Republic of Kenya
Kenya Forestry Research Institute

Republic of Kenya
Project for Development of Drought Tolerant Trees for Adaptation to Climate Change in Dry Lands of Kenya

Annual Report (FY 2012)

March 2013

Japan International Cooperation Agency
(JICA)

Forestry and Forest Products Research Institute
Forest Tree Breeding Center (FFPRI-FTBC)

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Kenya Forestry Research Institute

Japan International Cooperation Agency

PROJECT ON

DEVELOPMENT OF DROUGHT TOLERANT TREES FOR ADAPTATION TO CLIMATE CHANGE IN DRYLANDS OF KENYA

Consulting Service Completion Report (FY 2012)

March 2013

Forest and Forest Product Research Institute

Forest Tree Breeding Center

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Summary

1. Events

- May 30th 2012, Delegates of Ministry of Forestry and Wildlife, Ministry of Finance, Kenya Forestry research Institute, and Japan International Cooperation Agency signed on the "Record of Discussion", and the Project was officially kicked off.

- July 3rd 2012, Six KEFRI staff members departed for Japan in order to attend the counterpart training.

- July 11th 2012, Mr Ozawa Makoto and Mr Narumi Masaki were dispatched as JICA long term expert, and have been stationed in HQ building of KEFRI.

- July 17th 2012, JICA and FFPRI-FTBC signed on the contract of the project implementation which covers dispatching short term experts and receiving CP trainees.

- July 21st 2012, Project Manager Dr Gabriel Muturi departed for Japan to attend the counterpart training.

- August 4th 2012, Project director Dr Ben Chikamai departed for Japan to attend the counterpart training.

- Aug 22nd 2012, Dr Miyashita Hisaya and Mr Yamaguchi Shutaro were dispatched as short term experts, and instructed grafting procedures and planting preparation.

- Aug 25th 2012, Dr Gyokusen Koichiro and Dr Goto Eiji were dispatched as short term experts, and implemented preliminary survey for morphologic, phonologic and physiologic study.

- Sep 22nd 2012, Dr Fujisawa Yoshitake was dispatched as a short term expert.

- Sep 29th 2012, The 1st JCC was held in Nairobi.

- Nov 24th 2012, Dr Miyashita Hisaya, Dr Hanaoka So, Mr Yamanobe Taro, and Mr Chiba Nobutaka were dispatched as short term experts, and instructed DNA analysis and planting procedures.

- Dec 11th 2012, Dr Sakuta was dispatched as short term expert, and instructed the preliminary study of drought tolerant characteristics analysis.

- Jan 23rd 2013, Dr Miyashita and Mr Sakamoto were dispatched as short term experts, and instructed the progeny test field development.

- Jan 23rd 2013, Ass. Prof. Gyokusen was dispatched as short term expert, and instructed the test field set up for drought tolerant survey.

- Feb 5th 2013, Mr Kimura was dispatched as short term expert, and coordinated the consultant activities among project members.

- Feb 12th 2013, 2nd JCC was held at MFWL in Nairobi.

2. Activities

(1) Training in Japan

From July 3rd 2012 to August 26th, total eight KEFRI staff members were divided into five groups and sent to Japan for the counterpart training. FTBC Researchers in charge of project implementation established each curriculum and conducted it. Thus trainees successfully obtained necessary skills such as project management, DNA analysis, breeding design, and propagation techniques.

(2) Technical instruction in Kenya

Total fourteen short term experts were dispatched to the project. They provided necessary and timely instruction to KEFRI staff member for the project implementation. FTBC made cohere the design of training calcurams and their technical insturuction in the field, therefore Kenyan counterparts could implement their task smoothly, and the project got certain progress in this physical year even though very tight schedule of in its very initial stage.

(3) Coordination of Procurement

The project utilizes a couple of Japanese budget of equipment procurement, such as grant aid, procurement in Japan, and local purchase. FTBC team consolidated with the project"s long list of procurement and prepared necessary information for purchase order.

3. Evaluation and Recommendation

(1) Project activities

Despite tight schedule of project implementation, most of the project's targets reached in this half year. Especially seedling preparation including scion collection and grafting propagation was done on schedule. The site preparation in Kibwezi was delayed due to land tenure negotiation, and may affect to the plantation schedule. Countermeasure against the postponement of planting should be considered.

Regarding DNA analysis, some workable SSR primers for *Acacia tortilis* were identified during the training in Japan, and subsequent researches such as development of SSR markers should be done in Kenya. Due to the very complicated custom procedure, sequencer delivered with two month delay. It caused the expire of reagents which is necessary for initial caliburation and guarantee certification. Therefore KEFRI researchers were forced to reschedule their DNA analysis.

Regarding drought tolerance analysis, pre-survey on phenological variation was done, and dendrometers were installed. Data was collected periodically, and already useful data have

been appeared in this experiment. Other morphologic and physiologic survey will be gotten to work on time by time. Necessary measurement tools such as chlorophyll fluorometer, porometer and dew point generator should be delivered by April 2013. For the precise analysis, small scale test plantations were set in Kitui research center. Which include five species comparison garden plantation, and seedling stand raised from the seed of three inferior clone and three superior clone of KEFRI original progeny test field.

(2) Training in Japan

Thanks to the enormous endeavor and cooperation among persons involved, all of five training course were completed without neither any delay nor major trouble. Hopefully some more preparation time will be allocated next time.

(3) Equipment provision

Necessary equipments for grafting activities and necessary reagents for DNA analysis were provided by FTBC utilizing the budget for counterpart training in Japan. This provision system was very effective and indispensable for smooth project implementation.

Summary sheet of activities - 1st Half FY2012 (JICA-FTBC contract)

Month	C/P Training in Japan				Expert Dispatching			Other issues
April								
May								May 30, Signed on R/D
June								June 25, Call for the tender of consultant service
July	July 3 - Aug 26 Genetic analysis course Mr Machua Mr Omondi	July 3 - Aug 12 Breeding theory couse Mr Kariuki Mr Muchiri	July 3 - July 29 Propagation course Ms Mwangi Ms Maingi	July 21 - Aug 12 Breeding project management course Mr Muturi				July 11, Mr Ozawa and Mr Narumi were dispatched as long term experts July 17, Signed on the contract between JICA and FTBC
August	-ditto-	-ditto-	Aug 4 - Aug 12 Breeding project management course Dr Chikamai	-ditto-	Aug 22 - Sep 5 Breeding Dr Miyashita Nursery Mr Yamaguchi	Aug 25 - Sep 2 Draught tolerant Dr Gyokusen Dr Goto		
September					-ditto-	-ditto-	Sep 22 - Sep 29 Project management Dr Fujisawa	Sep 25, 1st JCC
October								
November					Nov 24 - Dec 9 Breeding Dr Miyashita	Nov 24 - Dec 9 DNA analysis Dr Hanaoka		

					Propagation Mr Yamanobe Nursery Mr Chiba		
December					-ditto-	-ditto-	Dec 11 - 23 Draught tolerant Dr Sakuta	
January					Jan 23 - Fe 13 Breeding Dr Miyashita Nursery Mr Sakamoto	Jan 25 - Feb 4 Draught tolerant Dr Gyokusen		
February					-ditto-	-ditto-	Feb 5 - 14 Project management Mr Kimura	Feb 12, 2nd JCC
March								

Photo Album of Activities

Presentation by Trainee (country report)

Audience

Specimen collection

Scion collection

Lecture

Lecture

Grafting exercise

Green house

Tissue culture exercise

Lecture

PCR exercise

Seed storage

Courtesy call to Vice President

Presentation by Dr Chikamai

Presentation by Mr Muturi

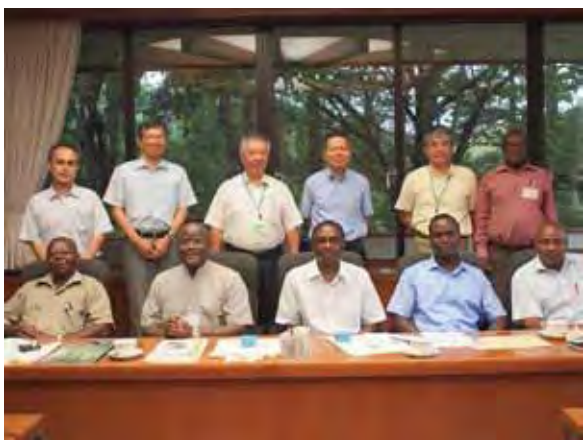
Discussion among researchers

Reception

Proud of DG's name card "近米勉"

Meeting with Mr Ikeda (JICA-HQ)

Meeting with Mr Furukubo (MAFF-FA)



Meeting with Dr Ohgochi (FFPRI-HQ)

Laboratory in FFPRI-HQ

Discussion with Mr Ohta (President of All Japan Tree Species Nursery Association)

Ohta Nursery

Plus tree

Clonal orchard

Progeny test forest

Kyushu Univ

Lecture by A.Prof Gyokusen

Physiology survey

FTBC-Kyusyu

Pine nursery

Sendan (Japanese Melia) forest

Sendan seedling

Crossing exercise

Acacia hybrid

Acacia hybrid

Timber museum

Chugoku Mokuzai

Chugoku mokuzai

Scion collection tool

Hook and cut down the branch

Branches

scion selection

scion collection

scion collection

Melia plantation

Melia plantation

Grafting demonstration(1)

Grafting demonstration(2)

Grafting demonstration(3)

Grafting demonstration(4)

Grafting exercise

Grafting exercise

Grafted seedling

Melia plantation

Site preparation in Tiva

Site preparation Kibwezi

Fencing by concrete pole with barbed wire

Planting hole digging with label

Seedlings in nursery

Labeled seedlings

Delivered to seed orchard

Instruction to workers

Planting instruction

Planting instruction

Planting instruction

Planted seedling with label

Growth speed exceeds our expectation

Mending tape should be removed earlier

Seed orchard over view in Kitui

Clone no 44 shows good performance so far

Dendrometer survey

Dendrometer survey

Plastic bottle water dripping

Plastic bottle water dripping

2nd JCC meeting at MFWL

PM chaired 2nd JCC

Chapter 1 Outline of the project

1. Background

In Kenya, the arid and semi-arid areas (ASALs)account for 80% of the country's land area and the forest area occupies only 6.1% according to FRA 2010 published by FAO. About 70% of sources of energy consumed in Kenya are accounted for by fuel wood, placing considerable pressure on forest resources. Furthermore, in recent years, immigration of farmers from other areas into the ASALs is accelerating degradation of forest resources and soils, and affecting living of local people, who are heavily dependent on these natural resources.

Kenya is considered to be one of the countries most affected by climate change. There is a forecast that the average temperature in the East Africa region could rise by 3 ºC over the next 100 years, and if this is the case, Kenya is likely to face extreme climate events like stronger and more frequent droughts, and inevitably the ASALs would be affected likewise.

Kenya's national development program, Vision 2030, recognizes climate change as an important issue to be dealt with and proposes formulation of adaptation programs on climate change and desertification in ASALs. In this respect, the Vision recommends development of commercial tree species in ASALs.

