Appendix 5-2 Training in Japan 2013

Appendix 5-2-1 Report on Training in Japan (DNA analysis)

1. Outline of training course

(1) Name of course "DNA analysis" (J13-21680)

(2) Period From June 9th 2013 To July 13th 2013

(3) Participants Mr. OMONDI Stephen Fredrick , Mr. MUNGAI John Gicheru

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, cloning, plasmid DNA extraction, sequencing reaction and etc.
- 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
June 10	Briefing	FFPRI
June 11	Briefing, preparation	FTBC
June 12~14	DNA extraction	FTBC
June 17~21	Genetic analysis by using SSR marker	FTBC
June 24~28	DNA analysis of chloroplast	FTBC
July 1~2	Final lecture and presentation	FTBC
July 3 ~5	Lecture of population genetics and ecology	Gihu Univ, Forest Academy in Gihu
July 9~11	Lecture and training of subtropical species breeding	FTBC-Iriomote

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. Mr OMONDI presented outlines of forest in Kenya and so on at Gifu University and FTBC. They exchanged their view of forest sector and the importance of mutual cooperation.

(2) Involvement

This course is designed as OJT like curriculum, thus trainees were involved very much.

(3) Facilities, training materials

FTBC provides necessary facility to the trainees. Lecturers use latest model of apparatus such as multi channel pipette. Lecturers prepared necessary materials for training course.

(4) Selection of trainee

Responsible counterparts are selected as trainees, and they are earnest, and have a good patience.

(5) Application of training result

This course dedicated for rapid skill up of DNA analysis because of sequencing machines was provided by Japanese Grant Aid in 2012.

(6) Environment of trainee

Trainees tried to communicate with FTBC staffs.

(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 5-2-2 Report on Training in Japan (Breeding theory)

1. Outline of training course

(1) Name of course "Tree Breeding Theory" (J13-21679)

(2) Period From June 9th 2013 To June 29th 2013

(3) Participant Dr. NDUFA James Kamri, Mrs. MUSYOKI Josephine Kamene

2. Results

(1) Achievement

- Trainees rechecked theory and technology of tree breeding, especially nursery management and procedures of progeny test stand .
- Trainee observed most of key techniques of project implementation.

(2) Main contents

Period	Contents	Organization
June 10	Briefing	FFPRI
June 11~13	Briefing, lecture of breeding theory, training of seed orchard management	FTBC
June 14~19	Visit of pilot forest station, elite tree, nursery, seed orchard and training facilities	FTBC-Tohoku, FTBC etc
June 20	Lecture of breeding theory, training of breeding	FTBC-Tohoku, FTBC
June 21	Presentation	FTBC
June 24	Briefing	Kyushu Univ
June 25~26	Training of breeding(tissue culture)	Kyushu Univ
June 27~28	Forestry facilities tour	Kyushu Univ

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.

(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, training materials

FTBC provided necessary facilities for trainees. Lecturers prepared and provided necessary training materials.

(4) 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.

(5) Application of training result

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

(6) Environment of trainee

Trainees tried to communicate with FTBC staffs.

(7) Other remarks

None.

Appendix 5-2-3 Report on Training in Japan (Propagation)

1. Outline of training course

(1) Name of course "Propagation Technology for Kenya tree breeding project" (J13-21678)

(2) Period From June 23rd 2013 To July 13th 2013

(3) Participant Mr. OTHUONI Samuel Auka, Mr. MUSAVA Ezekiel Kyalo

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
June 24	Briefing, Lecture of plant physiology	Kyushu Univ
June 25~26	Tissue culture training	Kyushu Univ
June 27~28	Forestry facilities tour	Kyushu Univ etc
July 2~8	Lecture and training of breeding, nursery management	FTBC-Tohoku
July 9~12	Field trip to private nursery and man-made forest management	FTBC-Tohoku

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, training materials

FTBC provided necessary facilities for trainees. Lecturers prepared and provided necessary training materials.

(4) 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.

(5) 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.

(6) Environment of trainee

Trainees tried to communicate with FTBC staffs.

