, it sometimes makes sense to think of land-use legislation as a strategy for articulating the solutions to land tenure issues. Be that as it may, both systems of tenure that are prevalent in contemporary Kenya -

individual and communal - generate problems for agroforestry. At the same time existing legislation on land-use also pose some difficulties for agroforestry development.

It may well be a more appropriate approach to think of "legal issues" in agroforestry development, and attempt to resolve them as such. If the issues are posed in this context, then problems of policy articulation and implementation, and especially problems of using the law as a means of requiring agroforestry development are likely to be more directly important than issues of tenure and land-use legislation.

The presentation is therefore firmly rooted in the belief that in spite of existing problems, the germ already exists in Kenya's tenurial arrangements and land-use legislation which can grow into a comprehensive legal framework for agroforestry development.

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SOCIAL FORESTRY AND LAND OWNERSHIP IN KENYA

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INTRODUCTION

Social forestry, as a term and as a type of project, has now been with us for about thirteen years. As a type of activity, on the other hand, it probably has a genealogy of two thousand years or more in some parts of the world, e.g. India. The terminology of social forestry or community forestry has been contested. At one extreme, community forestry has been restricted to those rare cases of village - initiated, self help schemes where the benefits will equitably be shared. Others have held that social forestry gives a false impression that there will be a distribution of social benefits. Thus social forestry entered forest policy internationally, as a major manifestation:-

- Village woodlots, run by Forest Departments of self help communities on government and community lands.
- Farm forestry on private land, including wastelands.
- Rehabilitation of degraded land by the Forest Departments, and
- Strip plantations on road, rail and dam sidesrun by Forest Department.

As a whole, taken in a nutshell, social forestry is a forestry practice, where rural based farmers are encouraged to plant trees either on their private farms and/or land communally owned so as to meet their felt needs of wood and wood products at the time and place where such a need is felt. It thus enables families and communities to decide their own priorities, and grow the types and numbers of trees they choose in the locations they feel are most relevant to their needs.

In his paper entitled: "A Plague On All Our Houses, Reflections of Twenty Years of Forestry For The Third World Development", Leslie (1985), contents that foresters and those in search of means and ways of accelerating rural development have turned to social forestry because industrial forestry has failed to do so for the last twenty five or so years. The same view has been expressed by Dargavel, Hobley and Kengen in their paper entitled "Forestry of Development and Underdevelopment of Forestry". This argument came about after F.A.O. published its policy paper on forestry in 1977 which was followed by the Jakarta Conference in 1979. Even though this argument can be considered as having some significance, it it our opinion that industrial forestry was being evaluated even before its appraisal.

One other reason for advocating this policy shift by F.A.O could be that in dealing with the problem of combating tree depletion which had been documented by Global 2 000 task force and the Tropical Forest Resources Assessment Report by F.A.O.: conventional forestry services are severely restricted in their scope

for action. Shortages of manpower and resources mean that few Forest Departments can consider replanting on the scale necessary to have a significant impact in combating deforestation or meeting the growing demands for tree products.

WHY DO PEOPLE GROW TREES

In their book entitled "Fuelwood, The Energy Crisis That Won't Go Away", Eckholm and Others (1985) have listed some of the reasons why people grow trees as:-

- to make money
- to provide some basic needs such as food, shelter and even clothing
- to conserve water and soil.

They have also listed some of the reasons why people do not grow trees as follows:-

- antipathy to trees
- lack of incentives
- land tenure system
- questions of tree ownership
- shortages of land
- seasonal competition for labour, and we may wish to add, "time preference".

THE LAW IN RELATION TO LAND PRACTICES IN KENYA

It is generally considered that agriculture and animal husbandry

are activities controlled by individuals for individual benefit. Forests, on the other hand tend to be regarded as national resources and a preservationist view of management is normally prescribed. The consequences for land law are that two separate organization structures emerge to deal with what we are wanting to view as an integrated whole. In Kenya, Private Property Law provides the basic legal framework. This essentially, implies individual freedom and limitations upon the state to open up new options. Even the legislation of groups in an exercise of private rights. In the context of the Land Act, which guarantees individual (or group) rights in land ownership and control, woodlands are considered as auxiliary to agricultural related uses. Forest lands come under the National Forest Act. A distinction is made in the Act between forest areas and forest lands, and a separate legal framework is provided for each. For the national gazetted forests, management is intended to be control-oriented and excludes the possibility of human interference. This concerns Kenya's existing legislation, social forestry as when practiced on either on private or communal land, cannot enjoy the same rights and protection as forestry practiced in gazetted forest areas - usually, industrial forestry.

LAND TENURE AND TREE GROWING

Where people have doubts over the ownership of land they are farming, they will almost be certainly unwilling to make long term investment involved in tree growing. Where land is owned communally, so as to make social forestry be in time with the

intended benefits, the ownership structure is usually unclear.

Apart from land tenure, there may also be a variety of legal constraints to tree growing (in some countries, the government owns all the trees, whether they are grown on private lands or not). Farmers have no right to cut trees, even if they plant them themselves, without going through the lengthy process of getting official permits. Laws of this kind, originally designed to protect forests, can actively discourage tree growing. In some countries, all the land is owned by the state. This makes individual tree planting initiative nearly impossible.

CONCLUSION AND SUGGESTION FOR FURTHER DISCUSSION

In this short paper, we have touched on some concepts of social forestry, its rationale, its place in terms of its workability and the place it has in our legal system of land ownership and management.

We have pointed out that for it to achieve its positively intended objective in resulting to the greater majority of the people being self sufficient in tree and wood products, it must have a foundation in a land tenure system which must take into consideration an anticipated national land use policy.

FARMERS' ATTITUDE TO TREE PLANTING IN RELATION TO LIVESTOCK

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INTRODUCTION

1.1 An agroforestry production system is basically a land use strategy which integrates agricultural and forest production under a common management. In a situation where population pressure is high and arable land is diminishing, agroforestry should be conceived and applied to offer an opportunity for a sustainable production system. This is because of its ability to minimize the conflict between agriculture and forestry through providing food, fuelwood, timber, fodder and other basic needs as well as facilitating the conservation of the environment.

1.2 All human beings aspire to have a good quality of life after fulfilment of their basic wants or needs of food, clothing and shelter. Thus, in an effort to achieve a desirable level of development in a country, our aim should be to improve the quality of life of the people, especially the poor and those living on the lower brackets of incomes. These particular people are often forced by

economic needs to damage the natural resource base on which they and the entire manking depend for survival and sustainance. Technology generated by agroforestry research can arrest this potential damage.

1.3 The paucity of literature citing attitudes of people within the country's rich varied cultures and traditions is extremely wanting. This situation may have arisen here as a result of our past colonial heritages and influences whereby the indigenous traditional values were seen as 'backward' and/or primitive in relation to the new concepts brought by the advent of the Europeans. This legacy in many ways still haunts many of Kenya's past rich cultural traditions to a large extent.

1.4 In this paper an attempt is made to define in broad terms the elements of an attitude, also factors influencing them and how these can be measured within the context of a new innovation and/or technology being introduced. Assumed benefits that the target farmers are expected to derive are briefly examined and highlighted within the constrints of the prevailing socio-economic environment. Two examples are used as case studies to illustrate the salient features that could possibly have come into play for their successful introduction and adoption. The success of the zero-grazing system technology and the bio-gas plant are highlighted.

1.5 In broad terms an attitude can be defined in several ways as:

- mode of thinking
- a disposition which influences a pattern of behaviour
- a mode of doing things within an accepted norm
- an orientation of reactions towards or away from a given position or stand in relation to a concept or situation.

In this respect an attitude presupposes a settled mode of thinking.

2. FACTORS INFLUENCING ATTITUDES

2.1 Attitudes are influenced by several factors, including: lifestyles, traditions, religion, socio-economic status, and/or incomes, laws and legal institutions, medicines and increasingly by education. In Kenya's diverse ethinic groups a variety of lifestyles is commonly in evidence. The pastoral people such as the Masaai, Turkana, Pokot and Somali have clear different lifestyles to the more sedentary ethinic groups such as the Kikuyu, Kamba (Central) and Luo and Luhya of the Western Kenya. Similarily, a variety of traditions have evolved within each of these groups influencing their eating habits, clothings, aesthetic values, land rights,

marriage and burial ceremonies, use of traditional medicines, etc. Religious concepts of a.god in existence also persists in various forms. In some of these societies, socio-economic status is valued by the number of livestock or wives he possesses and/or amount of land he owns. These factors are important in an attempt to understand the attitudes of any group of people be they "farmers" or otherwise.

3. FACTORS INFLUENCING AGROFORESTRY PRODUCTIONS SYSTEMS

3.1 Before examining the benefits facilitating the adoption of specific agroforestry production systems, it is worthwhile to consider the major factors which influence the agroforestry systems. These factors fall broady into two categories namely natural and institutional. I will deal with each in turn.

3.2 The natural factors include the biological and physical relationships which are normally relatively difficult to predict and influence by man. However, the factors can be amenable to change through systematic and sustained research efforts in the long run. The institutional factors which are equally important as natural factors are normally established by man to meet specific conditions and needs. They can therefore be modified or easily manipulated by man. The institutional factors include social, cultural, economic, political and legal systems. The institutional factors could be

endogenous, being factors who influence emanate from within the specific location (production system) where agroforestry practice is being carried out. Such endogenous factors largely include social and cultural factors although other inherent factors could be identified. The exogenous factors, which influence the production system from without are largely economic, legal and political factors.

3.3 It is in the institutional arrangement of the production system, that we have a big scope for identifying incentives and/or benefits for adopting emerging appropriate agroforestry technologies. Since the value of any new technology is closely related to its ability to suit or adapt to the socio-economic, cultural and physical condition needs, the benefits must also be related to these conditions.

3.4 Establishing suitable livestock/agroforestry production system.

3.5 For the agroforestry production system to qualify to be appropriate, some of the conditions which must be fulfilled include the following:

(a) The local resources should be considered before identifying necessary external assistance for the systems based on local knowledge and practices.

(b) The felt needs of the community must be considered and amply articulated. These needs may be one or a combination of many items like food, shelter, energy, water, etc. Technology is viewed as useful only when it serves the needs of the people it was intended to.

(c) The production system should be able to conserve the environment especially with a rapidly increasing population pressure, on a sustainable basis.

(d) The role of various pressure on interest groups in the community must be recognized. If men, women, and children have specific roles in a society, introducing a new technology that undermines the traditional structures and form of organization is bound to fail. For example, in many societies in Kenya women are traditionally involved in the task of collecting and using firewood, they must also be involved in the planning and implementation of technologies meant to increase fuelwood supply. They should be consulted about the suitable types of fuelwood trees for the area. Similarly, informal lending arrangements in a community could be helpful in facilitating credit where hitherto no formal institutions exist. Many of Kenya's peoples have had these set-ups in their traditions for

for a long time and has in the times of needs cushioned them from imminent dangers, disasters and famines.

(e) The policy on environment i.e. the role of both local and central government must be considered. The market structure, prices, the legal conditions for ownership and utilization of assets including land, formal credit arrangements, research and extension arrangements are all influenced by government policy.