At present, JICA gives a top priority for assistance to Kenya to environmental conservation, but JICA has collaborated with Kenya in forest conservation in the ASALs for more than 20 years. Through such collaboration, Kenya Forest Service (KFS) has strengthened its system to implement social forestry and the techniques to establish farm forests have been smoothly extended to farmers. At the same time, two species, namely, Melia volkensii and Acacia tortilis, have been more recognized as the most important trees, because both are fast-growing and of multiple use, the former produces high quality timber and the latter provides fodder and raw material for charcoal. However, stronger and more frequent droughts would narrow suitable areas to plant these two species in the future.

KFS has developed 'Strategic Plan 2008-2012', fully taking account of Vision 2030, and clearly stipulated 'developing drought tolerant trees for adaptation to climate change' as one of the dryland forestry programs. KEFRI has already commenced their study on plus tree selection based on appearance of tree size and shape, but has not yet had enough experience to conduct evaluation of growth and other traits, among other things, drought tolerance. Thus, the major challenge KEFRI is facing is to gain necessary expertise to undertake tree breeding. In addition, it is also indispensable to grasp geographical genetic variation of plus trees so that genetic contamination with respect to the said two species can be avoided as much as possible in Kenya when genetically improved seeds available from tree breeding efforts are extended to farmers.

In view of the foregoing, the GOK has officially requested a technical cooperation on "Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya" to the GOJ.

In a response to the request, JICA has dispatched a mission team to design the project in detail and agreed on the framework of the cooperation with GOK in March 2012, and signed and concluded the Record of Discussions (R/D) for the project in June 2012.

This technical cooperation project is to be implemented in accordance with the above R/D, for 5 years from 2012 to 2017, in order for capacity building of tree breeding research and establishment of system for extension of improved seeds of indigenous species, with KEFRI and KFS as the counterparts (C/P).

2. Objective of the project

(1) Overall goal

Quality plantations of indigenous species are extended in the ASALs of Kenya.

(2) Project purpose

Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced.

(3) Outputs

(i) KEFRI's capacity for conducting research on genetic diversity of indigenous species (Melia volkensii and Acacia tortilis as pioneer trial) is strengthened.
(ii) KEFRI's capacity for implementing forest tree breeding of indigenous species (Melia volkensii and Acacia tortilis as pioneer trial) is strengthened.
(iii) Quality seed and seedling supply system for Melia volkensii is established.
(iv) Awareness of relevant stakeholders on the importance of quality seed and seedling is raised.

3. Period of the project

5 years; From July 2012 to June 2017

4. Implementation body and beneficiaries

(1) Implementation agencies

Kenya Forest Research Institute (KEFRI) and Kenya Forest Service (KFS)

(2) Beneficiaries

- Staff member of KEFRI; Approximately twenty staff members
- Staff member of KFS; Approximately fifty staff members

- Inhabitants of Arid and Semi-Arid Areas (ASALs) of Kenya; Approximately one million people

5. Target area of the project

Muguga (KEFRI Headquarters), Kitui, Makueni, Garissa, Embu

Location map of the Project

Chapter 2 Basic Policy of the project implementation

1. Technical Policy

In this project, FFPRI-FTBC, as a front runner of tree breeding research, will provide the latest technical guidance to C/Ps as much as possible. The specific programs in this project have been formulated based on careful evaluation of the capacity of C/Ps and reasonable expectation of self-development after the termination of the project, and designed in such a way that the outcomes of this project will be effectively utilized on the ground without delay. The project will evaluate the progress and make adjustments to the programs if necessary. FTBC team is composed of the following four groups.

(1) Genetic analysis

The purpose of this project is to develop drought tolerant native species, *Melia volkensii* in particular, to contribute to promotion of productive forestation for various uses. However, the project also provides necessary assistance of DNA analysis for capacity development of C/Ps. Recently importance of genetic diversity has been increasingly emphasized, and simultaneous pursuit of both land productivity and diversity conservation is strongly required. This means that more careful consideration to the genetic diversity is required in the tree breeding strategy. The project assists C/Ps in developing the genetic diversity conservation guideline to indicate proper distribution areas for each variety without causing genetic pollution, through the analysis of the genetic variation of indigenous tree species in Kenya, namely *Melia volkenssi* and *Acacia tortilis* . The guideline makes the C/P agency achieve both objectives of the livelihood improvement of local people and conservation of genetic diversity.

The project introduces advanced techniques of DNA analysis by using the equipment to be introduced by a grant scheme by GOJ, such as Thermal cycler and Sequencer. Full utilization of advanced equipment requires operational knowledge of the system as a whole. The project therefore organizes OJT-like training in Japan, where C/P as trainees are given assignments, and technical advice in a timely manner during a training course which takes several weeks prior to the activation of the equipment to be introduced to KEFRI.

(2) Tree breeding system

The project aims at establishing the comprehensive tree breeding system of drought tolerant tree species. The breeding procedure mainly consists of the following activities.

A) Select candidate plus trees as breeding materials
B) Propagate clone seedling of the plus trees, and establish clonal seed orchard
C) Establish progeny test stand for identification of characteristics of each variety
D) Provide quality seeds from the seed orchard

In tree breeding, the same activities as above repeat for each generation . In order to demonstrate tangible achievements in a limited period, the project reduces the duration of one cycle of tree breeding system to only five years. KEFRI, FTBC and JICA Kenya office have already embarked on some part of the breeding cycle, and the project will take over the

activities such as root stock generation for grafting propagation. Thanks to these prior activities, the project will be able to establish the clonal seed orchard in the very first year of the project. In addition, the project limits the number of target species to two, *Melia volkensii* and *Acacia tortilis*, in order to concentrate limited resources and capacity.

The project coordinates the training in Japan in order to enable trainees to obtain necessary knowledge and skills for on-site activities in suitable timing. Especially as for managerial staff, trainees study comprehensive breeding system in Japan from national policy to ground facility, which includes basic concept of tree breeding, , plus tree selection, hybridization, progeny test, provenance test, quality seed production and so on. The curriculum is designed in a combination of lectures and practices for effective training.

(3) Propagation techniques

The project promotes nursery management skills of KEFRI staff in order to ensure the quality planting material provision, since the project plans many planting activities such as establishment of clonal seed orchard, progeny test field, seed stand and demonstration forest. In general, forestry nursery needs more effort than agricultural one in order to maintain the quality of propagation work since propagation works take place after a very long interval like several months or years in some cases to and tend to receive less supervising. Practical curriculum is prepared for KEFRI staff

(4) Drought tolerant index

The project aims at analyzing drought tolerant characteristics of *Melia volkensii* and developing a method to select drought tolerant variation In order to identify the drought tolerant characteristics of each variation, various morphologic and physiologic observations are proposed, which range from simple measurement of leaf shape to photosynthesis performance by high-tech equipment. The project provides necessary measuring tools together with appropriate training in Japan including the latest analysis techniques in laboratory.

2. Management Policy

(1) Linkage between Dispatching experts, Training in Japan and Equipment provision

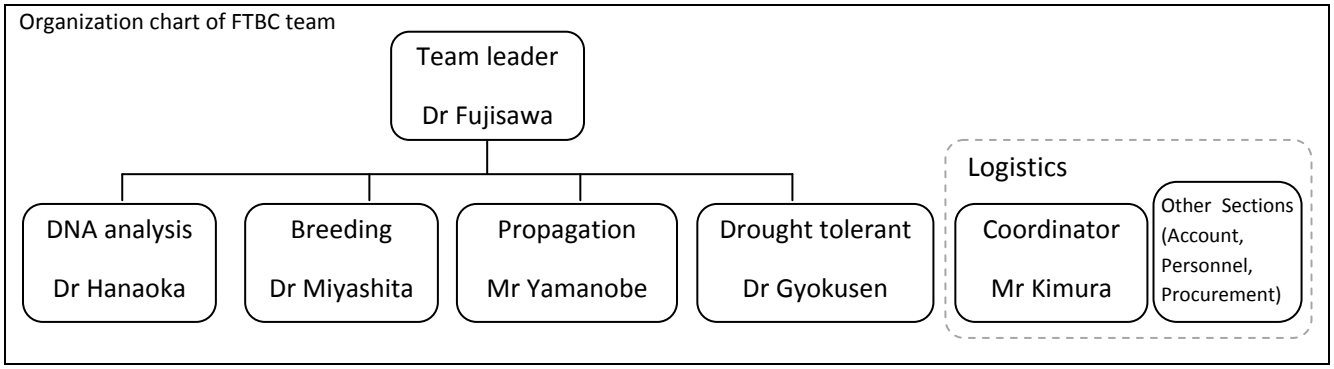
The project intends to introduce new system which does not exist in Kenya now, such as DNA analysis of Output 1, and tree breeding system of Output 2. C/Ps, therefore, may face the difficulty of operation, if they cannot figure out appropriate work flow of newly introduced system. In order to overcome this difficulty, FTBC proposes the followings for the project management.

(a) Synchronize the project implementation and the training program in Japan
(b) Short term experts take care of the training in Japan as well as technical guidance in Kenya, in their responsible subjects

(c) KEFRI introduces the same equipment as FTBC laboratory as much as possible.

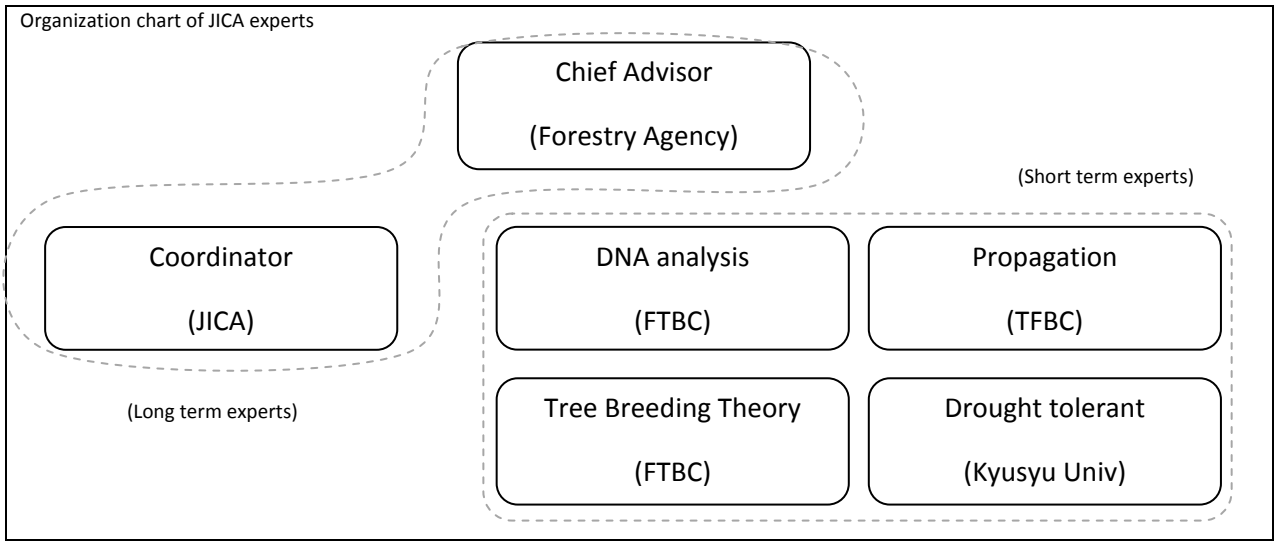
(2) Frame work of FFPRI-FTBC team

FTBC organizes the expert team as below;



(3) Framework of expert team

Long term experts and FTBC team closely cooperate and support each other under the framework of the expert team. The organization chart of the expert team looks like below;



In addition to individual TOR of each expert, general demarcation between the long term experts and short term experts is proposed as follows;

Category	Mandate
Long term expert	• Oversee general progress of the project as a whole • Implement activities of Output 3 and Output 4 • Procurement in Kenya and local currency accounting • Liase with KEFRI, KFS , other governmental organizations , JICA Representative Office, and other donors or NGOs.