(7) Other remarks

Non

Appendix 5-2-4 Report on Training in Japan (Drought tolerant)

1. Outline of training course

(1) Name of course "Drought tolerant for Kenya tree breeding project" (J13-21677)

(2) Period From June 23rd 2013 To July 20th 2013

(3) Participants Mr. KIGWA Bernard Kimani, Mr. MUCHIRI David Kimani

2. Results

(1) Achievement

- Trainees studied practical technology of drought tolerant, especially tree growth phenology.
- Trainees studied many relative issues of drought tolerant activities.

(2) Main contents

Period	Contents	Organization
June 24	Briefing, lecture of plant physiology	Kyushu Univ
June25~26	Tissue culture training	Kyushu Univ
June27~28	Forestry facilities tour	Kyushu Univ etc
July1~10	Measurement of photosynthetic capability	Kyushu Univ
July11~12	Forestry facilities tour	FTBC-Kyushu etc
July16~18	Measurement of photosynthetic capability	Kyushu Univ
July19	Presentation	

3. Evaluation

(1) Composition

Training curriculum consists of practical technology on drought tolerant and so on. Lectures and exercises are mixed and matched alternately in order to keep trainees interest.

(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, training materials

FTBC provided necessary facilities for trainees. Lecturers prepared and provided necessary training materials.

(4) Selection of trainee

Trainees are the in charge of drought tolerant section of KEFRI.

(5) Application of training result

This course dedicated for obtaining drought tolerant skill. Trainees had to maintain activities on drought tolerant of this project just after the training, and at the result, it shows reasonable progress.

(6) Environment of trainee

Trainees tried to communicate with FTBC staffs.

(7) Other remarks

None

Appendix5-1-5　研修員によるプレゼンテーション

研修期間中、研修員は、下記により研修成果などについてプレゼンテーションを実施した。

Appendix5-1-5-1　Training report of breeding theory course “BREEDING THEORY TRAINING PRESENTATION AT FTBC AND APPLICATION TO KENYA SITUATION”

BREEDING THEORY TRAINING PRESENTATION AT FTBC AND APPLICATION TO KENYA SITUATION

21ST JUNE 2013

James Ndufa & Josephine Musyoki

General course outline

- Breeding theory I– General issues of tree breeding
- Breeding Theory II– Progeny test
- Breeding Theory III– Data base
- Breeding Theory IV– Management of seed orchard
- Breeding theory V– Propagation and nursery management
- Field visits–Takahagi, Tendou, Yamagata,

Takahagi: Management of Progeny test trials

Planting Area: 1.00 ha
Spacing of plant: 1.7m x 1.7m (3460 trees / ha)
Planting method: Single tree plot, RBD (3blocks)
Year of Planting: April 1982
No. trees: 3502 in1982 →2325 in 2007

Takahagi: Plus tree no 6

Superior as compared to surrounding trees

Location: Shimo-Kimida, Takahagi, Ibaraki, Japan
Age : 101years old (since 1909)
Selected in : 1963
Ht = 36.1m
DBH = 63.1 cm
Scions/grafts are collected from the tree

Oou Propagation Work

- Major activity is to collect seed
- Pine germination
- nematode resistant pine selection

Scion garden for cider

Oou Propagation Green house

Scion/ Cutting propagation in glass house for seed orchard

Oou Preservation Garden

Yamagata Prefectural Forest and tree breeding garden–Branch

Seed drying machine

Miniature seed orchard

- For collection of scions and graft

Propagation of bamboo for shoot

Domestication from forest to farms

Destruction of Pine trees by snow

- Selection for snow resistant/nematodes
- Also for wind resistant

Yamagata Prefectural Forestry Research Training Centre

- Raising trees resistant to coastal strong winds
- Pest management
- Propagation and domestication of bamboo for edible shoots
- Expanding production of timber from Japanese Cedar in a cost-effective way

Yamagata Prefectural Forestry Research Training Centre

- Domestication of mushroom and development of new varieties.
- Breeding Japanese Cedar with less pollen
- Extension and dissemination
- Forestry mechanization