.6 In order to understand the operations of the above factors in a particular production environment, a series of concurrent surveys need to be undertaken to determine the current existing farming systems and their related production constraints. These surveys are crucial before setting up or introducing new agro-forestry production systems. The surveys should be able to depict among other things:-

(a) The needs and preceptions of the target group of farmers i.e. large or small scale farmers and their farming activities; tea, dairing, goat keeping, mixed cropping farmer or producer as well as the mode of production and technology in use.

(b) The resource base available to the target farmers or community, including land, labour and capital

and the problem associated with the resource use utilization.

(c) Credit availability and conditions attached.

(d) The spertial distribution of the target groups or clusters and any inherent enterpreneural abilities associated both within and between the identified groups.

(e) Whether the underlying assumptions are in step with the farmers' perceptions in the project technology conceptualization.

(f) Determine the feasibility of the intended technology for example zero-grazing systems or bio-gas plant.

(g) The characteristics of the existing production systems.

(h) The socio-cultural status of the community.

(i) The prevailing awareness and attitudes within the anticipated livestock technology intervention.

The information data-base gathered from the farming systems surveys should put into perspective the nature of the problems, scope and magnitude and call for possible appropriate interventions to be instituted.

3.7 The benefits associated with the adoption of the new technology.

3.8 The desirable result of an appropriate well integrated agroforestry production system would be to both raise incomes for the production activity, quality of life as well as resource conservation. Farm incomes are derived from the marketing of the agroforestry products, if a saleable surplus is realized. Therefore benefits consist of initiatives and prospects which;

(a) Increase the output of the systems.

(b) Raise the prices of the seleable products.

(c) Improve the infrastructure; to facilitate the movement of the saleable agroforestry products to areas where they are needed or

(d) Improve the availability of inputs to the production systems when needed.

(e) Encourage land utilization procedures to ensure investment on the land.

(f) Reduce drudgery by lessening the work load by use of simple tools and machines.

(g) Increase awareness of the community.

3.9 <u>Technical consideration</u>

The problems which farmers will be concerned with before adapting a new technology whether in an agroforestry production system or livestock enterprise activity are those aspects which will reduce the yields and/or productivity and therefore the need for these aspects

to be addressed by research. These problems consist of:

(a) Shading underneath crops by three crowns. This can lower yields and quality of the associated crops/pastures.

(b) Competition between trees and agricultural crops including fodders and pastures. The crops compete for nutrients, water and space and this can reduce production of either or both crops. This will have adverse effect on the quantity of feed available to the livestock.

(c) Tree harvesting may cause mechanical damage to associated crops/pasture. Appropriate tree-crop/past associations are desirable to minimize the damage.

(d) Fungal and bacterial diseases may be associated with particular systems due to increased moisture below the trees hence reducing yields and affecting the livestock as well.

(e) In some systems where trees are harvested and removed, they are essentially lost and ways of replacement must be made known to the farmers.

(f) Some agroforestry production system may promote the existence of particular pests which may eventually reduce the yield of one or more of the other and/or cause livestock diseases.

10 The role of R & D in technology development process.

11 The role of R & D in technology development is recognized worldwide and the major processes distinguished. In general, R & D can be divided into five major phases in the generation of a given technology as shown below:

(a) Scientific - displinary research.
(b) applied or mission - displinary research.
(c) Mission oriented invention or technology discovery.
(d) The product/technology development phase.
(e) Commercialization/dissemination stage.

.12 These are illustrated in Figures I and II showing the salient features, processes, interactions, information flow direction in arriving at the finished product. Though specific problem will result in variations, may of the problem approaches will be common and hence a genetic form of the simplified format for a given technology/invention.

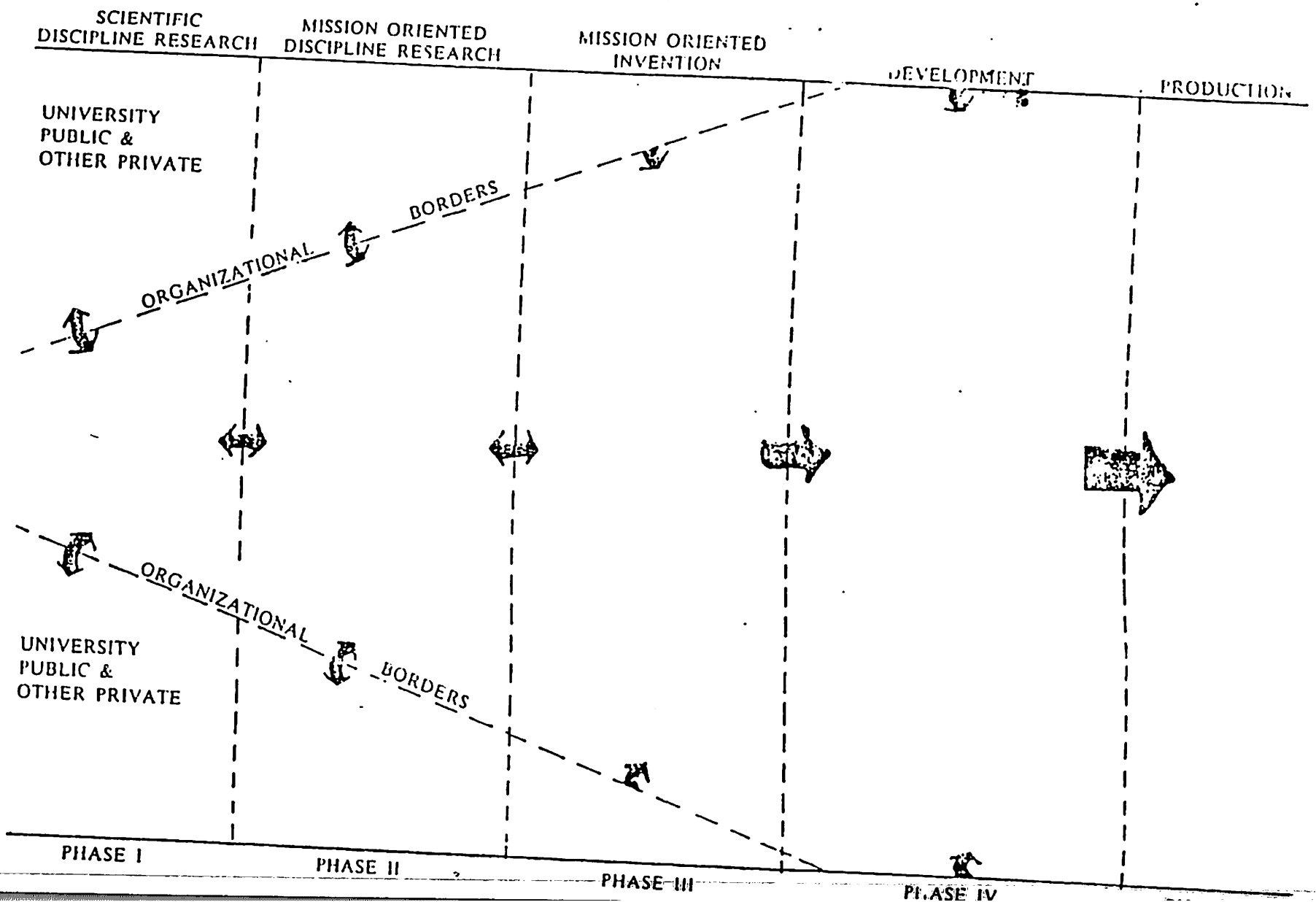
3.13 The first two phases to some extent the third phase comprises of disciplinary scientists or group of scientists whose main objective is to discover and/ or diagonise specific problems usually from a common discipline. In phase three a mix of scientists from different backgrounds are involved in combing the disciplinary packages into an integrated package taking into account the prevailing practices or market situations.

3.14 Finally, candidate packages are tested resulting into the finished product or tenology for dissemination and utilization by the consumer. There exists organizational borders in this respect which should be avoided when planning for farmers, pastoralists, etc, as they exist and conduct their lifestyles in an integrated whole farm system approach.

3.15 Government Policies.

3.16 The other incentives relate to government interventions and include various measures.

These are:


SCIENTIFIC DISCIPLINE RESEARCH
MISSION ORIENTED DISCIPLINE RESEARCH
MISSION ORIENTED INVENTION
DEVELOPMENT
PRODUCTION
UNIVERSITY PUBLIC & OTHER PRIVATE
ORGANIZATIONAL BORDERS
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PHASE I
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PHASE IV

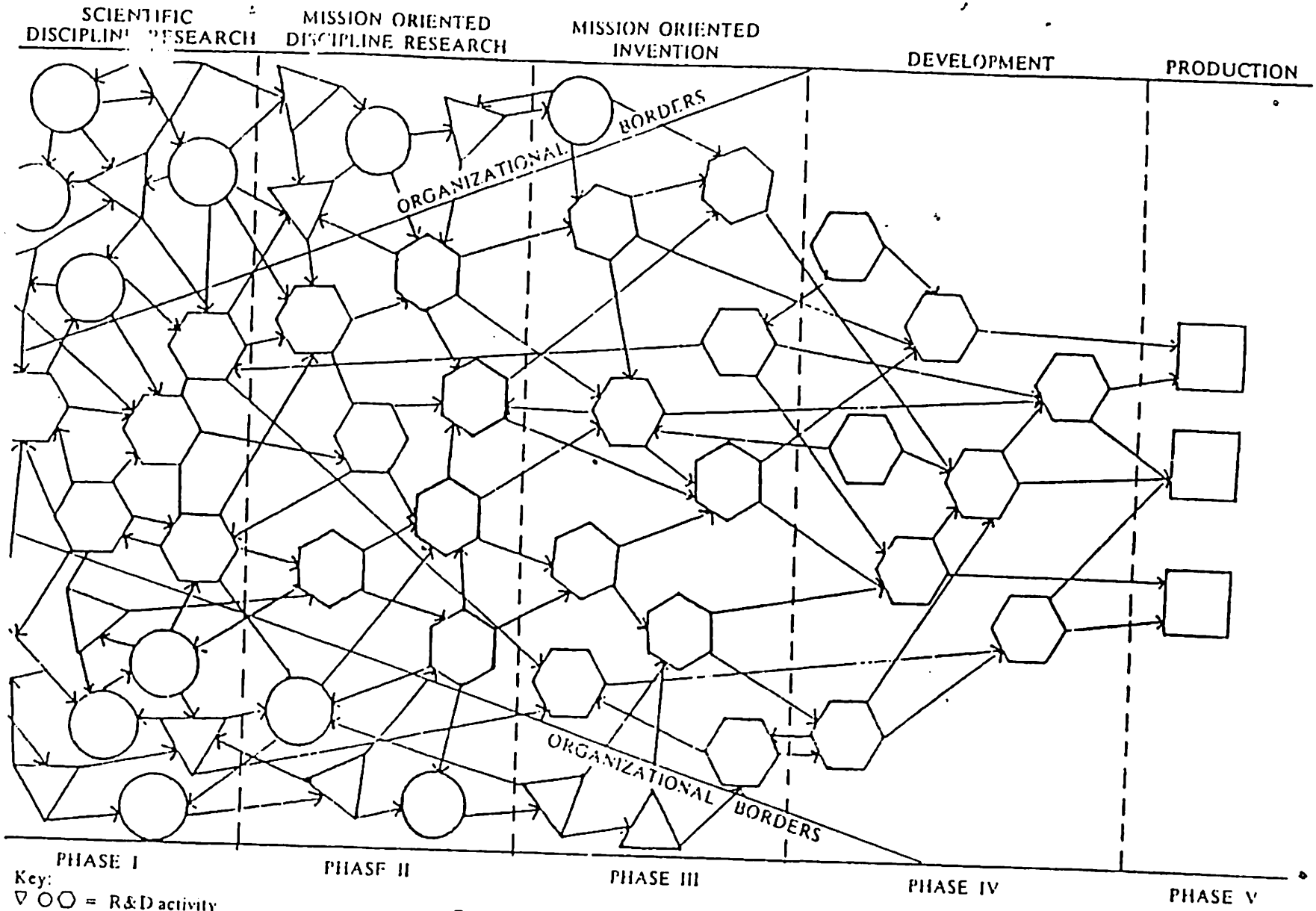


Figure 1. Interaction within the R&D process

(i) Product and input price policies

(ii) Land policies

(iii) Credit policies

(iv) Research policies

(v) Extension and education

(vi) Market and infrastructure development

The government of Kenya has commitment to promote agroforestry production systems as is shown in the Sessional Paper No. 1 of 1968 (Kenya, 1986).