Short term expert	• Implement activities of Output 1 and Output 2 • Technical advice on Output 3 and Output 4 • Organize the training in Japan • Procurement in Japan (in cooperation with JICA HQs) • Maintain communication and information gathering in Japan

3 Project Design Matrix (PDM)

Project Name: Project on Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya
Period of Cooperation: 5 years (2012.6～2017.6)
Implementing Agency: Kenya Forestry Research Institute (KEFRI)
Target Beneficiaries: Inhabitants of Arid and Semi-Arid Areas (ASALs) of Kenya

Version: June, 2012

Narrative Summary	Objectively Verifiable Indicators	Mean of Verification	Important Assumptions
Overall Goal Quality plantations of indigenous species are extended in the ASALs of Kenya.	2000 ha of quality plantations of indigenous species are established in the ASALs of Kenya.	Geo-referenced maps of indigenous species plantation	1. Sufficient budget is allocated for extension activities. 2. Other donor institutions or NGOs provide support in expanding extension activities.
Project Purpose Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced.	1. 400 ha of quality *Melia* plantations are established annually from the third year of the project. 2. A plan for breeding at least one other dryland indigenous species is developed	1. Geo-referenced maps of *Melia volkensii* plantation 2. Research plan	1. Farmers' demand for *Melia volkensii* remains unchanged. 2. Collaboration between KEFRI and KFS are smoothly implemented.
Outputs 1. KEFRI's capacity for conducting research on genetic diversity of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened. 2. KEFRI's capacity for implementing forest tree breeding of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened. 3. Quality seed and seedling supply system for *Melia volkensii* is established. 4. Awareness of relevant stakeholders on the	1-1 DNA markers of *Melia volkensii* and *Acacia tortilis* are developed. 1-2 Plus trees of *Melia volkensii* and *Acacia tortilis* are genotyped. 2-1 Plus trees of *Melia volkensii* and *Acacia tortilis* are selected. 2-2 Seed orchards for *Melia volkensii* and *Acacia tortilis* are established. 2-3 Superior clones are selected. 3-1 Guideline is developed. 3-2 Number of nurseries producing quality	-Research papers -Project reports -Catalogue (that includes location, characteristics, photos etc.) of plus trees -Project reports -Guideline -Nursery records	1. Sufficient lands for orchards are allocated. 2. Local communities' understanding and support is obtained in target areas.

importance of quality seed and seedling is raised.	seedlings increase to fifteen. 4-1 At least two project awareness events (seminars, workshops, trainings) are held annually. 4-2 More than 80 % of participants of project awareness events are willing to use quality seedlings.	-Project reports -Project reports -Questionnaire	
Activities 1.1 Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude. 1.2 Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population. 1.3 Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*. 2.1 Select plus tree of *Melia volkensii*and *Acacia tortilis* . 2.2 Establish clonal seed orchards of *Melia volkensii* 2.3 Evaluation of plus trees based on progeny performance (progeny test). 2.4 Select drought tolerant *Melia volkensii* from plus trees. 2.5 Improve the clonal seed orchards of *Meliavolkensii*. 2.6 Establish seedling seed orchards of *Acacia tortilis*. 3.1 Review, analyze and document the current status of seed and seedling production and distribution. 3.2 Develop a guideline for securing the quality seed and seedling production and distribution. 3.3 Pilot the guideline using improved seed sources from Output 2. 3.4 Improve the guideline.	**Inputs** (Japanese Contribution) 1. Dispatch of Experts 2. Training 3. Machinery and Equipment (Kenyan Contribution) 1. Project Staff Allocation 2. Office Space for Japanese Experts 3. Facilities and Running Expenses		

4.1 Establish on-station and on-farm demonstrations of improved *Melia volkensii* plantation in at least three regions. 4.2 Produce training materials. 4.3 Organize trainings and seminars for stakeholders. 4.4 Publish and distribute brochures. 4.5 Share project findings with participants of the third country training program.		

Chapter 3 Plan of Operation

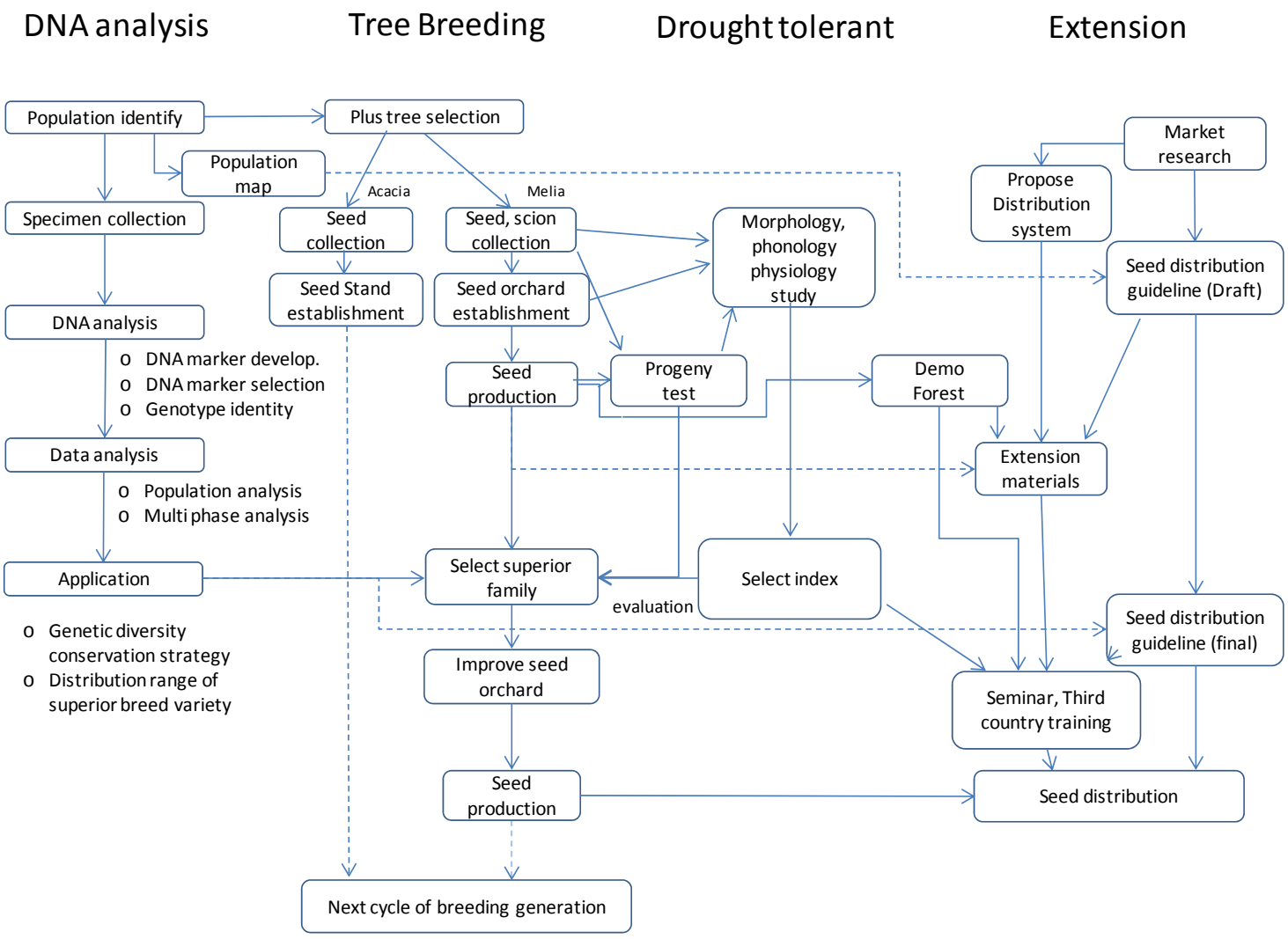
1 Plan of Operation

Activities		1st term			2nd term				3rd term				4th term				5th term					Section & Program in KEFRI	Responsible Person	
		2012			2013				2014				2015				2016				2017		KEFRI	JICA
		3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2			
0 General issue																								Chief Advisor Dr Fujisawa
0.1	Inception report	◊																						
0.2	JCC	†		†				†			†	†				†				†				
0.3	Evaluation										‡									‡				
0.4	Intrnational seminar																				◊			
1 DNA analysis																								Dr. Hanaoka
1.0	Training in Japan																							
1.1	Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude																					GIS STD	Mr. Kiama	
1.2	Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population																					Biotechnology DFP	Mr. Machua	
1.2.1	Collect the specimens, leaf and seed, from *Melia volkensii* populations																							
1.2.2	Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis*																							
1.2.3	Screen developed SSR markers in order to figure out genetic relationship between populations																							
1.2.4	Determine the genotypes of collected specimens by using developed SSR markers																							
1.3	Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*																							
2 Tree breeding																						Tree Breeding, DFP	Mr. Kariuki	Dr. Miyashita
2.0	Training in Japan																							
2.1	Select candidate plus trees of *Melia volkensii*																							
2.2	Establish clonal seed orchards of Melia volkensii																							
2.2.1	Prepare root stock of *Melia volkensii* for grafting propagation																							
2.2.2	Collect twigs or scions of candidate plus trees																							
2.2.3	Conduct grafting propagation, and provide clone seedlings for clonal orchards																							
2.2.4	Establish of clonal seed orchard in Kitui and Kibwezi																							
2.3	Evaluation of plus trees of *Melia volkensii* based on progeny performance																							
2.4	Select drought tolerant from candidate *Melia volkensii* plus trees																							
2.4.1	Prepare a drought tolerant selection procedure																							
2.4.2	Consider the potential indicators for drought tolerant selection																							
2.4.3	Select drought tolerant index																							
2.4.4	Select drought tolerant *Melia volkensii* by index																							
2.5	Improve clonal seed orchards of *Melia volkensii*																							
2.6	Establish seedling seed stand of *Acacia tortilis*																						Mr. Machua and Mr. Omondi	
2.6.1	Collect seeds of candidate plus tree of *Acasia tortilis*																							
2.6.2	Propagate seedling from the collected seeds																							
2.6.3	Prepare the seedling seed stand																							
2.6.4	Establish the seedling seed stand																							
3 Supply chain of Quality seed and seedling																						Seed Research TSP	Mr. Bernard Kamondo	Chief Advisor Dr. Fujisawa
3.1	Market research																							
3.2	Production and distribution guideline																							
3.3	Pilot distribution																							
3.4	Revice and finalize seed distribution guideline																							
4 Extention of quality seed distribution system																						DFP	Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi)	Chief Advisor Dr. Fujisawa
4.1	Establish Demonstration forest																						Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi)	
4.2	Training material																							
4.3	Seminer for stakeholders and NGOs																							
4.4	Brouchure																							
4.5	Third country training																							