Takahagi- Nursery practices and propagation

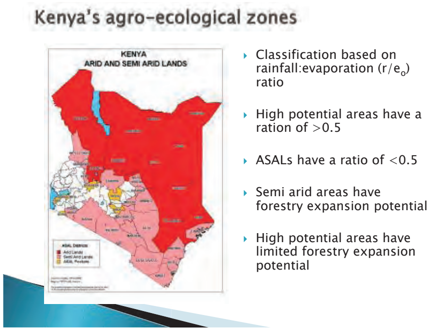
Grafting practical's in green house

Cuttings in the nursery


Pest Control -demonstration

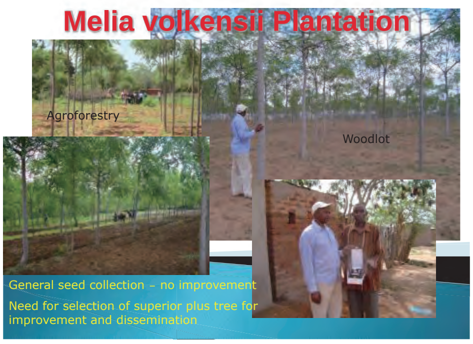

Pest Control


Important ASAL species-Kenya
Melia volkensii
Acacia tortilis


Kenya's agro-ecological zones
KENYA
ARID AND SEMI ARID LANDS
Classification based on rainfall:evaporation (r/e$_o$) ratio
High potential areas have a ration of >0.5
ASALs have a ratio of <0.5
Semi arid areas have forestry expansion potential
High potential areas have limited forestry expansion potential

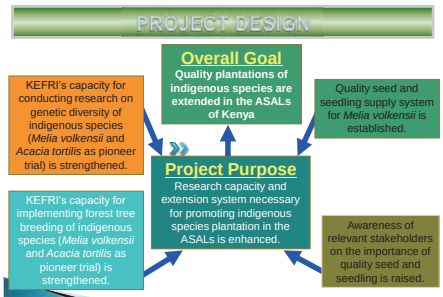

Vegetation tree cover/Land use
Bush lands
and plants diversity that provide goods and services to human and animals in dry areas
The interaction of people and dryland trees and plant remains a major concern – Over-exploitation

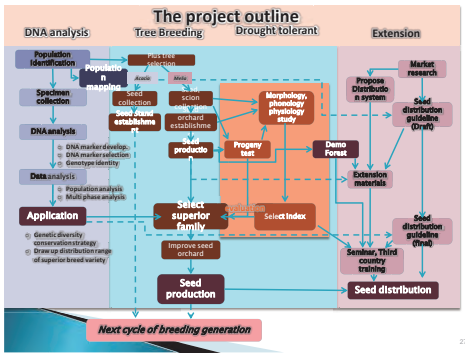

Threats to Drylands Ecosystems
Timber
Poor crop
Charcoal Burning
Environmental degradation
High poverty and malnutrition


Melia volkensii Plantation
Agroforestry
Woodlot
General seed collection – no improvement
Need for selection of superior plus tree for improvement and dissemination