3.17 The choice of enterprise the farmers adopt is largely dictated by the relative price of the products. The prices of the corresponding inputs also influence the level of input applied and therefore output expected. It is therefore necessary for these prices to reflect the need to promote agroforestry production systems. This is because as we have alluded to earlier agroforestry systems give substantial opportunity to conserve the environment and also supply the basic needs.

3.18 Land security associated with more permanent investments by the users. Since agroforestry practices incorporate trees in production, there is need for land tenure arrangements which confer security on the users. Registration and provision of land titles is one way users can be assured of ownership hence investment. Associated with land tenure policy would be the possibilty that with a title deed, the users could provide the production system.

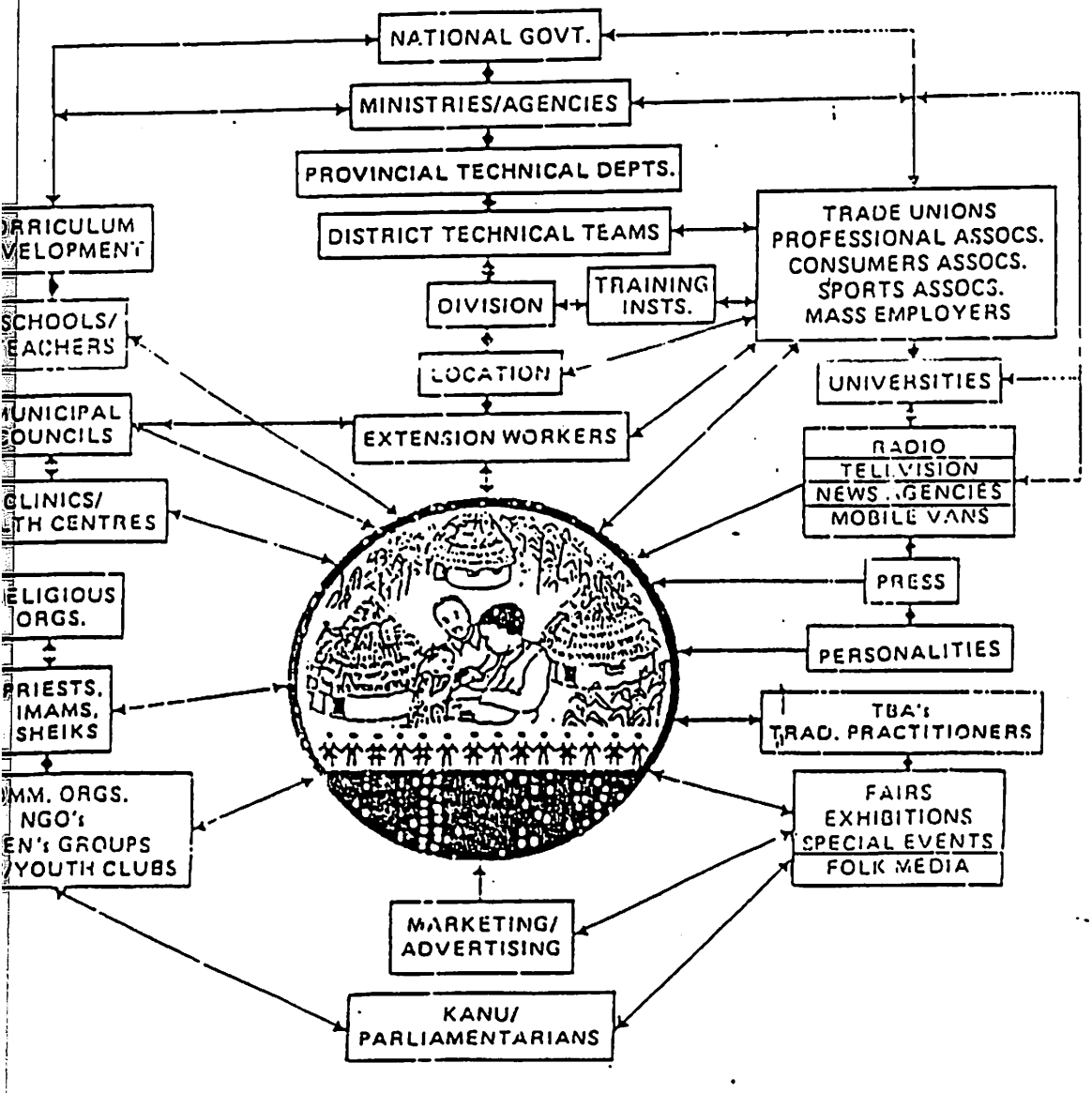
The credit policies need to take into account that, not many farmers have titles with which to pledge for production loans. Therefore, an arrangment whereby a collateral other than land title deeds should be in place. One possibility is to work through co-operatives or village groups where the leaders will be held responsible for defaulting and group assets can therefore be pledged. At the same time the interest rates on agroforestry production loans should not be so high as to discourage the potential beneficiaries.

Research on agroforestry production systems need to be intensified to help resolve the problems which emerge as farmers try to adopt the various production technologies. The role of R and D in the development, testing and formulation of the proposed invention or technology and finally disseminating the finished product in close conjunction with the target users at all stages is crucial for its eventual success. The various stages have been alludded to earlier.

Extension and education are very crucial. Many farmers may lack the knowledge about what trees to interplant with crops, how to care for the, and even the best uses for them. This information can be relayed through extension and social educational campaigns for the farmers (see Fig. III). Timing of various operations should also be critical for the agroforestry system and this needs to be known to farmers.

Communication for Social Mobilization in Kenya

The diagram is a simplification of how information reaches the community and family. Lines represent information flow and direction; the positioning of boxes is not meant to indicate official status.



Chart/Figure III

3.22 Marketing of output and input are essential. In this respect the government has a vital role to improve the roads (including the rural access roads) to facilitate transportation. At the same time, if tree nurseries are far apart, farmers will find difficulty in finding seedlings. Trees which are multi-purpose such as fruit tree should be encouraged. To the extent that many man hours spent on collecting fuelwood from distant places to the homestead can be reduced, this should be a benefit to farmers if suitable quick-growing species can be introduced in nearby nurseries for them. The fuelwood availability through agro-forestry production system can be a big incentive in itself. Food may be available but the energy to cook it could be completely lacking. The pinch of energy crisis is fast beginning to tell in some densely populated districts such as Kisii and Kakamega, where it would be unadvisable to tell a farmer in some instances to use maize stover as a feed for animals when he has no fuel for cooking for the family.

4.0 THE CASE FOR THE INTRODUCTION OF THE SPECIAL ENERGY PROGRAMM (SEP) BIO-GAS PLANT

development programme and was implemented by the Ministry of Energy and Regional Development in co-operation with GTZ to address the fuelwood problem in various ways.

Its recognized from the outset that however much its appropriateness it would never be able to solve all of Kenya's energy related problems. The salient features resulting to the successful adoption of bio-gas plant programmes therefore are briefly summarized below.

4.2 The clear and well defined target group to whom the bio-gass plant technology would focus. These were characterized as:-

- farmers with sufficient cattle to feed a bio-gas plant for a family of five to eight persons
- farmers with sufficient incomes to purchase the bio-gas plant commercially
- that it was essential for dung to be centrally collected or accummulated implying a zero-grazing situation
- substantial effect of dung for commercial fuels.

This approach let do the rationale that the technology could only be profitably performed in medium-sized farms two to six ha. with at least two to five cows, in densely populated areas.

4.3 The ready existence of zero-grazing technology was a pre-requisite for the central collection of dung to be fed into the bio-gas plant. The Ministry of Livestoc

Development was in a position to give intimate advice on the efficient working of a zero-grazing system.

4.4 The immediate benefits of the slurry (dung) as a fertilizer source to be applied to the cropping systems.

4.5 The high and desirable employment element as well as income generation of the technology.

4.6 The substitution effection of a commercial fuel and resultant conservation of the woodfuel on household land for cash sale.

4.7 The improved sanitation and hygiene by the means of a centrally placed dung collection, accummulation and eventual disposal mechanisms to the cropping systems as slurry manure.

4.8 The readily available labour to handle the bio-gas plants through a properly instituted training programme for masons and artisans.

4.9 The planned integration of the zero-grazing systems - bio-gas technology within the total farm context enabling easy accummulation of dung centrally for utilization into the bio-gas plant. These linkages are of crucial importance when introducing new technologies for them to succeed.

4.10 The importance of forging appropriate linkages with other organizations conducting similar activities, non-governmental organizations and the private sector for the commercial success of the project, the Masons/ Artisans and KENGO for commercialization of the various bio-gas plants and the JICKO ceramics.

5.0 THE CASE OF THE ZERO-GRAZING SYSTEM TECHNOLOGY

5.1 It is now widely appreciated and acknowledged that the zero-grazing systems technology has had an impressive national impact in increasing milk production in the country. Furthermore, it is seen as one of the key approaches in the intensification of milk production from the current 1.76 billion litres of milk to meet the national goals of 3.6 billion litres of milk in the year 2 000 A.D. In this respect it may be appropriate to pose the question; what has been the salient feature leading to the high adoption of this technology?

I hope by a careful diagnosis of the key processes entailing this system some insight can be obtained to explain the contributing factors and possibly the attributes influencing the attitudes of farmes who have adopted this technology.

5.2 The principles, steps and messages emphasized in a zero-grazing systems technology.

5.3 The acquisition of an improved cow for the efficient utilization of available forage for greater production of milk compared to the zebu cow. The benefits in terms of milk production showed a quantum jump and hence higher incomes.

5.4 The need to use bulk-feed resources such as napier or bana grass for greater D. M. yield production per unit area of land, in order to meet the demands of the rapidly expanding population in Kenya.

5.5 The need to construct a well designed housing unit to facilitate the efficient operation of the systems for ease of dung collection, bio-gas utilization, better feed resource utilization, watering systems, ease of milking a application of the dung to the crops.

5.6 The need to institute proper health and calf-rearing procedures for eventual herd replacement of the adult cows, in addition to extra-incomes derived from sale of bull-calves.