2. Annual Plan of Operation

Activities		2nd Q			3rd Q			4th Q			Section & Program in KEFRI	Responsible Person	
		2012						2013				KEFRI	JICA
		7	8	9	10	11	12	1	2	3			
0 General issue													Chief Advisor Dr Fujisawa
0.1	Inception report	◊											
0.2	JCC		†							†			
0.3	Evaluation												
0.4	Intrnational seminar												
1 DNA analysis													Dr. Hanaoka
1.0.1	Training in Japan												
1.0.2	Dispatch expert												
1.1	**Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude**										GIS STD	Mr. Kiama	
1.1.1	Make a strategy of ground survey of the populations and prepare a reporting format												
1.1.2	Gather the location information of populations through the subordinate network of KEFRI, KFS and other available sources												
1.1.3	Implement the ground survey, and gather the information of Melia volkensii population by using prepared reporting format together with photograph and GPS data												
1.1.4	Compile the gathered information of Melia volkensii into the GIS system and develop the location map of populations												
1.1.5	Consider to develop GIS system for information integration												
1.2	**Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population**										Biotechnology DFP	Mr. Machua	
1.2.1	Collect the specimens, leaf and seed, from *Melia volkensii* populations												
1.2.2	Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis*												
1.2.3	Screen developed SSR markers in order to figure out genetic relationship between populations												
1.2.4	Determine the genotypes of collected specimens by using developed SSR markers												
1.3	**Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis***												
2 Tree breeding											Tree Breeding, DFP	Mr. Kariuki	Dr. Miyashita
2.0.1	Training in Japan												
2.0.2	Dispatch expert												
2.1	**Select candidate plus trees of *Melia volkensii***												
2.1.1	Conduct plus tree selection work												
2.1.2	Selection criteria evaluation												
2.2	**Establish clonal seed orchards of Melia volkensii**												
2.2.1	Prepare ten thousands root stock of *Melia volkensii* for grafting propagation												
2.2.2	Collect twigs or scions of candidate plus trees												
2.2.3	Conduct grafting propagation, and provide clone seedlings for clonal seed orchards												
2.2.4	Embark on the establishment of clonal seed orchard in Kitui and Kibwezi												
2.3	**Evaluation of plus trees of *Melia volkensii* based on progeny performance**												
2.3.1	Prepare the plantation sites of *Melia volkensii* for Progeny test												
2.4	**Select drought tolerant from candidate *Melia volkensii* plus trees**												
2.4.1	Prepare a drought tolerant selection procedure												
2.4.2	Consider the potential indicators for drought tolerant selection												
2.5	**Improve clonal orchards of *Melia volkensii***												
2.6	**Establish seedling seed stand of Acacia tortilis**											Mr. Machua and Mr. Omondi	
3 Supply chain of Quality seed and seedling											Seed Research TSP	Mr. Bernard Kamondo	Chief Advisor Dr. Fujisawa
3.1	**Market research**												
3.2	**Production and distribution guideline**												
3.3	**Pilot distribution**												
3.4	**Revice and finalize seed distribution guideline**												
4 Extention of quality seed distribution system											DFP	Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi)	Chief Advisor Dr. Fujisawa
4.1	**Establish Demonstration forest**											Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi)	
4.2	**Prepare Training material**												
4.3	**Seminer for stakeholders and NGOs**												
4.4	**Prepare Brouchure**												
4.5	**Third country training**												

3 Work flow

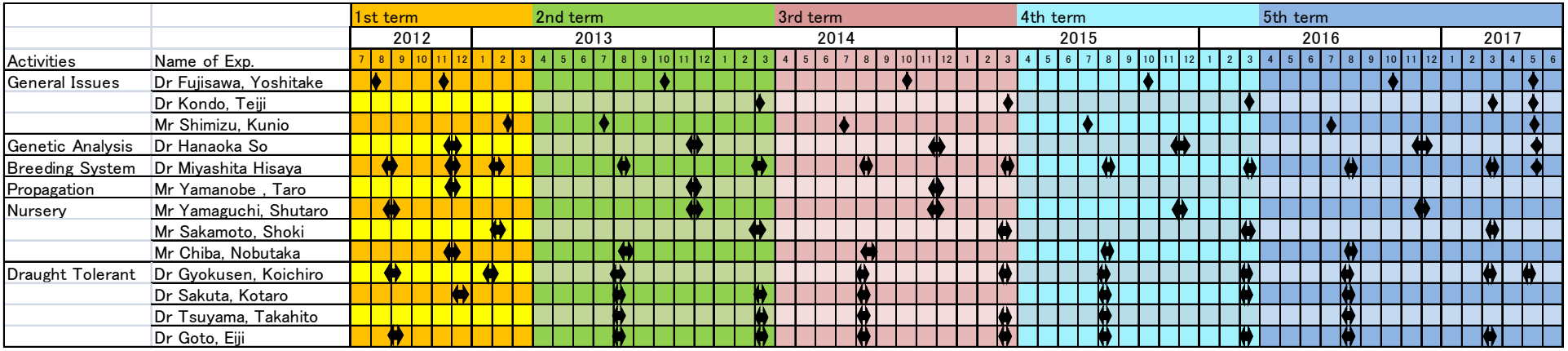

DNA analysis
Tree Breeding
Drought tolerant
Extension
Population identify
Plus tree selection
Population map
Acacia
Melia
Specimen collection
Seed collection
Seed, scion collection
Seed Stand establishment
Seed orchard establishment
Morphology, phonology physiology study
DNA analysis
o DNA marker develop.
o DNA marker selection
o Genotype identity
Seed production
Progeny test
Demo Forest
Data analysis
o Population analysis
o Multi phase analysis
Extension materials
Application
Select superior family
Select index
evaluation
o Genetic diversity conservation strategy
o Distribution range of superior breed variety
Improve seed orchard
Seminar, Third country training
Seed production
Seed distribution
Next cycle of breeding generation
Market research
Propose Distribution system
Seed distribution guideline (Draft)
Seed distribution guideline (final)

4. Assignment of experts

Experts play role of advisor and/or instructor of C/Ps in the field of their specialty.

Title	Name of Expert	Mandate
Team Leader	Dr Yoshitake Fujisawa	- Delegates Short term experts for coordination with Long term experts - Manages the progress of short term experts' activities - Supports the extension work - Proposes appropriate activities for problem resolution - Coordinates report writing
DNA Analysis	Dr So Hanaoka	- Gather the information of target tree species population - Gather the specimens for DNA analysis - Conduct DNA analysis - Analyze the data - Develop Genetic diversity conservation guideline
Tree Breeding	Dr Hisaya Miyashita	- Select plus tree of target tree species - Prepare seedling seed orchard and seed stand - Develop and maintain seed orchard and progeny test stand - Evaluate the candidate plus tree
Propagation/Extension	Mr Taro Yamanobe	- Provide necessary planting materials - Develop demonstration forest - Support the extension work
Nursery management	Mr Shutaro Yamaguchi Mr Nobutaka Chiba Mr Shoki Sakamoto	- Instruct nursery management - Support the extension work
Drought Tolerant	A-Prof. Koichiro Gyokusen Dr Kotaro Sakuda Dr Takahito Tsuyama Dr Eiji Goto	- Consider evaluation method of drought tolerant - Conduct morphologic and physiologic survey - Select appropriate index of drought tolerant - Identify drought tolerant individuals
Coordination	Dr Teiji Kondo Mr Kunio Shimizu	- Coordination at JCC level

5. Schedule of Short term experts dispatching



Chapter 4 Progress of Contract Work Implementation

1. Progress management

(1) Inception Report

FFPRI-FTBC submitted and presented the draft inception report of the project to the JCC in September 2012. JCC members accept the report and discussed substantial activities based on it.

(2) Annual Work Plan of Contract

FFPRI-FTBC submitted the annual work plan of contract to the JICA-HQ in July 2012.

(3) JCC

Dr Fujisawa, the team leader of FFPRI-FTBC, attended 1st JCC meeting in 25th September 2012. He presented the contents of the draft inception report to the JCC members, and they officially kicked off the project's steering committee.
Mr Kimura, the coordinator of FFPRI-FTBC team, attended 2nd JCC meeting in 12th February 2013. He together with the project manager and the chief advisor presented the first year progress and second year plan. JCC member confirmed the progress, and approved the plan of project activities.

2. Progress of Activities1 (DNA analysis)

1.0 Conduct training in Japan

As a schedule, prior to activation of the newly installed equipment in KEFRI, a training was conducted in Japan. The contents of the training is designed as OJT like, targeted SSR marker development of *Acacia tortilis.* Two trainees obtained basic skill of genetic analysis, and they successfully developed workable primers for DNA analysis of *Acacia tortilis* by themselves. They are resuming DNA analysis in KEFRI after the delivery of the Grant Aid equipments.

Table Training course for DNA analysis 2012

Course name	Term	Participants
DNA analysis	July 3rd 2012 ~ Aug 27th 2012	1. Mr Joseph Machua 2. Mr Stephen Omondi

1.1 Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude

Based upon a part of location data of *Melia volkensii* population, growing area was figure outed on the GIS map. This preliminary information is highly suggestive that the natural stand of *M. volkensii* may be restricted by a couple of condition.

Additional data collection was delayed due to budgetary constraints, and have been resumed at the timing of the end of fiscal year.

1.2 Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population

During training in Japan, CPs identified 144 SSR (microsatellite) markers of *Acacia tortilis* by themselves, but no SNP markers of chloroplast genome was identified. In order to accelerate their analysis, next generation sequencing service will be applied in this fiscal year.

Delivery of a sequencer was delayed due to complicated custom procedure, and it induced more problem of the machine setup which was happen by expire of certain reagents.

3. Progress of Activities2 (Tree Breeding)

2.0 Conduct training in Japan

In order to obtain the necessary knowledge of tree breeding, six trainees studied in Japan. They are dived into total four course of trainings as follows;

Table Training courses for Tree Breeding 2012

Course name	Term	Participants
Tree Breeding Project Management	Aug 8 2012 ~ Aug 8 2012	1. Dr. Ben Chikamai
Tree Breeding Management	July 22 2012 ~ July 11 2012	1. Dr. Gabriel Muturi
Tree Breeding Theory	July 4 2012 ~ Aug 11 2012	1. Mr. Jason Kariuki 2. Mr. David Muchiri
Tree Breeding Technology	July 4 2012 ~ July 28 2012	1. Ms. Mary Mwangi 2. Ms. Frouza Maingi

Details of each training course are described in the appendixes. Tree breeding theory course and tree breeding techniques course are resuming next year together with draught tolerant course. Detail contents of the courses will be discussed based on the capacity of CPs and the progress of project implementation.