Melia volkensii Products
High quality timber
Termite resistance timber

Acacia tortilis – Fodder

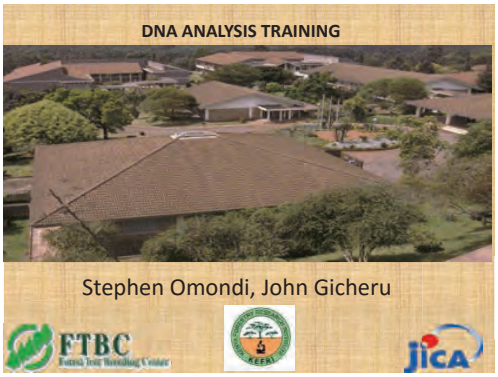


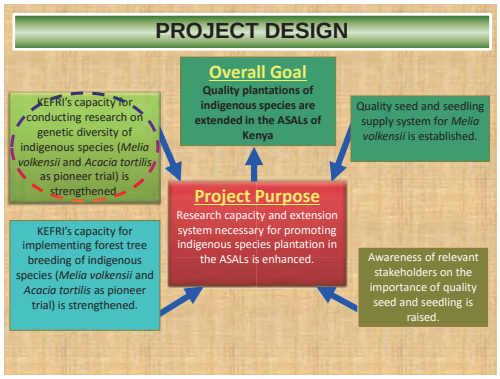


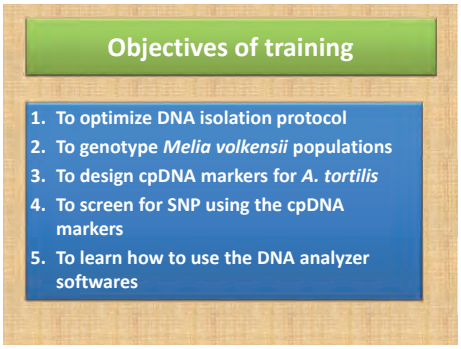
Conclusion

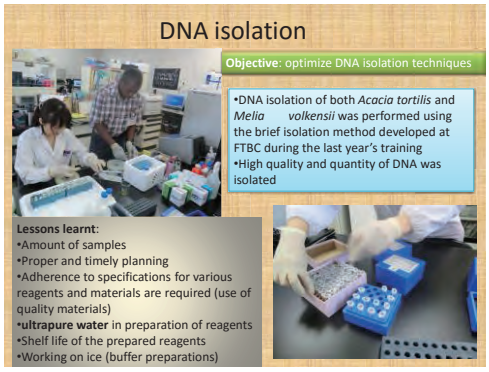
- Breeding theory training was very useful and timely for the implementation of the project
- We have learnt a lot
- We have seen alot
- We have made a lot of friends
- Grateful to FTBC and the resource persons for the work well done, And JICA for logistical support

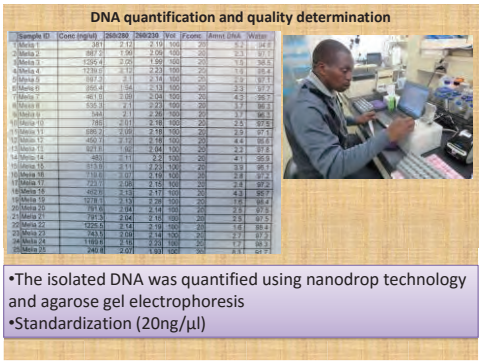
Appendix5-1-5-2 Training report of DNA analysis course “DNA ANALYSIS TRAINING”

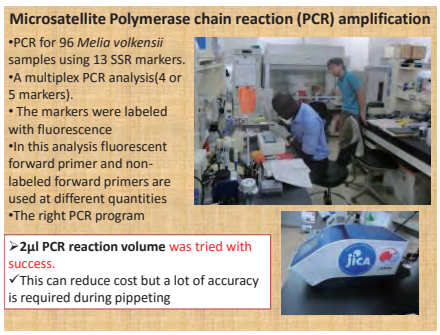


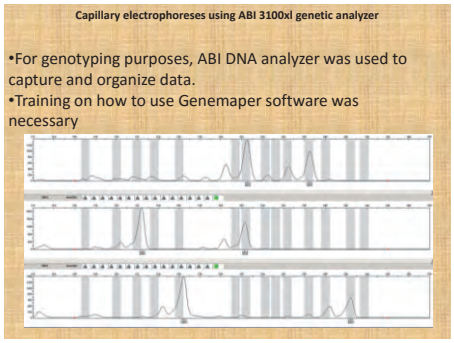












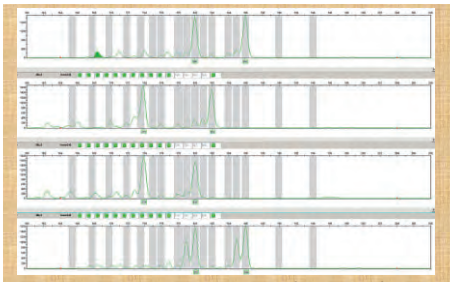


Figure showing SSR marker bcmv141 PCR amplification peaks for genotyping

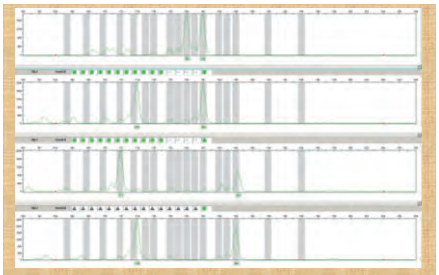


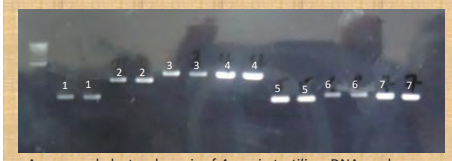
Figure showing SSR marker bcmv141 PCR amplification peaks