5.7 The need to have a sustained productivity from the dairy herd by ensuring that only fertile and productive

animals are maintained while culling the unproductive and/or barren cows. Emphasis is placed on the realization of a calf -er thirteen months.

5.8 The need to supply appropriate feeds to meet the cows' nutritional requirements both in quantity and quality.

5.9 The appropriateness of the zero-grazing unit in meeting and solving simultaneously the multiple problems associated and found on the farms, the amelioration of drudgery, ease of collection in relation to the bio-gas plant attachment.

5.10 The viable and profitable outlook of the activity both financially, employment-wise, fertilizer-wise, as a supplement, etc.

5.11 The convenience of the staircase approach model which enables the resource poor farmers to incrementally adopt at his convenience and depending on the resources availabile to him, any of the technological components singly or in combination sequentially. In all cases the benefits accruing to the farmer are amply articulated for the farmer to take rational decisions (see Fig. 4).

CONCLUSION

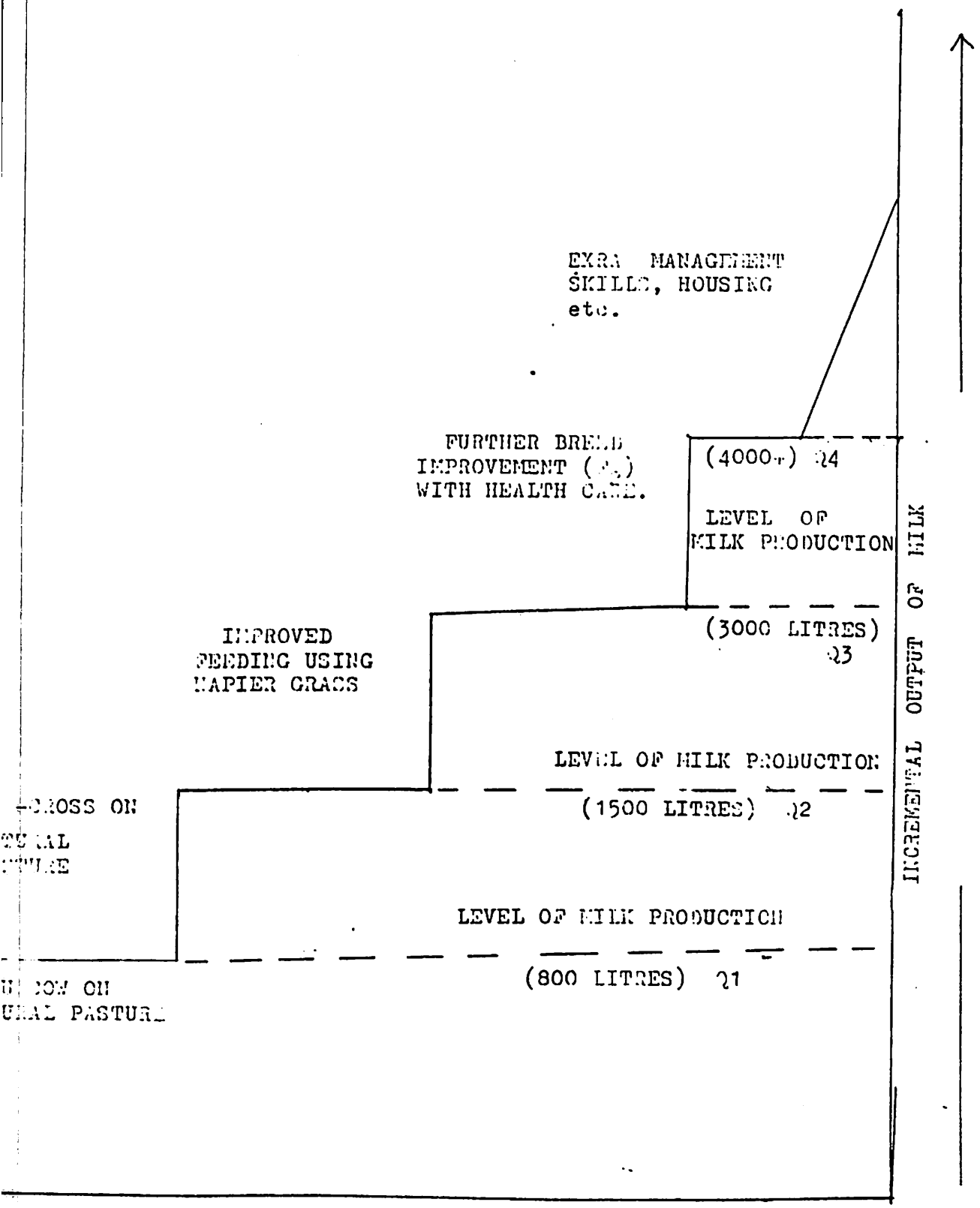
The objective of agroforestry is to create a sustained land management system which would result in increased yields of the land, compatible with the principles of sound environment practices in harmony with cultural outlook of a people. The technical and socio-economic aspects that come into play have been examined in light of the success or otherwise of understanding the factors influencing the attitudes of farmers in adopting a given technology. The need to have a proper understanding of socio-cultural factors, technical constraints and how these inter play with the exogenous factors were highlighted. The exogenous factors, largely explained and exhibited through the social and cultural behaviour of any given community are cited, to the extent that these reflect and act as mirrors for the societal needs, aspirations, and hopes. The generation and development of any technology therefore has to take cognisance of the above factors while working closely at all stages with the target community of farmers, the eventual users of the technology generated.

This close identification with the farmers' perceptions and the type of expected responses from the anticipated benefits does not call for sympathy with the targeted groups but emphathy. Despite the inherent difficulties that this entails, the problems are not unsurmontable

if appropriate approaches and methodologies are put into place. The case of the zero-grazing systems technology and the special energy programme for the bio-gas plant have been used to aply illustrate the salient features involved in the successful adoption of new technologies and how these may influence the farmers attitudes.

DEL SHOWING A STAIRCASE APPROACH EMPHASIZING MAJOR IMPACT

OINTS IN A ZERO-GRAZING SYSTEMS.



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FARMERS ATTITUDE TO TREE PLANTING AND LIVESTOCK PRODUCTION

Patrick Mung'alla

Kenya Woodfuel Development Programme

INTRODUCTION

Traditionally, farmers in Kenya and especially in Kakamega have planted or left to naturally grow trees of useful species which by and large did not affect crop production adversely. These trees provided food (fruit), fuel and fodder for use on the farm. When "modern" agriculture was introduced, farmers were advised to remove trees from the agricultural fields, primarily because of convenience in mechanization of cash crop farming e.g. sugarcane in Mumias. As the agriculturists tried to keep trees out of the shamba, so did the foresters try to keep animals out of the forest plantations. It can be imagined too that an ardent Extension Forester would wisely advise a keen tree farmer that "if you want trees forget about animals" because, according to him both cannot do well on the same farm at the same time (Mutual exclusivity).

WHY SHOULD FARMERS PLANT TREES?

The Forester's View

The Forestry Policy as stated in Sessional Paper No. 1 of 1968 is clear on what forests and trees are for. The priority areas include soil and water conservation, production of forest/tree products (timber, pulp, poles) and preservation of fauna and flora for tourism and genetic resource conservation. Forestry extension is a recent phenomenon and is yet to be spelt out in a sessional paper. However, Forest Department's efforts in extension and training so far are commendable. A lot of course remain to be done.

The Farmer's Attitude

The farmer sees trees on the farm, whether deliberately planted or naturally growing, as a part of the total farm production system. All plants and animals that he keeps should relate. Ultimately they should be eaten or sold for much needed cash for school fees, clothing and general survival. The animals that produce milk, meat, draught power and cash after sale must eat grass and fodder grown on the farm, and this includes pods, leaves and twigs lopped from trees. The trees also produce food (fruit), fuelwood, charcoal, poles, posts and fodder for use on the farm. The surplus may be sold e.g. as construction poles, fuelwood and charcoal where market is available. The farmer may

not immediately recognize some of the ecological benefits of trees e.g. wind break, soil conservation and fertilization by nitrogen fixing species. Nonetheless he will only use those species that give him maximum economic benefit while, on the other hand, affecting his soil and crop positively.

KWDP'S EXPERIENCE WITH KAKAMEGA FARMERS

Pre-conceived ideas in the Project Documents (1983)

To solve the assumed woodfuel shortage trees had to be planted on the farms. Seedlings had to be produced in six hundred community based nurseries with a capacity of five thousand each, preferably managed by women groups. Three million seedlings would be available to Kakamega farmers every year. Of course the main beneficiaries would be the women, logically the group most hard hit by woodfuel shortage as they collect and use it for cooking.

Baseline Surveys (1984)

The Agroforestry Survey showed that 79% of all farmers had planted trees the previous year. Eucalyptus was the most important species. 40% of all those who planted trees had raised them in small on-farm nurseries. The Cultural Survery indicated that women neither planted nor cut trees due to some taboos. Men managed the trees for cash, selling Eucas. poles to Kisumu. Women were

left to scavenge brushwood like Lantana camara and woodfuel scarcity continued unbated. The Woody Biomass Survey showed that the higher the population concentration, the bigger number of trees planted. In the South Maragoli and Bunyore 20 - 30% of the land is covered by woody biomass. Compare this to 6 - 11% in the northern settlement areas of Chekalini with scattered population and big farms.

Lessons Learned

- Farmers had a lot of experience and knowledge on tree regeneration, management and utilization.

- Their choice of species was dictated by end use/ market forces (poles for cash).

- The woodfuel shortage was not a technical problem but a cultural (socio-economic) one.

- It was a taboo for women to plant trees and hence working through women groups was a non-starter.

KWDP's Strategy

KWDP started to test her technical agroforestry and extension methodologies in 1984.

Agroforestry technical packages:

- Central nursery seedlings production

- Choice of species: - Multipurpose shrubs
- On-farm nursery development
- Seed distribution vs seedling distribution
- Seed collection; SPUs, orchards, schools, farmers
- Commercial seed packing and selling
- Limited research - on station and on farm trials.

Extension methodologies

- Individual farmer approach
- Group approach
- Mass awareness approach - drama, films
- Schools - Kuni Clubs.

Monitoring

A monitoring unit was later set up to monitor effectiveness of both the agroforestry and extension packages. The main monitoring systems used are:

- On-the-spot - beginning of an activity
- Continuous - in phases
- Surveys - for specific issues

4. THE FUTURE OF FARM FORESTRY

Areas of attack

- Extension: 94% of all tree wood goes to the fire. Emphasis must therefore be on getting the farmer to grow trees on the farm for woodfuel.

- Training/Orientation: Learn to listen to the farmer. Build on indigenous knowledge.

- Choice of species: Appropriate for AF, dryland, MPTS, indigenous etc, for the farm. Priority end uses are WF, poles, fodder, food.

- Seed: Flexible ways of collection, storage and distribution.

Constraints

- Personnel: too thin on the ground
- Logistics: transport
- Contradictory statutes (policies)
  e.g. Coffee Act., traditional agricultural practices (mechanizations/cash crops), Chief's orders on cutting of trees, administration's ban on charcoal burning and cutting of trees, directives like on removal of Eucs.
- Range of species: rarely suitable for farmer's needs
- Inappropriate, expensive technology
  e.g. - central nurseries always far from users
  - standard materials imported/expensive
  - inflexible recommendations (forest soil).