2.1 Select candidate plus trees of *Melia volkensii*

The candidate plus tree selection was delayed due to budgetary constraints. Project members understand this delay is very critical for the future project implementation, therefore asked JICA for temporally financial support of travelling allowance, and kindly JICA approved it.

So far, the selection activities have been resumed at the timing of the end of fiscal year.

Table Number of plus tree selection (*Melia volkensii*)

Year	Number	Note
selected	60	
2012	20	Selection from ASALs
2013	20	Selection from ASALs

ASALs : Arid and Semi Arid Lands

2.2 Establish clonal seed orchards of *Melia volkensii*

(a) Preparation of root stocks

Before the project opening, KEFRI intended to produce ten thousands of *Melia volkensii* root stock for grafting propagation. KEFRI produced them with technical support by FTBC researchers and the financial support by JICA Kenya office. By the end of August, approximately nine thousand root stocks are raised.

(b) Scions collection of candidate plus trees

Target numbers of grafting propagation as eighty seedlings each for sixty family has been set, thus around hundred of scion were collected.

(c) Grafting propagation for clonal seed orchards

Collected scions were packed in cooling box, and delivered immediately to Kitui Regional Research Centre. In order to provide sixty seedlings for each family, eighty grafting propagations were done. After the grafting, root stocks were kept in light intensity controlled seedling bed. Insect damages of spider mite were observed, and insecticide was applied. As the result, the nursery could not provide necessary number of seedlings, it means sixty seedlings, for around ten families. Deficit of seedlings will be compensated in next year.

(d) Site preparation of clonal seed orchard

Two clonal seed orchards will be established in Tiva and Kibwezi, and the size and number of seed orchards are described as follows;

Table Size and Number of Seed orchard (*Melia volkensii*)

Type of design	Number of Families	Trees per Family	Number of Trees per site	Number of sites	Total number of trees
Seed Orchard	100	30	3000	2	6000

Planting spacing is 6m x 6m, therefore total 10.8 ha of area is required for each seed orchard. Boundary of the orchards are rounded by concrete pole fencing with barbed wire. Water tank was set for watering for each orchard.

Planting location of each tree was allocated by computer program, and marked by plastic label.

(e) Planting seedling in the clonal orchards

All of available clone seedlings were planted in December in Tiva, and in January in Kibwezi.

2.4 Select drought tolerant from candidate *Melia volkensii* plus trees

(a) Preliminary research on phenologic characteristics

In order to collect periodical growth data, dendrometers were set in Tiva station nursery. Ten melia trees were selected and apparatus was set to each trunk.

Several phenologic aspects such as leaf, flower and fruit were observed in clone bank in Tiva. As a result, most of families shows variability on their phenologic timing. This result cannot explain the possibility of phenologic data for the indicator of drought tolerant characteristics, thus further observations are needed.

Dendrometers were set on several mature melia trees in Tiva. Preliminary result of this experiment suggests the potential of scientific evaluation of melia's phenology.

(b) Preparation of fixed-point observation

In order to observe the periodical change of physiologic characteristics, such as hydrologic potential and photosynthetic property, special test field was set in Kitui regional center. Seedlings of five species, *Melia volkensii, Melia azedarach, Eucalyptus camaldurensis, Gmelia arbor*ea, and *Acasia tortalis*, will be planted nearby grafting nursery, and are designated for fixed-point observation.

Also test seedling stand is going to be constructed which seedlings raised from the seed of three inferior and three superior clones of existing progeny test field in Tiva.

Chapter 5 Miscellaneous

1. Procurement

Following items were provided to KEFRI as "Carry-in equipment" by short term experts, in order to be up-to-date project implementation.

Item	unit price	number	amount
1. Measuring rod w/ knife, 8m, glass fiber	31,710 jpy	2 pcs	63,420 jpy
2. Measuring rod w/ knife, 12m, glass fiber	45,885 jpy	2 pcs	91,770 jpy
3. Measuring rod w/ knife, 8m, glass fiber	26,460 jpy	2 pcs	52,920 jpy
4. Measuring rod w/ knife, 8m, carbon fiber	61,950 jpy	2 pcs	123,900 jpy
5. Grafting tape (Mederu)	1,680 jpy	60 rolls	100,800 jpy
6. Grafting cream (Top-gin M)	861 jpy	50 pcs	43,050 jpy
7. Reagent for DNA analysis, primer	239,935 jpy	1 set	239,935 jpy
8. Simplified centrifugation	1,659 jpy	2 pcs	3,318 jpy
9. Microscope with web camera	77,721 jpy	1 set	77,721 jpy
10. Label printer with refill cassette tape	45,696 jpy	1 set	45,696 jpy

This "carry-in equipment" procurement is very useful in case of happening urgent needs of project implementation.

List of appendix

3-7 Short term expert (Breeding and propagation)

3-8 Short term expert (Drought tolerant)

3-9 Short term expert (Project management)

4 Minutes of 1st JCC meeting

Appendix 1-1 Report on Training in Japan (DNA analysis)

1. Outline of training course

(1) Name of course "DNA analysis for Kenya tree breeding project" (J1221696)

(2) Period From July 4th 2012 To Aug 24th 2012

(3) Participants Mr. Joseph Mwangi MACHUA, Mr. Stephen Fredrick OMONDI (two participants)

2. Results

(1) Achievement

- Trainees obtained necessary skills of DNA analysis such as identification of microsatellite markers.
- Substantially trainees got understandings of the genomic DNA extraction, a couple of PCR method, clonig, plasmid DNA extraction, sequencing reaction and etc.
- Trainees successfully identified 144 of microsatellite SSR markers of *Acacia tortilis* by themselves.
- Trainees got a handle on the sequencer manipulation.
- Trainees got a handle on tissue culture propagation.
- Trainees studied many relative issues of tree breeding and understand the importance of DNA analysis for tree breeding activities.

(2) Main contents

Period	Contents	Organization
July 5 ~6	Briefing, meeting about project activities	FTBC
July 9	Presentation by trainees	FTBC
July 10~13	Tissue culture, DNA extraction	FTBC
July 17~Aug 3	Development of SSR marker	FTBC
Aug 5~6	Courtesy call to FFPRI	FFPRI
Aug 7~10	Development of SNP marker	FTBC
Aug 13 ~15	Progeny test field observation	FTBC
Aug 16~23	SSR marker screening	FTBC
Aug 24	Final presentation and evaluation	FTBC

3. Evaluation

(1) Composition

In order to economize the training time, the training curriculum skipped basic lecture based on trainees' back ground experience. Lecturers tried to compose ideal curriculum, and to combine laboratory experiments and its description for each step. Although much effort as above, due to time constraints this course could not cover all of necessary issues of DNA analysis. This course may resume next year. Also much useful information written by Japanese may be translated and provided to trainees.

(2) Involvement

This course is designed as OJT like curriculum, thus trainees were involved very much. As a fact, during the course, trainees could identify SSR markers by themselves.

(3) Facilities

FTBC provides necessary facility to the trainees. Lecturers use latest model of apparatus such as multi channel pipette. Using such a sophisticated tool much speedups their experiment, but has some potential risks. Because, once technician mishandles a tool, for example holding a pipette with unacceptable angle, it may critically affect to the result of experiments. Trainees should understand this kind of basic mechanisms if they want to introduce same type of apparatus.

(4) Training materials

Lecturers prepared necessary materials for training course. Trainees satisfied those preparation. In addition, there are a lot of good reference information written in Japanese. The project may translate some of them, and provide to KEFRI.

(5) Selection of trainee

Responsible counterparts are selected as trainees, and they are earnest, and have a good patience. If they continue making steady efforts of skill up, they may obtain necessary skills of DNA analysis.

(6) Application of training result

This course dedicated for rapid skill up of DNA analysis because of sequencing machines will be provided by Japanese Grant Aid in 2012. Lecturer will be dispatched and instruct trainees again in Kenya.

(7) Environment of trainee

FTBC doesn't facilitate any accommodation for trainees, thus trainees rent a room in a hotel in Takahagi city. They suffered lacking of kitchen facility and are fed by boxed lunch every day. The other hand, trainees tried to communicate with local residents, and enjoyed local festival and so on.

(8) Other remarks

In order to accelerate SNP marker identification, large size deciphering may be applied by using next generation sequencing technology. With preliminary data of chloroplast DNA, trainees can focus on the target area and proceed SNP identification by using equipped sequencer.

Appendix 1-2 Report on Training in Japan (Tree Breeding Project Management)

1. Outline of training course

(1) Name of course "Tree Breeding Project Management for Kenya tree breeding project" (J1221790)
(2) Period From August 6th 2012 To August 10th 2012
(3) Participants Director of KEFRI, Dr. Ben Chikamai (one participant)

2. Results

(1) Achievement

- Director met board members of FFPRI and other high ranking officers of Japanese government who are responsible for the project implementation. They exchanged their view of forest sector of Kenya and the importance of mutual cooperation.
- Director studied many relative issues of tree breeding activities and re-acknowledged the application of the tree breeding project in Kenya.

(2) Main contents

Period	Contents	Organization
August 6 ~7	Courtesy call to FFPRI, FTBC, JICA-HQ, MAFF-Forestry Agency	FTBC
August 8~10	Field trip to observe tree breeding activities	FTBC-Kansai

3. Evaluation

(1) Composition

Even thought short term period of training course, Director could meet many distinguished people in this field, and could observe actual tree breeding activities in Japan. Also he observed the other training courses of the project and confirmed the effectiveness of the trainings.

(2) Involvement

Director fully enjoyed the training course with eager interest, and even more he made a presentation at the international seminar in FTBC.

(3) Facilities

FTBC provided necessary facilities for the fulfillment of the training course.

(4) Training materials

Not so many but necessary training materials are prepared by lecturer.

(5) Selection of trainee

Trainee is the project director.

(6) Application of training result

This course dedicated for project management skill. Director could communicate with key person in Japan. Also he was introduced tree breeding activities in Japan.

(7) Environment of trainee

Trainee didn’t face to any difficulty of staying in Japan.

(8) Other remarks

None.

Appendix 1-3 Report on Training in Japan (Tree Breeding Management)

1. Outline of training course

(1) Name of course "Tree Breeding Management for Kenya tree breeding project" (J1221698)
(2) Period From July 23th 2012 To August 10th 2012
(3) Participant Dr. Gabriel Mukuria MUTURI (one participant)

2. Results

(1) Achievement

- Trainee met board members of FFPRI and other high ranking officers of Japanese government who are responsible for the project implementation. They exchanged their view of forest sector of Kenya and the importance of mutual cooperation.
- Trainee met all of JICA experts and lecturers of FTBC.
- Trainee observed most of key techniques of project implementation.
- Those information will be helpful for discussing project activities among project members.