Example of genotyping data sheet of *Melia volkensii*

Sample File	Sample Name	Marker	Allele 1	Allele 2
AT1_A01.fsa	AT1	bcmv030	155	159
AT10_B02.fsa	AT10	bcmv030	153	157
AT11_C02.fsa	AT11	bcmv030	157	161
AT12_D02.fsa	AT12	bcmv030	157	157
AT13_E02.fsa	AT13	bcmv030	157	161
AT14_F02.fsa	AT14	bcmv030	155	161
AT15_G02.fsa	AT15	bcmv030	157	163
AT16_H02.fsa	AT16	bcmv030	155	161
AT17_A03.fsa	AT17	bcmv030	155	161
AT18_B03.fsa	AT18	bcmv030	157	157
AT19_C03.fsa	AT19	bcmv030	157	161
AT2_B01.fsa	AT2	bcmv030	155	161
AT20_D03.fsa	AT20	bcmv030	155	157
AT21_E03.fsa	AT21	bcmv030	159	161
AT22_F03.fsa	AT22	bcmv030	155	161
AT23_G03.fsa	AT23	bcmv030	161	161
AT24_H03.fsa	AT24	bcmv030	155	157
AT25_A04.fsa	AT25	bcmv030	150	161
AT26_B04.fsa	AT26	bcmv030	155	155

Designing cpDNA markers for *Acacia tortilis* using cpDNA sequences from genebank database

- *Acacia tortilis* cpDNA sequences were downloaded from online genetic database
- Aligned using sequencher software
- Eleven markers designed using Primer3 plus software
- PCR analysis using step-down program
- 10 markers showed sharp and clear amplification



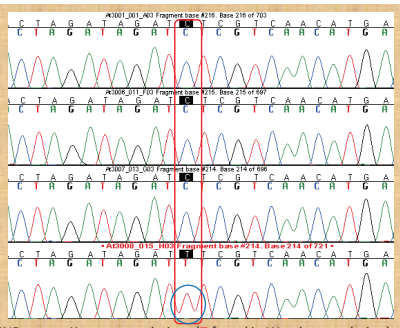
Agarose gel electrophoresis of *Acacia tortilis* cpDNA markers

SNP discovery in *Acacia tortilis* using cpDNA markers

- Ten markers (At001, At002, At003, At004, At005, At006, At007, At008, At010 and At011) were selected for direct sequencing.
- PCR amplification was performed using eight *A. tortilis* samples from eight populations (Machakos, Kibwezi, Voi, Ngurumani, Isiolo, Kitui, Bura and Wamba) in Kenya.

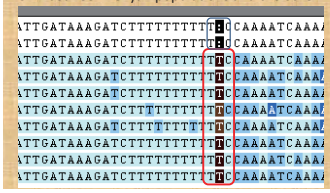
SNP among the Kenyan populations (T found in Kibwezi population)

Two SNPs were discovered among the Kenyan populations, one in Kibwezi and another in Wamba population



SNP among Kenyan populations (T found in Wamba population)

SNP between Kenyan populations and the other world populations



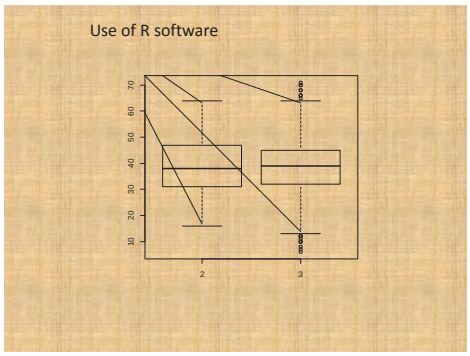
Insertion of T in the Kenyan population in comparison with other world populations

Way forward.