SUGGESTIONS

At the moment RAES is too thin on the ground to reach

most farmers and there should be collaboration with the Ministry of Agriculture TAs to pass the tree planting message to the farmer. They are experts in extension and cover the country very effectively.

5.2 Let the RAES be manned by those interest in extension. Training in extensions should emphasize skills for working with farmers. Intake for Extension Foresters to be stepped up, locally and externally.

5.3 Let us be innovative, listen to the farmer and build on existing technology. Start from the known. Let us give to the farmer what he wants.

5.4 Let us take flexible (simple, cheap) technology to the farmer: species, seed, nursery, technical information, etc.

5.5 Let us monitor what we give to the farmer - seedlings survival, species preference, technology adaptation, etc.

5.6 Let there be co-operation and co-ordination as we approach the farmer with Government Ministries, NGOs, Research Institutions, Universities, etc. - to avoid expensive duplication, contradictions and confusing the farmer and ourselves.

6. CONCLUSION

The conventional approach to agricultural products and farm tree planting by agriculturalists and foresters respectively seems not to merge with the farmers' priorities. Since the farmers is the best placed to decide on what is appropriate for his conditions, it is curcial that his knowledge, experience and interests be taken into account by the technologists because building on the existing is easier. Innnovative, flexible, cheap technology is the key to the future in farm tree planting in this country. Due to shortage in time and resources, we must utilize the little there is (including trained personnel) economically. In this connection co-operation with others in extension is the wisest choice at this point in time.

CURRENT SITUATION OF SOCIAL FORESTRY DEVELOPMENT IN KENYA

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Kenya Forest Department

INTRODUCTION

There is a current debate on what the appropriate defination of social forestry is, since for different socio-economic situation, this type of forestry has different application. In 1980, Food and Agricultural Organization (FAO) defined social forestry for Local Community Development as that forestry that is performed or geared towards social and economic needs of the people rather than the country or its government as a whole.

In 1980 FAO wrote in "Towards a Forest Strategy for Development" that: "Forestry development will be consciously directed towards rural development and the eradication of poverty ..... Governments of both developed and developing countries shoudl lend support to institutionalising self-reliant mechanisms by which forestry activities will be increasingly based on endogenous decision making and the full participation of the rural poor."

It is easy to see how "community", "ppor orientated" and many such clinches become in-appropriate for the Kenya situation when one looks at the diverse social, land ownership, cultural and economic fecets the country has.

The Indian Social Institute, New Delhi in 1983 defines this type of forestry as follows:

Social forestry is the establishment of wood, forage, food production systems on uncultivated lands ..... It is to reduce destructive pressures on forest resources by providing economic alternatives to villagers who presently depend on forest exploitation for their livelihoods. It is to improve the lot of these villagers by intensifying production on uncultivated unforested lands.

THE OBJECTIVES OF SOCIAL FORESTRY

As defined by the National Commission on Agriculture, they are:

(a) Supply of fuelwood to replace cowdug

(b) Supply of small timber

(c) Supply of fodder

(d) Protection of agricultural fields against wing soil erosion

(e) Provision of recreation amenities.

The main components of social forestry are therefore farm forestry, rural forestry and urban forestry.

THE IMPACT OF SOCIAL FORESTRY

Social forestry projects are meant to bring a social change, to ameliorate distortions in the economy and to ensure a more equitable distribution of income and more equitable distribution of decision making powers. The purpose of social forestry is the creation of forests for the benefit of the community through active involvement and the participation of the community. In the process, the rural environment will improve, rural migration will reduce, and rural unemployment will substantially cease.

The overall concept of social forestry therefore aims at making the villagers self sufficient and self reliant in regard to their forest material needs.

RURAL FORESTRY

GOVERNMENT INITIATIVES

In Kenya, tree planting in rural areas has a long history particularly in the Central Highlands and in Western Kenya. In the former region, most of the planting is associated with European settlements are revealed by the earliest Forest Department (est. 1902) records. In the latter region, various forms of traditional rural forestry seem to be more widespread than elsewhere in Kenya. Thus, in at least two major regions of the country, modern efforts to intensify rural afforestation benefit from long familiarity and experience with rural tree planting.

The two main elements of the present context of rural afforestation in Kenya are, however, the Forest Policy for Kenya (Sessional Paper No. 1 of 1968) and the establishment of the Rural Afforestation Extension Scheme (or, "Service", RAES) in 1971.

The Forest Policy of 1968 was primarily concered with the reservation of land for the forest estate and the management of this estate for industrial and water management purposes. Other main elements of the Policy were finance, employment, recreation, wildlife, research and education in the forest sector. As far as rural afforestation is concerned, the Policy of 1968 is vague beyond a general recognition of the role played by "Private forests and other forests not under state ownership".

Thus there are no stated policy goals for rural afforestation such as the stabilization of rural fuelwood and other wood supplies, provision of 1968 outline a framework for promoting rural afforestation.

It should be added that the Forest Policy is now under revision, an earlier revision having been rejected by Parliament allegedly in 1983 or 1984. The new policy is reported to address the issues of removal of fuelwood from public lands and the role of local authorities in rural tree planting. Apparently the new policy still fails to outline a strategy of rural afforestation with specific national and regional goals as has been done, for example, in Rwanda.

In 1971, a major gap left by the Policy of 1968 was filled with the establishment of the Rural Afforestation Extension Scheme within the Forest Department (Ministry of Environment and Natural Resources). Its mandate was to promote tree planting outside the gazetted Forest Reserves, i.e. tree planting on individual farms or as local woodlands. RAES was placed under a conservator of Forests (answerable to the Chief Conservator of Forests (CCF). The Conservator of Forests (RAES) is assisted by four (4) graduate (BSc.) Assistant Conservators (ACFs) in-charge of Operations, Planning and Evaluation, Training and Media and Communications and by one (1) Diploma level Forester.

In the field, RAES, consisted initially of thirty nine District Forest Extension Officers (DFEOs) assigned to the thirty nine non urban districts. The DFEOs were placed under the authority of the District Forest Officers (DFOs).

Until about 1986, the basic field structure of RAES was a netwood of tree nurseries the aim being to establish one RAES nursery in each division (two hundred and twenty in total). By late 1987, about one hundred and seventy such nurseries have been established. In theory, these nurseries, were supposed to supply a wide variety of seedlings to meet citizen's need for poles, timber, fuelwood, fodder and other products. In practice many nurseries are still almost indistinguishable from the plantation development nurseries with their emphasis on "industrial" species (pines, cypress, etc).

Thus until recently, RAES did not really operate as an extension service. It concentrated on producing seedlings in the nurseries without caring whether these seedlings were appropriaate or in demand. The pressure to produce seedlings was increased with the 1984 - 88 National Development Plan which incorporated a 1983 "Policy Statement" to the effect that the country should be producing two hundred million seedlings annually (it was never made clear what RAES contribtuion should be).

As described below, the emphasis on seedlings persists, the RAES "standard of performance" has essentially been the number of seedlings produced.

True extension work by RAES has been handicapped by a number of factors. Its staff has consisted mainly of conventional (industrial plantation and forest management) Foresters, many of whom resented being posted to RAES. Until recently, effective extension work was also prevented by lack of adequate transport and operation funds. Staff also lacked policy guidelines as well as technical packages. In seventeen years RAES has never produced even a single Technical Note for its field staff. Even with the best of intentions, there was little that RAES could do in their way of extension with only one extension officer per district.

Political support of rural afforestation has, however, been strong from the start at least at the level of rhetoric and broad initiatives. RAES was indeed established at the instigatio

of Mzee Jomo Kenyatta, the First President of Kenya. His successor, His Excellency Daniel arap Moi, has consistently promoted rural tree planting (most visibly, during the Annual Tree Planting Day) especially in conjection with soil conservation. In January 1982, a Permanent Presidential Commission on Soil Conservation and Afforestation was established in order to review, co-ordinate and monitor inter-ministerial efforts in these fields. Political support has however, tended to take the form of more nurseires ran by more organizations, in response to real or alleged unsatisfied demand for seedlings by citizens and self-help groups. These are now the so called Chief's Nurseries (theoritically, one in each location in order to make nurseries more accessible to the people), District Development Committee (DDC) nurseries (in line with the the District Focus for Rural Development), and KANU (ruling party nurseries). Other nurseries belong to the Forest Department, Ministry of Energy, self-help groups, private nurseries, etc. This network of tree nurseries is at once, an asset and a liability to Kenya's rural afforestation programme. The liability stems from the duplication of efforts and the focus on seedling production as be-al-end-all of rural afforestation: it has detracted from the extension effort and from purposeful tree planting.

In 1985 - 86, with the deployment of the first Diploma level Divisional Forest Extension Officers, substantial improvement of the field activities of RAES occurred; however, this deployment was foreseen under the Fifth Development Plan.

(1984 - 88). About half of the divisions (i.e. about one hundred and sixty out of a total of two hundred and twenty) have now been assigned an extension forester. Most of these young officers are in the field without offices (some have at least a desk at divisional headquarters) or transport, but they are usually enthusiastic about their jobs. They have received at least the rudiments of extension work (especially those who graduated from Egerton College), which means that they are able to use their time effectively despite their handicaps. They suffer mainly from poor or lack of support from the District Forest Extension Officers (DFECs), many of whom are totally unqualified on the management and leadership tasks they should be performing at district level.

NON-GOVERNMENT INITIATIVES

As mentioned in the proceeding overview, Non Governmental Organizations and private individuals play a role in Kenya's rural afforestation programme. Indeed, one of the basic strengths of this programme is willingness (and skill) of large sections of the population to undertake tree planting. Surveys in some of the humid, high potential areas of Kenya have shown that over half of the farmers have engaged in some form of rural tree planting. Another important strength of Kenya is the proliferation of self-help groups, especially women's groups, interested and active in tree planting. These groups have served to increase the effectiveness by creating a multiplier effect of the official (mainly RAES) forestry

extension. Most of these groups also come under national umbrella organizations (Kanu - Maendeleo Ya Wanawake, Green Belt movement, National Council of Women, Kenya Freedom from Hunger Campaign, etc) which facilitate donor support.

On the debit side, the non-government initiatives suffer from poorly co-ordinated efforts, from lack of continuity and, all too often, from "tokenism". By the latter expression is meant ritualistic ceremonial activities such as the opening of tree nurseries and spotty tree planting that never lead to sustained production of tree products, especially of fuelwood. Hundreds of local group nurseries must be opened and abandoned each year. Many plantations never survive past the seedling stage, and even if they reach maturity they do not begin to meet local needs.

On individual farms, a great deal of ritualistic tree planting also take place, usually in response to local political pressure. The mortality rates of trees planted in response to propaganda rather than genuinely felt need are very high. A more important problem is gender conflict, as men (who generally own the land) may not allow women to plant for fear that trees can be used to establish a customary claim to the land. More often men are interested in planting trees only for timber (for own use or cash sales), regardless of local scarcity of firewood. Women are, of course, responsible for collecting the latter. In some areas, women ingeniously get around this problem by planting "non trees" like sesban among

among crops thereby securing a supply of firewood among other needs, even if they have adequate land. This means that the residual demand must be satisfied from somewhere else, thereby reducing woodstocks elsewhere. There is, therefore, a great need in Kenya to focus rural afforestation efforts so as to address and solve problems. In turn, this means setting qualitative and quantitative targets based on surveys of supply and demand, most likely at the district level.