(2) Main contents

Period	Contents	Organization
July 23~24	Lecture and exercise of physiological analysis	Kyusyu Univ
July 25~Aug 3	Lecture and field exercise of tree breeding	FTBC-Kyusyu
August 6 ~7	Courtesy call to FFPRI, FTBC, JICA-HQ, MAFF-Forestry Agency	FTBC
August 8~10	Field trip to observe tree breeding activities	FTBC-Kansai

3. Evaluation

(1) Composition

Training curriculum contained general information lectures of tree breeding, information exchange with Japanese side key persons of project implementation, and observation tour to the actual tree breeding activities in Japan. It helped trainee to understands and obtains necessary perception of the project management.

(2) Involvement

Trainee attended the training course with eager interest, and made a presentation at the international seminar in FTBC.

(3) Facilities

FTBC provided

(4) Training materials

Lecturers prepared and provided necessary training materials.

(5) Selection of trainee

Trainee is the project manager.

(6) Application of training result

This course dedicated for project management skill. Trainee could communicate with all of FTBC researchers and engineers who are appointed as JICA experts, and key persons of FPRI, JICA and MAFF-FA as well. Also he was introduced tree breeding activities in Japan.

(7) Environment of trainee

Trainee didn't face to any difficulty during his stay in Japan.

(8) Other remarks

None.

Appendix 1-4 Report on Training in Japan (Tree Breeding Theory)

1. Outline of training course

(1) Name of course "Tree Breeding Theory for Kenya tree breeding project" (J1221596)

(2) Period From July 4th 2012 To August 11th 2012

(3) Participant Mr. Jason Gathirwa KARIUKI, Mr. David Kimani MUCHIRI (two participants)

2. Results

(1) Achievement

- Trainees studied basic theory of tree breeding.
- Trainees and FTBC staff who appointed JICA expert discussed project implementation directory.
- Trainees exercised basic components of tree breeding such as plus tree selection, clone bank, scion garden, seed orchard, progeny test field. More over they studied phenological analysis, wood market and so on.

(2) Main contents

Period	Contents	Organization
July 5~6	Briefing, meeting with experts	FTBC
July 9	Presentation by trainee	FTBC
July 10~13	Lecture and exercise on Breeding theory	FTBC
July 17~20, Aug 3, Aug 8	Exercise on breeding, observation of breeding application (wood market)	FTBC-Tohoku, FTBC
July 23~24	Lecture and exercise of physiological analysis	Kyusyu Univ
July 25~Aug 29	Lecture and field exercise of tree breeding	FTBC-Kyusyu
July 30 ~Aug 2	Lecture and exercise on subtropical species tree breeding	FTBC-Iriomote
August 6~10	Preparation of project implementation, course evaluation	FTBC

3. Evaluation

(1) Composition

Training curriculum consists from general guidance of tree breeding activities, basics of breeding theory, field exercise of tree breeding, scientific analysis, and field observation of tree breeding application.

Training on application theory such as statistical evaluation of breeding value will be conducted next year.

(2) Involvement

Trainee attended the training course with eager interest, and self-evaluated their achievement. Most of lectures and exercises are including many practices with questions and answers session.

(3) Facilities

FTBC provided necessary facilities for trainees. Mostly trainees stayed at the hotel nearby.

(4) Training materials

Lecturers prepared and provided necessary training materials.

(5) Selection of trainee

Trainees are the main staff member of the project, and in charge of tree breeding section of KEFRI. They are responsible for the seed orchard construction.

(6) Application of training result

This course dedicated for obtaining tree breeding theory. Trainees had to start seed orchard construction just after the training, and at the result, it shows reasonable progress.

(7) Environment of trainee

Trainee had some problem with meals during their stay in Japan. Also they said that they enjoyed but somehow it was difficult to communicate with local people in Japan.

(8) Other remarks

None.

Appendix 1-5 Report on Training in Japan (Tree Breeding Technology)

1. Outline of training course

(1) Name of course "Tree Breeding Technology for Kenya tree breeding project" (J1221697)

(2) Period From July 4th 2012 To July 28th 2012

(3) Participant Ms. Mary Wambui MWANGI Ms. Frouza Mwende MAINGI (two participants)

2. Results

(1) Achievement

- Trainees studied basic technology of tree breeding, especially grafting propagation and nursery management.
- Trainees and FTBC staff who are appointed as JICA expert discussed project implementation directory.

(2) Main contents

Period	Contents	Organization
July 5~6	Briefing, meeting with experts	FTBC
July 9	Presentation by trainee	FTBC
July 10~13	Lecture and exercise on Breeding technology	FTBC-Tohoku
July 17~20	Field trip to private nursery and man-made forest management	FTBC-Tohoku
July 23~24	Lecture and exercise of physiological analysis	Kyusyu Univ
July 25~Aug 29	Lecture and field exercise of tree breeding	FTBC-Kyusyu

3. Evaluation

(1) Composition

Training curriculum consists from general guidance of nursery management and propagation techniques. Lectures and exercises are mixed and matched alternately in order to keep trainees interest. Each subject covers large range of techniques, therefore lecturers tried not to concentrate the lectures in one time.

(2) Involvement

Trainee attended the training course with eager interest, and self-evaluated their achievement. Most of lectures and exercises are including many practices with questions and answers session.

(3) Facilities

FTBC provided necessary facilities for trainees. Mostly trainees stayed at the hotel nearby.

(4) Training materials

Lecturers prepared and provided necessary training materials.

(5) Selection of trainee

Trainees are the in charge of nursery management section of KEFRI. They are responsible for the grafting propagation for seed orchard construction.

(6) Application of training result

This course dedicated for obtaining nursery management and grafting propagation skill. Trainees had to start grafting propagation of candidate plus trees just after the training, and at the result, it shows reasonable progress.

(7) Environment of trainee

Trainees had some problem with meals during their stay in Japan, but they could managed

(8) Other remarks

Non

Appendix 2 Trainees' presentations

2-1 Information sharing between lecturers and trainees

(1) General Profile of Kenyan Forest

(2) General Information of KEFRI

(3) Overview of Drylands Forestry: Research and Development at KEFRI

(4) Strategy of genetic research of KEFRI

(5) Strategy of tree breeding research of KEFRI

2- 2 Training Report

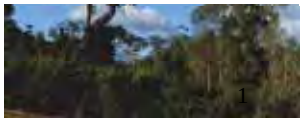
(1) Training report of genetic research course (main)

(2) Training report of genetic research course (field visits)

(3) Training report of breeding research course

KENYA FORESTRY RESEARCH INSTITUTE

Kenya: General Profile



1

CONTINENT OF AFRICA

AFRICA

- *Size: 11,608,000 sq. miles; second largest continent*
- *% of Earth's Land: 20.2%*
- *Population: 807,419,000*
- *Number of Countries: 53*
- *World's Longest River: Nile*
- *World's Largest Desert: Sahara*

2

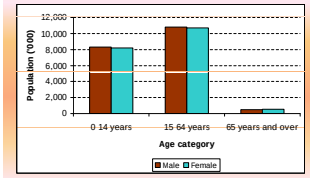
KENYA, EAST AFRICA

1: Kenya:General Information

- Location and land area: Between latitudes 5º North and 4º 40' South and, longitude 33º 53' East of GM to 41o 55.5' East
- Area: 582646 km² of which 13,400 km² (2.3%) of the total area is occupied by water surface
- Kenya has 536 kilometers of coastline on the Indian Ocean
  - Population: 38,612,523
  - Official Language: Swahili & English
  - Currency: Kenyan Shilling

3

2: Population



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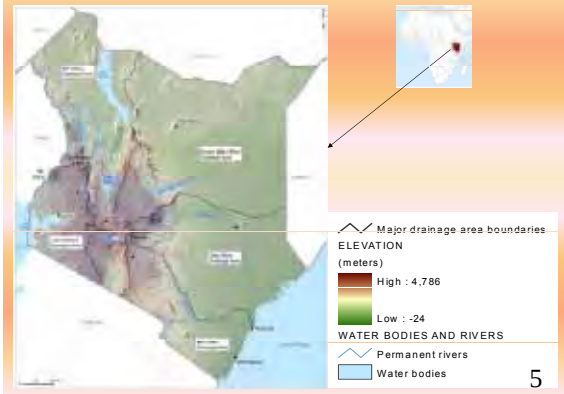
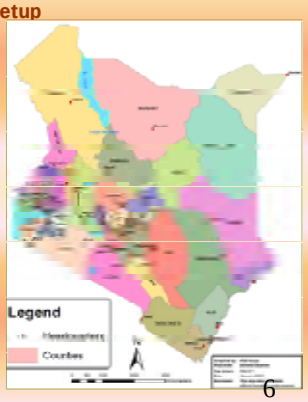
3: Physical Geography and Major Drainage Areas



5

4: Kenya administrative setup

- There are 47 counties in Kenya as shown in figure opposite
- There is the central Government responsible for major ministries like Defense, Security, Policy formulation while county governments are responsible for detailed implementation of plans
- Eg the central government makes policies for forestry while the county ones implement forest management activites in their areas



6

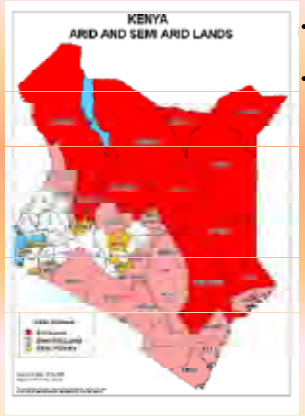
5: Physiography and relief

- Altitude: Sea level in the east, to 5,199 meters at the peak of the snow-capped Mount Kenya
- The Great Rift Valley bisects the Kenya Highlands into east and west. Mount Kenya is on the eastern side. The Highlands are cool and agriculturally rich

7

Physiographic units, Kenya

8



- Only 20% humid environment
- Mainly dry lands
  - Savannas (8%)
  - Semi arid rangelands (14%)
  - Arid rangelands (36%)
  - Very arid rangelands (22%)

9

6: Climate

- The Kenyan climate is generally equatorial and influenced by movement of the Inter-Tropical Convergence Zone (ITCZ) Some parts of the country experience an equatorial kind of climate especially the central highlands, whereas along the coastline the climate is mainly tropical. The country has a bimodal type of climate
- Two thirds of the country receives less than 500 mm of rainfall per year
- Kenya receives an average annual rainfall of 620 mm
- Most parts of the country are characterized by two rainy seasons, March to May (long rains) and October to December (short rains)
- Air temperatures vary from 40° C in the low altitude arid areas to below freezing on Mt. Kenya.
- The mean annual rainfall over the country is approximately 620 mm and this ranges from 130 mm a year in the most arid regions of the northern plains to 1930 mm in the Lake Victoria Basin
- The coastal temperature averages 27° C and the temperature decreases by slightly less than 2° C degrees Celsius with each 300 m increase in altitude. Nairobi, at 1,661 m, has a mean annual temperature of 19° C and at 2,740 m the average is 13° C .