GENETIC STUDIES

- Genotyping of Melia plus trees
- Develop cpDNA and SNPs discovery for *Acacia tortilis*
- Perform SSR markers screening for *Acacia tortilis*
- Carry out genetic studies of *Acacia tortilis*

1. Sampling of the remaining populations of *Melia volkensii and Acacia tortilis*
2. Training on various molecular analysis softwares


Use of R software
70
60
50
40
30
20
10
2
3


Inoculation of pine nematodes


Arigato
gozaimashita

Appendix5-1-5-3-1 Information sharing between lecturers and trainees in the propagation technique course, “Establishmentt and Management of Melia volkensii seed orchard in Kitui and Kibwezi”

Establishment and Management of *Melia volkensii* seed orchard in Kitui and Kibwezi

By Samuel Auka
KEFRI KITUI -2013

Establishment activities

- Reconnaissance
- Site identification
- Demarcation
- Bush clearing
- Ripping
- Staking

Activities cont’

- Labelling
- Pitting
- Refilling(top soil and charcoal dust)
- Planting
- Fencing
- Watering (Kibwezi)
- Weeding

Staking

Pitting

Plot design

- Area planted – 11 ha approx.
- Rectangular – 360m x 300m
- Espacement – 6m x 6m
- Inner perimeter margin – 12m

Seedling distribution in Kitui

A total of 1800 seedlings were planted in Tiva site as follows:

No. of clones : 60
Seedlings per clone: 30
Total No. : 1800
Date of planting: Nov/Dec 2012

Seedling distribution in Kibwezi

- A total of 1300 seedlings were planted in Tiva
  Date of planting: January 2013

Kitui orchard

5 months after planting

3months after planting

Management activities

- **Weeding** - removal of weeds started almost immediately after planting. 3 weedings done so far.
- **Debudding** - early pruning(removal of buds) started approximately 2 months after planting. Done upto 1m above ground.
- **Stem support** – done to prevent bending or breakage of fast growing stem.

Kibwezi orchard

Water tank in kibwezi

Manual weeding

Stem support

Debudding

Current status

- A number of clones infected on both sites.
- Kitui site affected by Psyllids in early June but successfully controlled through pesticide application.
- Root stock infection in Kitui and Kibwezi observed. Removal and destruction of infected plants ongoing.

Current status cont'

- Stem support ongoing
- Manual weeding continues
- Monitoring of pests and diseases

Tallest tree almost 4m

Psyllid control

Arigato gozaimasu

Appendix5-1-5-3-2 Information sharing between lecturers and trainees in the propagation technique course, “Grafting of Melia volkensii for drought tolerant project”

Grafting of *Melia volkensii* For drought tolerant project

INTRODUCTION: REASONS FOR GRAFTING

- Perpetuate clones that cannot be readily maintained or economically propagated by other means.
- Combine different cultivars into a composite plant with each part contributing a special characteristic (Disease resistant, drought tolerant, high yielding etc.)
- Change cultivars of established plants.
- Diseases indexing to test latest viral diseases.
- Study plant development and physiological processes.

WHY MELIA VOLKENSII

Harvested Melia plus tree for timber Collected Melia fruits

Melia seeds

De-pulped nuts Melia Nut cracking Extracted seeds

WHY MELIA CONT.

•Altitudes between 150 m.and 1700 m. above the sea level
•mean rainfall of 300-800m
•over exploited from its natural habitat
•Rotational period of10 –15 years
•over exploited from its natural habitat
•. Feeling of the good formed Melia trees has adversely affected seed

FACTORS AFFECTING GRAFTING

•Plants.
•Moisture.
•Growth activity of the root stock.
•Graft manship
•Pest and diseases.
•Compatibility.
•Temperature.