It is mainly in semi arid areas that non governmental initiatives are inadequate, though these are areas that are now receiving the demographic overflow from the densely populated high potential areas. Relatively few trees are planted in these areas because much natural bush remains as a source of wood, land may not yet be adjudicated (title of ownership not yet awarded), and it is technically difficult to grow trees (drought, termites, free ranging cattle, etc).

DONOR ASSISTANCE IN THE RURAL AFFORESTATION SECTOR

In the districts, RAES Is usually strengthened whenever donors implement direct rural afforestation projects because RAES is normally the co-operating agency. The strengthening takes the form of transport, supplemental operating funds, in service training and technical inputs (new species; better seed; extension materials, etc).

In late 1987, RAES benefited from rural afforestation projects in Turkana (NORAD), Baringo (FAO Australia), Embu, Meru, Isiolo

(ODA), South Nyanza (DANIDA), (CARE kenya), Taita Taveta (DANIDA), Siaya (CARE Kenya; may not be renewed as this is being written), Kisumu (CARE Kenya; barely started), Garissa (FINNIDA: mainly technical inputs; almost no extension support), Kakamega (Dutch Beijer Institute), Kisii (Dutch Beijer Institute), to name the major ones. Until recently, RAES was also supported by EDF-EEF in Machackos. In Laikipia, the Swiss financed (LRDP) was also able to offer some support to the local RAES through its small agroforestry component.

There are other locations where RAES has profited from externally assisted projects, as for example the many church funded projects.

As far as RAES is concerned, the presence of these projects greatly facilitates its (RAES) task in the particular districts. In practical terms, this means better distribution and uses of materials made available from Nairobi (e.g. extension and nursery materials)less pressure on conducting in-service training organized from Nairobi, more purposeful extension (as projects have specific objectives) and better technical inputs.

Of particular relevance is the Kenya Woodfuel Development Programme (KWDP) funded by the Beijer Institute in the early 1980 under the Ministry of Energy. It has carried out a number of intensive studies of regional and on-farm wood production, notably in Kakamega and Kisii Districts. It has also made in depth studies of the socio-ecological aspects of rural

tree planting, which have provided valuable insights for RAES extension work. Most importantly, KWDP has experimented with new ways of promoting rural tree planting, for example through networks of seed orchards, seed distribution and rural drama.

KWDPs first phase ran from 1983 to 1988. A new phase is now under negotiation to cover Murang'a and Nakuru districts with Dutch, Swedish and Canadian (CIDA) support. The intensive studies that KWDP intends to carry out could be a basis for introducing District Rural Afforestation Planning at the District level.

Another project which has assisted rural afforestation is the Kenya Renewable Energy Development Programme (DRDP), also located in the Ministry of Energy. It ran from 1982 to late 1986 with USAID and GTZ (special energy programme) support. This project established six regional agroforestry and renewable energy research and demonstration centres, one in each major agro-ecological zone of Kenya. These centres have served primarily to introduce new agroforestry combinations. The project was located in the Ministry of Energy because neither Forest Department nor the Ministry of Agriculture extension has made more use of the centre since 1982. In practice, agricultural extension has made more use of the centre than RAES. Extension was also insured in part by American Peace Corps Volunteers who are still active in this capacity, and who thus support RAES in the field. If the idea is ever implemented, it would solve two of RAES's problems: lack of technical support, especially at the district level, and the

lack of district planning and target setting needed to focus rural afforestation efforts. Social, though, a lot uf us believe we are practising social forestry, the truth is that most of us are not. Douglas (1985) expresses the same.

Views; "It is extremely doubtful that traditional foresters are the best people to manage such schemes. The technical forestry content of rural forestry ecompassing agroforestry techniques and based largely on the production of basic fuel, fodder and simple structural outputs is actually fairly limited. Practitioners need to know a good deal more about the agricultural options to accompany tree planting, the traditional land uses and their bases, and the socio-economic characteristics of the area (in particular the rural hierarchies and their degree of economic control) than they do about forestry

Such knowledge may be acquired by a Forester, but often rural forestry development schemes proceed from the assumption that Foresters already posses it. Most do not. Moreover, most Foresters come from backgrounds, social and professiona, which will equip them to make the transition to these forms of land-use management easily especially in those cases where Foresters have regard (by themselves and the community at large) as having primarily a policing role in the forest. That historic inheritance must represent a severe disadvantage to any Forest attempting to make transition.

The transition must however be made. The current situation o social forestry in Kenya is that we are stranded between Soci

and industrial forestry. The challenge for the next decade is to provide a meaningful social forestry, which meets the people's needs and aspirations.

"To provide basic forest products in chronically short supply in the area concerned (fuelwood, basic structural materials, fodder and the like); to utilize unemployed or underemployed human resources in forest production, simultaneously relieving pressure on overtaxed government forestry organizations; to integrate forestry production with other traditional forms of land use, thus making it more relevant to local people and therefore more likely to involve their localized skills and knowledge in the process". (Douglas 1985).

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A STRATEGY FOR IMPROVING FARM FORESTRY IN KENYA

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1.0 INTRODUCTION

I hope that it has not been too gruelling or too exerting to you, given that you are all senior Forest managers/extension officers. Evidently, there is a lot to be covered in a seminar of this kind. Under the circumstances, it is often tempting for organizers to try to cover a large ground. I would like to assure you that there is no attempt by any quarter or claim of a professional-student relationship on matters of social forestry today. We are all at the rennaissance stage - focussing on assembling the body of knowledge on farm forestry, inventorying different land use systems that incorporate trees, developing methodologies for assessing the relevance and potential for trees in the farming systems, constraints to adoption of farm forestry etc. We have therefore cherished having you here to pave the way with us.

It is evident that there has been a varitable explosion in the number of organizations involved in tree planting during the last decade and an increased government support. Many farmers have sponteneously taken to tree planting in their holdings as a profitable land use activity. Tree seedlings are either issued freely or sold at greatly subsidized rates from points within easy reach of the farmers.

About 65 m and 100 m seedlings were produced and distributed in 1987 and 1988 respectively (equivalent to 54 000 and 83 000 ha respectively). However, available evidence suggest that overall area cut to that of green cover is diminishing fast and that the ratio of the area cut to that of the planted area remains dismally low at about 5:1.

Mr. Chairman, today we meet at a most auspacious time. Our government has openly registered its concern about the accelerated loss of forests and the concommitant imperishment of the economic fabrics and the well-being of the people, particularly the sustainability of agriculture in areas where crops and livestock production is dependent on trees and shrubs. Environmental issues arise, too. Concerns about the loss of potentially valuable species of flora and fauna, accelerated erosion in deforested areas particularly watersheds, environmental degradation and the onset of desertification

in the marginal land areas. Environmental issues and forestry (including agroforestry) agenda have ears of our leaders and the relevant bodies of the world communities.

OPPORTUNITIES FOR TREE PLANTING IN FARMS

The practice and opportunities for farm forestry are clearly different between the high potential and the marginal land areas, and between the small scale and the large scale commercial farms. Because our most immediate concern is with the small scale farmer, we strive to focus on strategies which do not compete for land with the farmers' food production priorities. Direct competition with food and animal production for land can be avoided by planting trees in unused areas, such as roadsides, ridges, terraces, pasture leys, boundaries of fields, reverine areas and surrounds of dwellings as live fences or living fence posts. The needs of medium scale farmers can be accommodated by using areas or sites that are too steep for cultivation or grazing, gravelly to rocky or beset with shallow soils to vlei soils subject to water logging.

In these situations different crop design and spatial arrangements are possible including:

(a) Hedegrow intercropping with arable or fodder crops;

(b) scattered trees in crop lands or pastures;

(c) multistata home gardens;

(d) trees/shrubs for stabilization of ridges, and terraces, and riverine areas, etc;

(e) intensive woodlot or fodder banks;

(f) farm boundaries, or aesthetic amenity trees in the crop lands.

The Research Agenda in Farm Forestry Today

The role and place of wood plants in the farmlands and in community land areas are already recognized. What is lacking?

(a) A clear policy guideline for managing forest resources in private or community land areas.

(b) Proven technological packages that are technically feasible, economically viable and environmentally acceptable that are drawn out by ecological zones and farmers' needs oriented.

(c) Established market outlets for wood products from farm forestry to foster prompt sale of these products and a reliable source of income and farm revenue.

Scientific research and development hold the key to guiding farm forestry into a productive form of land use.

Experiences from crops and forest management vehemently reveal that failure to align R & D effort with the development initiative that is attuned to the competitive dynamics of the environment produces risky and usually futile expenditure of scarce resources.

As the country looks into the future with optimism and confidence, emphasis must be on joint and sustainable production of fodd and wood. Key priority areas in farm forestry research agenda embrace technical and socio-economic issues including:

CHOICE OF WOODY SPECIES

The choice of suitable and useable tree/shrub species based on economic and agro-ecological considerations is the heart and soul of farm forestry development. Burley and von Carlowitz (1983) have provided a compedium of multipurpose trees and shrubs (MPTs). The most popular of these are those with varying potentials for fixing or absorbing large amounts of nitrogen then returning it to the soil, while concommitantly providing wood products - poles, woodfuel, fodder and browse for livestock and other products and services. MPTs have a wide appeal because:

(a) They provide many goods and services at the same time and hence stand to occupy a small land area to produce a range of desired products.

(b) Can be integrated complementarily and non competitively in other forms of land use.

SPECIES AND PROVENANCE SELECTION

Past work has shown that certain species have ability to enrich their microsites all be it at a slow rate. Investigations by different workers have shown that intercropping the Leucaena and application of green manure from prunning increases maize yield by upto one hundred percent. But obviously no single tree can cope with the range of variations of sites, management purposes, ecological and environment considerations, etc. It is generally agreed that a good farm tree/shrub should possess ease of establishment, good survival, rapid growth with high yield of biomass, nitrogen fixing capability, vigorous regrowth when cut or pollarded, efficiency or recycling of nutrients, favourable canopy and development of a deep rooting system that possess no competition to the arable crops.

There is therefore an urgent need for conducting systematic species and provenance selection and recruitment, including indigenous and exotic germplasm in different sites and management systems.

Urgent studies should be undertaken to compare the productivity of candidate woody species and arable

crops within and between sites in order to establish a better appreciation of their resource use capabilities.

Species and provenance studies on various sites stand to generate a wealth of knowledge on tree performance under different conditions and management systems. It is envisaged that this initiative will provide a range of proven woody species for incorporating in the farming systems and given ecozones and land use types.

GENETIC TREE IMPROVEMENT

Genetic improvement of utility MPTs is the next step. This should focus on achieving:

(a) Increased biomass yield per unit land and labour

(b) Disease and pest resistance

(c) Selection of species and provenaces of high calorific value for fuelwood species

(d) Site adaptability particularly for the harsh ASALs combining drought resistance with fast tree growth.

Given time, selection and breeding programmes can greatly improve both the variety and quality of the planting stock available. Dramatic yield increases can often be achieved, in some cases by several hundred percent. Tree improvement programmes of softwood

plantation species in Kenya has boosted yield by forty percent, through advanced genetic tree improvement.