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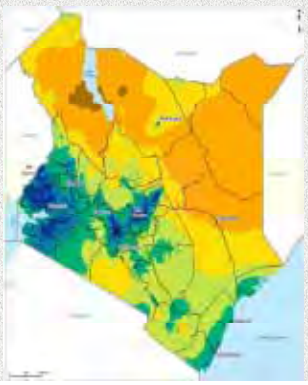
Rainfall distribution



The mean annual rainfall ranges from less than 200 to over 2000mm per year

AVERAGE ANNUAL RAINFALL (millimeters)
- > 2,000
- 1,600 - 2,000
- 1,200 - 1,600
- 800 - 1,200
- 600 - 800
- 400 - 600
- 200 - 400
- <= 200

OTHER FEATURES
- District boundaries
- Water bodies

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7: Hydrology

- Kenya is classified as a chronically water scarce country with a renewable surface water estimated at 19,500 million m^3 or 650 m^3 per capita per year of fresh water
- Kenya's water towers determine and regulate water flow. The surface water forms 96% of the total available water resources while the rest is the groundwater component
- Kenya's largest lake, excluding Lake Victoria on its western border, is Lake Turkana, in the northwest. Smaller lakes, including Lake Baringo, Lake Nakuru, Lake Naivasha, and Lake Magadi, lie in or near the Eastern Rift Valley

Lake	Type	S/Area (km^2)
L. Victoria	Freshwater	3,755
L. Baringo	Freshwater	129
L. Naivasha	Freshwater	210
L. Turkana	Brackish	6,405
L. Elementaita	Saline	21
L. Nakuru	Saline	52
L. Magadi	Saline	104
L. Bogoria	Saline	34
L. Jipe	Saline	39

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- Major water towers (Mountains) in Kenya (Left)

- Major drainage basins in Kenya (Above)

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8: Major Soil types in Kenya

- The major soils in Kenya, (FAO classification) in order of abundance are (1) Regosols (unconsolidated soils), (2) Planosols (slowly permeable soils), 3. Solonetzs (sodium affected soils) and (4) Ferralsols (highly weathered soils)
- In terms of agricultural usage the major soils are Ferralsols, Cambisols, Vertisols and soils with an Argic B horizon (Acrisols, Luvisols, Lixisols and Nitisols)

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Occurrence of major soils

Soil Group	Area in hectares	Natural fertility status	FAO 1974 classification
Weakly developed	3,638,235	Low	Xerosols and Yermosols
Shallow/juvenile	6,697,809	moderate to high	Lithosols, Regosols,Rankers and Rendzinas
Sodic and saline	13,489,985	Low	Solonetz, Solonchaks,and Solodic Planosols
Alluvial	1,936,582	High	Fluvisols
Deep to very deep	3,796,669	Moderate	Nitisols and Andosols
Sandy	436,683	very low	Arenosols
Poorly drained	5,604,302	Moderate	Versols, Gleysols other Planosols, Greyzems, Chernozems
Moderately deep to deep	7,408,426	High	Luvisols, Cambisols, Phaeozems and Chernozems
Deep red, strongly weathered acid	6,839,464	Low	Ferrasols, Acrisols and Ironstone soils
Shallow to moderately deep	7,688,796	High	Shallow Cambisols, Luvisols and Phaeozems

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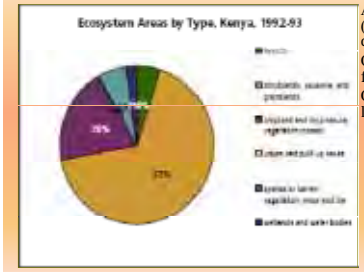
General Environment



A Low Forest Cover Country (LFC) with less than 10% forest cover

Over 35 000 known species of flora and fauna

Over 10 freshwater and soda lakes

- Remarkable conservation efforts53 national protected areas
- 5 Biosphere Reserves
- 4 Ramsar Sites
- 3 World Heritage Sites

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9: Vegetation Types

- Kenya's natural vegetation is determined by climate and topography
- Dean & Trump (1983) mapped 19 distinct biotic communities; which can be grouped as follows (Next slide)

(a) Afro-alpine moorland: Occurs 3000m in Mt Kenya and Mt Elgon, Aberdares and Cherangani. 1.2 % of country. Man Species are Lobelia and Senelio spp

(b) Highland grasslands 2,400 m on either side of the central Rift Valley (in the Kinangop and Mau Narok/Molo grasslands and forms (0.05%) of land area. Many tussock-forming grass species occur

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(c) Highland moist forests and other forests: Form about 2% of the Kenya area, occur between 1,500 m and 3,000 m in areas with rainfall of > 1,200 mm per year. A mixture of forest and *Arundinaria alpina* (bamboo) present at the higher altitudes. Typical montane forest trees include species of *Podocarpus, Olea, Juniperus* and *Newtonia spp*, but the forest type varies greatly according to altitude and rainfall.

- Kenya contains portions of the Eastern Arc montane forests, East African Coastal Forests, East African Highland Forests, East African Acacia savannas, East African Moorlands, Rift Valley Lakes, East African Mangroves, and East African Marine Ecosystems
- Forests cover less than 3% of the country and may be largely divided into natural ones (about 2 million ha) and plantations (about 0.24 million ha

(d) Coast forests and woodlands: Composed of (0.1%) of Kenya, they are characteristic of the Zanzibar-Inhambane Mosaic vegetation region, occur along the narrow coastal strip. Characteristic trees include Cynometra, Malinkara, Afzelia, Brachylaena and Brachystegia. Coastal evergreen bushland (0.4%) also occurs, in a mosaic with cultivated land

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(e) Thorn bushland and woodlands:

- These are the most extensive vegetation types in Kenya (41.7%), running from Amboseli in the south through the Tsavo parks to northeast and northwest Kenya
- Characteristic tree species are Acacia, *Commiphora ssp*., while grasses include species of Hyparrhenia, Digitaria and Themeda
- Contains concentrations of large mammals and many large protected areas are in this vegetation zone. It is often favourable for ranching and pastoral land
- The north-central and northwestern parts of the country are covered by semi-desert (16.8%) with characteristic shrubby thornbush species, mainly Acacia

(f) Wetlands

- Are an important habitat in Kenya, covering about 14,000 km sq of the country's land surface.
- Some of the larger wetlands of Kenya include Lakes Nakuru, Naivasha, Magadi, Kanyaboli, Jipe, Chala, Elementaita, Baringo, Ol'Bolossat, Amboseli and Kamnarok; the edges of Lake Victoria and Lorian, Saiwa, Yala, Shompole swamps; Lotikipi and Kano plains; Kisii valley bottoms and Tana Delta; and coastal wetlands including the mangroves swamps, sandy beaches, sea grassbeds and coral reefs.

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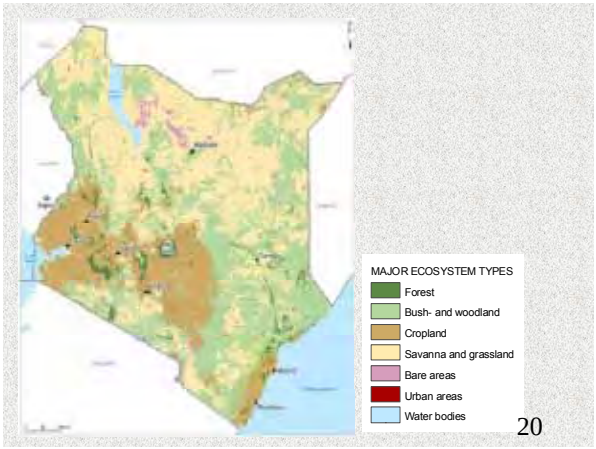

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Kenya's wetlands

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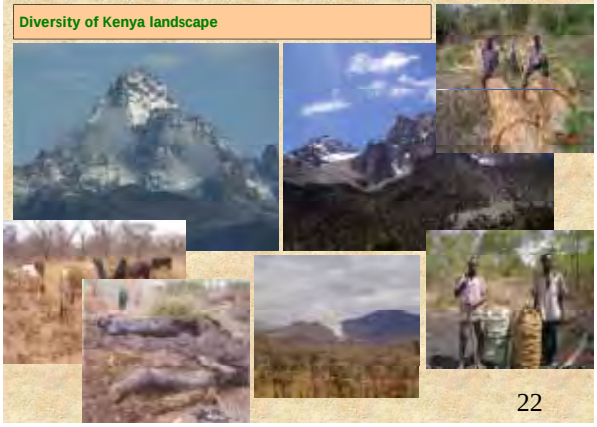
Diversity of Kenya landscape



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Trends in Forest plantation 2002-2006

'000 Hectares

Type of Forest	2002	2003	2004	2005	2006*
Indigenous Trees	12.3	12.3	12.3	12.3	12.3
Exotic Trees	89.4	92.5	98.7	98.7	98.7
Total	101.7	104.8	111.0	111.0	111.0
Fuel Wood and Poles					
Exotic Trees	19.3	20.3	21.3	21.3	21.3
TOTAL AREA	121.0	125.1	132.3	132.3	132.3

*Provisional

Source : Ministry of Environment and Natural Resources

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Trends in recorded sales of forest products 2002-2006

Forest Product	2002	2003	2004	2005	2006*
Timber - '000 true cu. metres-					
Soft wood	162.0	233.3	213.0	994.0	448.2
Hardwood	0.0	0.9	0.0	0.0	0.0
TOTAL	162.0	243.2	213.0	994.0	448.2
'000 stacked cu. metres-					
Fuel wood /Charcoal	67.0	14.6	16.1	47.2	44.0
Power & Telegraph Poles	0.0	2.0	9.8	8.3	9.5

* Provisional.

Source: Ministry of Environment and Natural Resources.

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10: Land Use

- The national economy is primarily agro-based with about 68% of the population living in rural areas and engaged in agricultural activities. Other agricultural statistics indicate that livestock production comprise (54.34%) while settlements land uses account for 0.08%.
- About 17% of Kenya's total land area is of high and medium potential, while the remaining 83% is classified as arid and semi-arid lands (ASALs).