The work on browse woody plants must strive to investigate the nutritive quality of candidate fodder and browse woody plants as well.

ESTABLISHMENT METHODS

Agroforestry intervention will only win the day with farmers when it becomes possible to obtain the tree/shrub seeds from the open market and to raise these with the same simplicity of raising other farm crops, such as maize, cabbages and potatoes, etc.

The research initiative should therefore develop and evaluate low cost do-it-yourself packages for raising trees and shrubs for farm forestry investigations. Direct seeding has been proposed for some species and should be explored.

CROP DESIGNS AND MANAGEMENT PROTOCOLS

As already discussed, there is convincing evidence that mixing trees and crops may offer a great opportunity for the short-term environmental benefits both aerial and edaphic. Past initiative has concentrated on alley cropping studies, and very little consideration has been

accorded to other technologies. It is imperative that promising accessions should be tested under different crop designs already discussed under Section 1.1 and according to farmers needs and preferences. Hedgerow intercropping can certainly be seen as a potential alternative to shifting cultivation or Taungya cultivation, functioning mainly as a soil fertility restorer. But this initiative should be extended to other spartial arrangements and crop designs. Supportive studies should investigate:

(a) The heterogeneity of crops and the interaction between component species, including competitive influences; symbiotic relations and other ecological associations and possible allelopathic influences.

(b) Physiological parameters including crop water use.

(c) Microclimatic influences.

(d) Nutritional changes.

(e) Productivities of food and wood crops under different technologies, nutrient turn over and recycling and total nutrient pools by MPTs and crop designs etc.

(f) Opportunities for using strategic biotechnologies such as mass propagation techniques for key MPTs, development of cultures of productive provenances of symbiotic micro-organisms and appropriate

methods for innoculating selected micro-symbionts into associated MPTs and agronomic manipulation for improving crop performance.

(g) Development of management protocols including harvesting of the woody biomass, cutting frequencies and lopping, pollarding and subsequent regrowth; and time and method of applying prunnings.

(h) Development of avenues for protection from pest and diseases.

(i) Development of non-destructive utilization, and

(j) Economic interactions between different components.

Assessment should also cover crop productivity, changes in soil nutrients and physical structures under different MPTs and other treatments, and comparative water and soil conservation efficiencies of different crop spartial arrangements, soil chemicals and physical changes.

Development of modules and prescriptions for managing natural forests and riverine areas outside the forest reserve should also be covered.

SOCIO ECONOMIC STUDIES

Socio-economic research has hitherto received virtually

no attention in the forestry management agenda. But undoubtedly hold the key to great understanding of national collective responsibility for forest management including conservation of plant germplasm, the management of catchment forests and riparian areas etc and the role and place of trees/shrubs in the farming systems and the development of a positive strategy for effecting unimpeded adoption: of agroforestry technologies.

The following areas are particularly important and merit urgent attention:

(a) Identifying critical points for intervention where integration of trees/shrubs in the farming systems stand to raise overall farm productivity.

(b) Developing market outlets for tree crops from farms, and pricing policy of wood products.

(c) Exploring possible application of incentives for tree growing in farms, particularly in critical sites, such as catchment forests and water ways etc.

(d) Developing a policy frame-work embracing farm forestry and a basis for scientific evolution of integrating trees in the farming systems and substainable management of forests etc in all areas.

(e) Identification of barriers to diffusion of agroforestry initiatives and innovation of agroforestry technologies.

(f) Documenting the traditional values of trees and shrubs including socio-cultural values, herbal and folk medicines among different communities.

(g) Conducting basic studies on the utilization of minor tree/shrub products including wood and plant extractives and other avenues with potential for promoting a wider range of utilization of wood resources and reduction of wastes in wood utilization.

These studies would provide a better understanding of the extent to which specific socio-economic enviornments facilitate or constrain given farm forestry technologies.

SEED ACQUISITION AND DISTRIBUTION

The question of seed availability can also pose a number of problems. The supply of high quality seeds currently obtainable at the national seedcentre and on the world market is restricted to a relatively small number of species. There is an urgent need to develop seed stands and clonal seed orchards of proven agroforestry trees, through selection and recruitment of indigenous candidate

agroforestry trees/shrubs species. Systematic introduction of plant germplasm of proven species should be organized from suitable sources and tested under the provenance studies programme. Proven material should be cultivated in the seed stands and orchards' programme. This initiative should be accorded the highest priority to build national capabilities for providing improved seed authenticated origin and pedigree. Supportive studies should examine avenues for improving seed germination for seeds with germination problems, and mass propagation techniques for key MPTs.

The researchers and field officers should work out interim strategies for seed acquisition. This could cover identification of local sources of seed for regular collection while clonal seed orchards etc are being developed.

MOBILIZING JOINT RESEARCH-EXTENSION INITIATIVES

The challenges to scientific devlopment of farm forestry are many and varied touching on different land use systems and ecological zones. With a force of well trained forest extension staff present in nearly all administrative divisions, we have a great opportunity for pooling resources between research and extension lines. Under this initiative the extension staff can undertake some adaptive prototype or pilot technology appraisal in farm forestry research and development.

ere are urgent needs for information on tree growth and eld in natural forests outside the forest reserve and on fferent MPTs and others that are being cultivated in farm- nds for poles, woodfuel, soil and water conservation and te rehabilitation etc in different ecozones. This would ovide volume and yield tables and a data-base essential r providing clear options for planned tree planting in rms based on quantified returns and the true character of restry in national development.

t is also possible that under this initiative the researchers nd field officers and the farmers can jointly respond directly particular needs and constraints facing farmers and other nd use agencies in given sites, ecozones, and socio- onomic environments.

am convinced that in this background we can promptly develop chnically feasible and economically viable packages for mproving and sustaining increased food and wood productivity r domestic and industrial use, for all time.

NURSERY TECHNIQUES IN SOCIAL FORESTRY

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INTRODUCTION

The success of any afforestation scheme depends largely on the quality of seeds, nursery techniques and the planting stock itself. Although direct seeding has given good results with some species in particular areas e.g. Acacia nilotica and Acacia senegal in the Sudan, Eucalyptus camaldulensis and Eucalptus tereticornis in Katanga and Zambia and Azadirachta indica (neem) in Nigeria, afforestation by this method is extremely limited; the general practice is to plant stock raised in nurseries. All nursery operations are directed towards the production of healthy, vigorous plants. The paper reviews the existing nursery techniques and operations and highlights those relevant to social forestry practices.

CHOICE OF NURSERY SITE

Under the normal forest conditions, a nursery site should be located as near the planting site as is possible. There should be reliable supply of good quality water and the site

should be well drained. A site with gentle slope may be preferred but not necessary when using polythene tube containers. Once site has been selected, shelter (live fence) should be planted to protect the seedlings against wind. In social forestry, the emphasis is on the farm and consequently most of these requirements are limiting. Among the important factors that require consideration are good drainage and this can be achieved through raised soil platform or intermixing the local soil with crushed murram. The farm nursery should approximate those used in raising agricultural crop seedlings.

PREPARATION OF SEEDBEDS

Seed germination beds may be constructed using timber planks, or bricks or concrete blocks. Unfortunately, all these have some expenses attached to them. While the important factor is sufficient drainage, this should be achieved in the cheapest way possible. Proposals have been made from experience that raised soil platforms can be guarded on the sides with rocks collected on the farm, at very little expense. To improve on the drainage, the raised soil should be overlaid on rough material such as broken stones. The top of the bed should however be firm and level as practicable.

SOIL MIXTURE

The Forest Department in the past has developed a guide to the possible soil ingredients and amounts to use. For example, in

Muguga the following mixture, which is referred to as Muguga Standard Mixture has been adopted:

Five parts of forest soil (top soil from local indigenous forest)

Two parts local pest (chopped into 0.5 cm to 1 cm chunkes)

One part clay (crushed to 0.5 cm crumbs)

One part rotted compost manure

One part crushed stones (0.5 cm).

To every cubic metre of the mixture two kilogrammes of NPK were added. Later the peat part was avoided and its place taken by compost manure. This indicates that depending on unavailability of one component changes are feasible. In social forestry these changes are inevitable and therefore the locally available ingredients including the cow dung manure and compost manure should be emphasized.

NURSERY CONTAIENRS

The nursery containers in use today varies from those holding 0.5 litres of soil to those of more than 20 litres. However, the choice of the size of a container should basically be governed by the purpose for which the seedling is being raised. If the purpose is general planting at 20.30 cm of height, the 0.5 litre container may suffice. On the other hand, for the ceremonial trees which require to be of a big size thus taking upto two years in the nursery, a larger container is essential. The important fact to remember is that the larger the size, the more expensive and justification of this cost is vital.

SOWING OF SEEDS AND PRICKING OUT

Seeds should never be sown densely. Smaller sized seeds may be mixed with sand or partially crushed soil before broadcasting. A thin layer of soil may be spread after broadcasting the seeds. The beds should be watered at least once a day and preferably in the evenings. Two to three weeks after germinating, the seedlings are pricked out into containers. This technique is time consuming and results in losses of seedlings through physical damage and fungal attack.

In social forestry, direct sowing into containers or open beds is recommended. This method unlike use of seedbed, requires a lot of seeds but is simpler and overall cheaper. For the small sized seeds, the use of a seedbed cannot be ruled out completely, whereas as in most of our indigenous species with large seeds, the direct sowing method is very applicable.

PROTECTION

Protection actually refers to elimination of animal interference on the seedling. In the normal forest station, this is quite easily achieved through fence and establishment of a live fence around the nursery. In the high potential areas, the nurseries are established on the cultivated part of the farm and thus well protected from animals.

The tricky part is in the arid and semi-arid areas where the main activity is pastoralism. However innovative ideas have

cropped which are very effective in terms of protection. The technique involves putting soil in a broken 'sufuria' or 'karai' and sowing the seeds. The container is hung up a tree where seedlings cannot be disturbed. Further the seedlings by virtual of hunging up a tree are shaded and at the time of planting out, can easily be transported upto the planting site. This reduces the time of exposure of the roots and therefore improves on the survival.

SHADING

In the arid areas, seedbeds require full shade on top and sides to protect the bed from direct sun. After pricking out, the seedlings should be in full shade for two to three weeks, and half shade for a further week, after which no shade should be necessary. With some species, on certain sites, very light shade may be an advantage to plant growth, but it is felt that these rather special conditions.are rarely met with. The practice of affording shade to growing plants in the nursery to reduce the necessity for watering in very dry weather is quite wrong as will be shown below.

MULCHING ON SEEDLING BEDS AND CONTAINERS

Heavy mulch is more efficient and beneficial than shade in soil moisture conservation. During the dry periods of the year it is essential in may areas to add some mulch to your beds and containers. This is more so where the seedling canopy is not closed and thus evaporation can take place directly from the

soil surface. Many local products can be tried for this purpose - wood shavings, chopped leaves,chopped sacculent grass etc. The best method is to cultivate your beds and containers first, and then literally spread the mulch between the rows of seedlings. With containers, small stones can be effectively used.

It will be observed even after two to three months, that the top layer of soil having been protected from the direct effect of watering, still remains loose. The layer of mulch can over-flow the plant tray, as water will pass through the mulch quite easily. Experience has shown that this mulch greatly reduced the drying out of seedling beds and containers.

WATERING

Seedlings must be watered twice a day, in the mornings and evenings. In some areas where evapo-transpiration is not too high like in the high altitude areas, watering once in the evenings may be adequate. Seedlings should not be watered during the hottest part of the day as this raises the mortality rate through induced evapo-transpiration. However an exception to this is during pricking out operation.

WEEDING

The top soil collected for use in the nursery contains huge quantities of weed seeds. Weeding in all nurseries in the country is manually done and can be labour intensive. As such weed seeds should be reduced before filling the soil into

containers. One most effective way of doing this is to induce weed seed germination through watering to stimulate weed growth and then remixing the soil thus killing germinated weeds. This technique can be undertaken on the nursery site or on the collection site where soil is still being collected.

ROOT PRUNING

This is very essential for plants raised in boxes, Swaziland beds and polythene containers.

The main purpose of root pruning in container raised seedlings is to restrict the growth of tap roots. This encourages development of fibrous laterial roots as well as preventing the tap root from going deep into the soil. Root pruning may be done by cutting the roots with either a strong wire, sharp knife or by constantly moving or lifting the polythene tubes. Root pruning should be done once a month and should start once to one and a half months after pricking out.

HARDENING OFF AND CULLING

A few weeks or months before field planting starts, seedlings should be hardened off. This means that the quantity of water to each plant should be reduced to condition it to environment which is likely to encounter after planting. The reduction must be done gradually through. Culling on the other hand means the separation of healthy vigorous plants from stunted, abnormal and

weak ones. The objective here is to get the best seedlings to the field.

TRANSPORT TO PLANTING SITES

The plants should be thoroughly watered a night before transporting to the field. They should be carefully handled at the time of lifting in the nursery, during transportation and at the planting site. The transporting exercise should be undertaken early in the morning to ensure planting is done in the early morning hours. On the farm, if the planting site is secure from animals, it is also possible to transport seedlings in the evening and plant them the following day.

Polythene tubes must be removed at the time of planting.

SELECTION OF SPECIES

In different areas, people have differing opinions about specific species and thus for one reason will opt to plant a given species instead of another. Consequently as an extension worker, it is of paramount importance to try to meet the people's requirement rather than going out with a well documented package for them. Actually people will be more responsive to an indigenous technique with the associated modification as opposed to imposed packages.

FARMERS' ATTITUDE TO TREE PLANTING IN RELATION TO AGRICULTURE

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The key word in this paper is attitude. While trying to tackle the problem of agriculture and food policy worldwide, Knutson et al (1983) described attitude as what is generally believed and this involves mental conviction, acceptance, confidence or faith that a proposition is true. In Weber's Handy College Dictionary (1981), the word attitude is described as a position or manner indictive of feeling, opinion or intention towards a person or a thing. These are definitely neither the most exhaustive or the best definitions of the word.

As early as 1930s it had been observed by a Japanese scholar, Toyohiko Kagawa that conservation with ordinary trees was not being practiced in Japan and elsewhere. The reason, he observed was that the ordinary trees did not yield early cash returns. Rural families were therefore not ready to plant them. It is true that the majority of our farming communities are rural based and most of them are subsistence farmers whose time preferences are short, risk discounted returns are low and

and their propensities to invest are also low. Most of such farmers produce to consume and thereby ensure their survival and that of their families.

While the above is true, it has already been recorded that there is a general shift in forest policies worldwide which have gone in tune with similar changes in economic development policies towards the emphasis on meeting the needs of the rural poor in their quest for survival resources e.g. food, fuelwood, poles, fodder, medicinal herbs, etc; and that industrialization and economic growth will not necessarily ensure achievement of the equity goals of development; thereby stressing the need for self reliance for the provision of production and utility goods and services, through the use of locally available resource.

2. HISTORICAL PERSPECTIVE

Attitude, as beliefs, are developed. They can be developed based on truth, partial truth and false beliefs. One event which must have contributed immensely to the farmers' attitude to tree planting is the historical evolution in Kenya of both agriculture and forestry. All through the years there has been a sharp division in the activities of both agriculture and forestry even though these should have been made to look, at least in the observers eyes, as truely compatible activities involving to a greater degree the utilization of the land resource. This structural division is provided

for legally by separate Acts of Parliament i.e. the Agriculture Act Cap 318 and Forest Act Cap 385; and the policies which are geared towards the utilization of the one resource, land, are implemented by two separate ministries.

The Aldev Plan 1945, the Swynnerton Plan, 1954 and the Agriculture Act 1967, have all dealt with the development of agriculture in isolation from forestry development. In the same way, the East African Forestry Regulations of 1902 and the current forest policy, 1968, have both considered the development of forestry in complete isolation from that of agriculture.

A casual look at both acts reveal clearly that while the Forest Act limits wananchi in their role in forestry development, the Agriculture Act encourages their involvement in agricultural production. The forestry personnel used to be considered as somebody far removed from the day to day activities of forestry development as his/her major role was that of a protector of the forest resource from the people. The agriculture personnel used to be and is still somebody working with the farmers to assist them with their activities in agricultural production. These sharp divisions have had two effects in the way in which they have helped the farmers' attitudenal development towards agriculture and forestry.

- The first one is that agriculture and forestry are not complimentary but are to be persued separately; and,

- Agriculture is for the people while forestry is for the government.

These results were that the farmers' attitude towards agriculture tended to be positive while that towards forestry tended to be negative.

3. THE NATURE OF FORESTRY AND AGRICULTURE

Of the three basic needs for a human being, food, shelter and clothing: food, the resultant of agriculture, is considered the first. If not only because of this reason, agriculture has always had an advantage over the other uses of land. It is not uncommon to find forests being excised, cleared legally to give way to agriculture. This attitude has given an added courage to those individuals who encroach into protected forests.

When one considers the time involved between the production of an agricultural crop and that of a tree crop, save for the fast producing vegetatively grown fruits, agricultural production process usually takes a shorter time. Because of this reason alone, farmers attitude may favour agricultural production process to that of forestry. This is not surprising when one takes

into consideration that the longer the production processes in terms of time, the less the products will be valued as the rate of discounting the future incomes must be very high for them to compare favourably with those products which take short time to produce e.g. compare the production process involved in producing equal volumes of hybrid maize and wood from cypress tree.

In some cases, farmers have developed close relationship to certain things, e.g. nomadic tribes cannot compromise land for grazing with land for afforestation even though they may be well aware that afforestation will result into an increased amount of fodder for their animals. Cases are well documented where farmers have developed an apathy towards the planting of certain tree speices e.g. Markhamia lutea in some parts of South Nyanza. Women farmers in Western Province particularly in Kakamega are known to fear planting trees for the fact that if they plant a tree, their husbands may die.

4. OTHER CONSTRAINTS FARMERS HAVE IN TREE GROWING

Farming, being a business, calls for rational decision making process. A farmer has a number of things he/she would like to undertake on his/her farm, and as such, he/she must give them priority based on felt need. Cases have been noted where the development of forests has resulted into an increased number or birds and animals which may not be favourable to food production.

Where land holdings are small, they may feel that the competition of trees for water, sunlight or nutrients will lead to an unacceptable reduction in crop yields.

Where there are doubts over land ownership rights, farmers will tend to be unwilling to make the long term investiment involved in tree growing. The same reluctance to plant trees is often felt by tenant farmers with no permanent right to their land holdings. Such farmers will tend to mine the land resource through the production of short maturing high producing crops rather than investing on the soil improving trees with long production cycles.

In some countries, the government controls the management of trees to the extent that farmers tend to think that trees are for the government. Where this is so, the obvious attitude developed is that since trees are for the government, the government should plant and manage the tree resource.

This state of affairs is also rampant in commonly owned land resources. We are all aware of the tremendous limitations there are in the proper management of the common property resources, as effectively, such resources have no owners. This problem is very urgent when one notes that it is on such lands where trees depletion has occurred at the fastest rate due to non control of use.

has been labelled "agroforestry" has been practiced by farmers and institutions involved in the production of tree crops for decades, even though it has been made into a scientific practice only recently. It can be considered at the global level as a complimentary practice between forestry and agriculture.

5.2 DEVELOPMENT OF INCENTIVES

It is generally accepted that incentives will lead to rewards or vice versa. The community, e.g. the Kenya community has already accepted that for the country to forge ahead with her economic development, tree planting must be accelerated. This implies that the nation should be able to commit resources to ensure that this happens either directly using the limited public land. There are various institutional arrangements which have been organized to encourage agriculture e.g. Public Corporations, some of them with the ability to lend farmers money for agricultural production. The same should be considered actively for forestry since tree growing involves huge monetary investiments.

5.3 COMMUNITY FORESTRY

Since it is the people who will benefit from the trees, the same people should be actively involved in tree growing. Here the paramount requirement is active participation by the people in tree growing, especially

on communal lands. The most limiting factor here is how to achieve spontaneous participation from the people.

6. PUBLIC PARTICIPATION IN TREE GROWING

Everywhere there is settle agriculture, spontaneous tree cultivation occurs, this happens even where climatic conditions are difficult. The problem is that such meagre spontaneous cultivation cannot meet the urgen and escalating requirement for trees and tree products on farm. The necessity of this requirement is the need to activate and accelerate this spontenous tree cultivation.

6.1 UNDERSTANDING THE PEOPLE'S SOCIO-ECONOMY

The most important aspect of stimulation of spontenous participation by farmers in tree growing lies in understanding and appreciating ghe farmer's existing behaviour, which we have explored in this paper, and their own perception of what is desired i.e. the need for increased efforts in tree plating in public and private lands. If this is achieved then our efforts will be sustained. Diamo and Cambell (1986) have argued that people follow their present behaviour patterns for very good reasons and will only participate in anything new if they see they is something in it for them. Of those farmers who live in arid and semi-arid areas of Kenya, Konuche and Milimo (1989) have quoted from Burley (1980) that environmental constrains and practical afforestation techniques are not considered the major factors limiting

tree planting in ASALs; important are the social features (such as land tenure system and community organization), and economic factors including lack of monitorized economy, poor transport and marketing systems, and poor understanding of long term benefits.

We are convinced that once we understand these problems and device ways and means of surmonting them then, we are sure of solicitizing spontaneous participation from the farmers. Some of the ways and means which have been put forward by many scholars include:-

- creation of favourable conditions of tree planting by the people such as incentives, proper land tenure system

- development of marketing systems and structures capable of absorbing the products of participation e.g. making sure that the activity will give tangible rewards and personal satisfaction

- multidisciplinary approach. This calls for an approach to a problem in different ways which are both complementary and compensatory such that loses and gains are easily cushioned by the participants.

- creation of responsiblity such that the participants are responsible for both the activity of tree growing and its products. The participants must

also be involved in the decision making process at all levels.

- equity in distribution of the resource or product to benefit the greater majority of the participats within the limits of social acceptability will sustain participation.

One of the most difficult questions to answer is how do you ascertain that the answers indicated are the right answers to the right questions:

To know and get this right, the farmers themselves must be involved. They must decide on their needs and priority of needs in afforestation. They must decide how these needs can be met. Ours is only to guide them to follow the right procedure in problem solution.

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