Ecological Zones	Potential Land use	Area ("000" Ha)	% of Total
I-III	• Medium to High: Agriculture, livestock (intensive), forestry and water catchment.	8,600	15
IV & V	• Marginal to Medium: Agriculture (drought-tolerant crops), forestry, livestock (ranching), wildlife conservation	11,500	20
VI & VII	• Marginal: livestock (extensive pastoralism) and wildlife conservation	37,400	65
	Total	57,500	100

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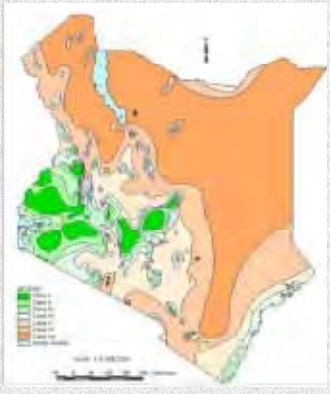
Agro-ecological zones



- Zone I : This zone is the source of rain and some rivers/streams. It is confined to mountains and immediate surrounding such as Mt. Kenya and Mt Elgon
- Zone II: Restricted to the highlands of Kenya between 1980 and 2700 m and occurs as a forest or open grasslands
- Zone III: This zone occurs mainly at elevations between 900-1800 m with a annual rainfall between 950 and 1500 mm
- Zone IV: This zone occupies more or less the same elevation (900-1800 m) as the previous or may be at times lower. However, it has lower rainfall of about 500-1000 mm
- Zone V: This zone is much drier than Zone IV and occurs at lower elevations. Annual rainfall is 300-600 mm.
- Zone VI: This zone is considered as semi desert and is the driest part of Kenya. Annual rainfall is 200-400 mm and is quite unreliable.
- Zone VII: This is represented by Chalbi desert in Marsabit district. The Chalbi is a salt desert with very sparse salt bushes as the only vegetation found

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Kenya's land use classification

Land Use	Area ("000"Ha)	% of Total
Crop (with intensive livestock) production	9,379.1	15.78
Livestock production	33,486.2	54.34
Forests and Woodlands	3,062.7	5.19
National Parks and reserves (protected areas)	4,346.9	7.31
Settlement and associated land uses	46.6	0.08
Others (water bodies, sparsely vegetated etc)	9,099.3	15.31
Total	**59,450.8**	**100**

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11: Summary of Kenya's main economic indicators

Natural resources	Wildlife, soda ash, land
Agriculture	*Products*: Tea, coffee, sugarcane, horticultural products, corn, wheat rice, sisal, pineapples, pyrethrum, dairy products, meat and meat products, hides, skins
	Arable land: 17%.
Industry	*Types*: Petroleum products, grain and sugar milling, cement, beer, soft drinks, textiles, vehicle assembly, paper and manufacturing.
Structure of economy	(% of GDP): *Services* (59.5%), *Industry and commerce* (16.7%), *Agriculture* (23.8%)
Work force	*Formal sector wage earners*:1.95 million (public sector 30%; private sector - 70%)
	informal sector workers: 6.4 miiiion
Trade (2008)	*Exports*--$4.4 billion: tea, coffee, horticultural products, petroleum products, cement, pyrethrum, soda ash, sisal, hides and skins, fluorspar.
	Major export markets: Uganda, UK, Tanzania, Netherlands, United States, Pakistan
	Imports: $9.9 billion: machinery, vehicles, crude petroleum, iron and steel, resins and plastic materials, petroleum products, pharmaceuticals, paper and paper products, fertilizers, wheat
	Major suppliers: United Arab Emirates, India, China, South Africa, Japan

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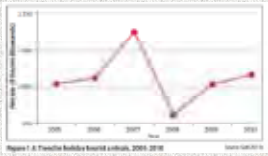
Economic activity



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12: Wildlife and protected areas

- There are currently 46 protected areas that represent the key ecosystems, all covering approximately 8% (47,674 km^2) of the national land area
- Of this, national parks account for 5% and national reserves and sanctuaries for about 3%
- There are 27 national parks, 34 national reserves and 4 wildlife sanctuaries. In addition, there are also many other designated areas for wildlife conservation outside the gazette protected areas Currently there are 17 community sanctuaries and private conservancies covering a total area of 300,000 ha
- Conservation of wildlife, especially through tourism accounts for over 20% of the National Gross product
- National parks, the only area under the direct jurisdiction of Kenya wildlife service, only occupy 4.9 % of Kenya's land service and contain about 10% of Kenya's biological diversity

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Kenya National parks

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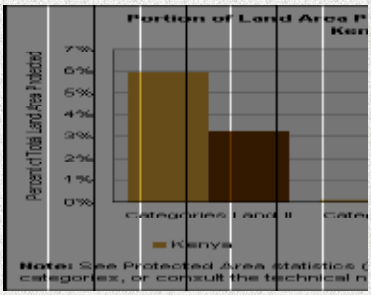
Main Protected land categories in Kenya



- **Category I and II**: Nature Reserves, Wilderness Areas, and National Parks
- **Category III, IV AND V**: Natural Monuments, Species Management seascapes
- **Category VI & Unclassified areas**: Areas Managed for Sustainable Use and Unclassified Areas

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- Major wildlife parks and reserves include: Aberdare National Park, Amboseli National Park, Lake Nakuru National Park, Maasai Mara National Reserve, Meru National Park, Mount Elgon National Park, Mount Kenya National Park, Nairobi National Park, Saiwa Swamp National Park, Samburu National Reserve, Tsavo East National Park, Tsavo West National Park

Category	Amphibians	Birds	Mammals	Reptiles	Total Wildlife species
Total species	76	1103	407	261	**1847**
Endemic species	13	17	22	22	**74**
Threatened species	4	28	33	5	**70**

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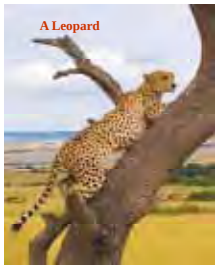
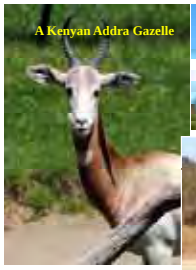
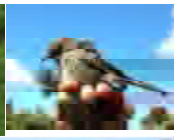

A Leopard


A Kenyan Addra Gazelle



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S Important bird areas

OTHER FEATURES

National parks and reserves

Forest reserves

Water bodies

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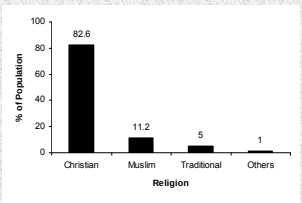
13: Cultural environment

- Kenya has a very diverse population whose indigenous tribes fall into three of Africa's major socio-linguistic groups; Bantus (67%), Nilotes (30%), and Cushites (3%)
- English is the language of choice when doing business in Kenya and is also used in Kenyan schools. Swahili (also called Kiswahili) is the national language of Kenya.



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14: Major international and regional Conventions/Treaties:

Kenya has acceded to major international treaties, accords, and conventions in many areas. The environmental agreements include some 16 global and regional accords

- UN Convention on Biological Diversity (UNCBD), 1992;
- UN Framework Convention on Climate Change (UNFCC), 1992 ;
- UN Convention to Combat Desertification (UNCCD), 1994;
- Protocol for Sustainable Development of the Lake Victoria Basin, 2004;
- Stockholm Convention on Persistent Organic Pollutants (POPS);
- Basel Convention on Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989;
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1987;
- Convention on International Trade in Endangered Species, 1973;
- Ramsar Convention, 1971.
- Convention on internationai Trade in Endangered Species, 1973
- Basel Convention on Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989

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KENYA FORESTRY RESEARCH INSTITUTE

1

1.0 INTRODUCTION

- Kenya's forest cover is about 5.9% of the land area. It comprises (FRA, 2010):
  - Closed indigenous forests - 1.14m ha
  - Woodlands – 2.05m ha
  - Bush lands – 24.51m ha
  - Public plantations – 0.125m ha
  - Private plantations – 0.09m ha
  - Forests on farms - 9.3m ha (agroforestry)
- The forests are important:
  - For conservation of biodiversity and the environment.
  - As a source of industrial and domestic wood and non-timber forest products.
  - Source of livelihood

2

KEFRI's Mandate

- KEFRI is a State Corporation, Science and Technology CAP 250.
- Mandate:
  - Conduct research in forestry and allied natural resources
  - Disseminate research findings
  - Co-operate with other research organizations within and outside Kenya carrying out similar research
  - Establish partnership with other organizations & institutions of higher learning in training and matters of forestry development

3

Vision and Mission

Vision

To be a centre of excellence in forest science through technology development, deployment and dissemination of scientific information

Mission

To conduct research and provide information and technologies for sustainable development of forests and allied natural resources

4

Strategic Objectives

- To generate knowledge and technologies for forest development, conservation, management and utilization
- To strengthen research and management capacity
- To improve seed production, distribution and marketing
- To disseminate forest research findings
- To improve corporate profile and public image of KEFRI, and
- To strengthen linkages and partnership with stakeholders

5

2.0 Core Programmes

- Research programmes
  - Farm Forestry
  - Natural Forests
  - Drylands Forestry
  - Industrial Forest Plantations
  - Tree Seed

6

Support Programmes/Unit

- ❖ Technology Dissemination and Service Programme
- ❖ Partnership and Networks Programme
- ❖ Corporate Affairs and Public Relations Unit

7

Farm Forestry

- ❖Carry out research to generate technologies for on-farm tree growing.
- ❖Research is undertaken on:
  - ➢ Development of fast growing tree species;
  - ➢ Developing trees for soil fertility improvement and fodder production;
  - ➢ Investigating efficient methods of wood conversion;
  - ➢ Generating information on production and marketing opportunities for farm tree products.
  - ➢ Economic and policy challenges impending farm forestry development

8

Natural Forests

- ❖Research activities include:
  - ➢Generating information and testing participatory forest management (Governance and Institutions)
  - ➢Investigating and demonstrating methods of rehabilitating degraded forests with indigenous species
  - ➢Development of timber and non-timber forest products including bamboo.

9

10

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Drylands Forestry

- Research focuses on:
  - ➢ Developing technologies for growing valuable indigenous tree species such as *Melia volkensii, Commiphora baluensis, and* Ebony;
  - ➢ Development of non-timber forest products such as Aloe, gums and resins and wild fruits for poverty alleviation;
  - ➢ Investigating integrated strategies for management and control of invasive *Prosopis* species.
  - ➢ Social Forestry Extension Training methods

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Plantation Forests

- Undertake research to develop technologies for management of forest plantations.
- The main activities are:
  - Development of indigenous plantation species;
  - Investigating alternative plantation establishment methods (natural regeneration)
  - Genetic improvement of the main plantation species (development of hybrids)
  - Monitoring of forest insect pests and diseases.

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Technology Dissemination and Service

- Coordinates the following activities:
  - Documentation and dissemination of research findings
  - Dissemination of research findings through production and distribution of extension materials and scientific papers, holding of annual open and field days, attending agricultural shows, KEFRI website, networking, etc
  - Short-term training courses for forest managers, extension staff and NGOs involved on forest activities nationally and regionally.
  - The Institute has training facilities at Muguga and Kitui Research Centres
  - Income generating activities

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Tree seed production

- Focuses on production of tree seed for plantation development in public and private land.
- Main activities are collection, processing and marketing of seed, and establishment and management of seed stands and orchards.
- Conducts national and international courses on tree seed production

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20

Partnership and Networks

- Builds and strengthens linkages with other organizations relevant to KEFRI.
- The Institute collaborates with many national and international institutions, forestry research institutions in eastern Africa and other organizations outside the region.
- KEFRI hosts five Regional Networks on Acacia gums (NGARA), research Institutes (AFREA), research (AFORNET), information sharing (FORNESSA) and participates in Bamboo Network (INBAR)

21

Corporate Affairs and Public Relations

Coordinates the following:

- Public awareness events,
- Consultancies
- Production of KEFRI publicity materials

22

Distribution of KEFRI's Regional Research Centres, Sub-Centres and Field Stations

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