First year of the project

The first rootstock for grafting was raised between March and June 2012 where 7000 seedlings were raised and 60 clones were used.
. The challenges below were evident during the seedling production

•Suitability of the seedbed collection (too much heat/too low temperature).
•Water logging due to use of enclosed polythene bags.
•Attack by red spider mites

Grafting

• Grafting started in august 2012 by both KEFRI staff and Japanese experts and ended in October 2012.
• total of 3275 Melia seedlings were successfully grafted
•A bout 1800 seedlings were planted in Tiva and 1300 seedlings were taken to Kibwezi

Infested melia seedlings by Red spider mites

Collapsing shade

To counter the above challenges;

•Roofing metals were made to shade the young seedlings from rain
• Alternative seedbed was sought,
High voltage bulbs were installed to improve temperatures

High voltage bulbs Good germination Metal roofs made

chemicals used for control of pests and diseases during raising of Melia rootstock for grafting:

Application stage	Disease control (Fungi)	Pest control (Red spider mites)	Nutrient enhancer
Pre-treatment stage	• Ridomil • Apron star • Sodium hydroxide (JIK)		DAP - Fertilizer
Pricking out stage			• Sharp shooter-stimulant for rooting and shooting)
Tenting stage	• Ridomil • Apron star	• Dynamec 018EC (Abamectin) • Vapcomic 1.8EC (Benxotiagebine) • Pyrinex 48EC • Agral 90	•Folia feed

Some of the grafts were transported to Kibwezi where they were planted and monitored.

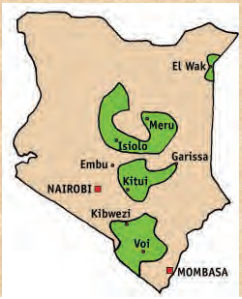
Grafted Melia seedlings at Kibwezi site

planted graft at Kibwezi plot

Second year

•The second Melia root stock production activity started in late February 2013 to May 2013 to raise a target of 7000 seedlings.
•Up to june 2013 10,000 seedlings were raised
•Target to graft 2000
•20 clones to be used this year

Distribution of *Melia Volkensii* in Kenya



Clean stem late pruning

4 Months old

8- years old

Furniture made from Melia

Timber Prices in Kitui

Melia.....15.24cmx2.54cmx30cm.....Ksh. 65.00...Local
Pinus patula..15.24cmx2.54cmx30cm Ksh. 35.00.Tanzania
Grevillea.....15.24cmx2.54cmx30cm …Ksh. 28.00...Meru

THANK YOU

Appendix 5-3 Training in Japan 2014

Appendix 5-3-1 Report on Training in Japan (Project Management)

1. Outline of training course

(1)Name of course ”Project management”（J14-21600）

(2)Period From June 1st to June 14th 2014

(3)Participant Dr.ADHAYA Ebby Chagala Mmbone

2. Results

(1)Achievement

-Dr.Adhaya improved understanding of advanced forest tree breeding business.

-She understood how to expand forest tree breeding business for wood utilization.

(2)Main contents

Period	Contents	Organization
June 2	Briefing Courtesy call to FFPRI, FTBC	JICA Tsukuba FFPRI FTBC
June 3	Lecture of breeding, Facility tour Visit of elite tree	FTBC, Iwaki
June 4~6	Visit of private nursery, progeny test forest, wood processing industry	Naka,Shirosato,Yaita, Ohtawara,Nikkou
June 9~13	Courtesy call to JICA and Forest Agency Visit of Kyoto-Osaka District Forest Office, afforestation, nursery, wood processing plant	JICA, Forest Agency, Kyoto-Osaka District Forest Office, FTBC-Kansai, wood processing plant (Hiroshima)

3. Evaluation

(1) Composition

Lectures were composed with broad perspective training for the deputy director of KEFRI.

(2)Involvement

We shared some perceptions about forest tree breeding project in a wide sphere at FTBC, FFPRI and Forestry agency.

(3)Training period・contents

Training period and contents were suitable.

(4)Facilities, training materials

FTBC provided necessary information and knowledge timely.

4. Selection of trainee

(1)Requirement

Trainees who are directly and indirectly involved to the project as acting of project director and director of KEFRI extension department.

(2) Attitude of trainees

She attended the training course with eager interest.

5. Application of training result

(1)Training result

As the project is becoming important last half, she will contribute directly and indirectly to the project as the director of KEFRI extension department.

(2)Application

The outcome of this training is directly affected to the progress of the project.

Finishing training and construction of seed orchard at this timing are essential conditions to achieve results in five years.

6. Environment of trainee

She seemed to enjoy life in Japan.

7. Other remarks

None

Appendix5-3-2 Report on Training in Japan (DNA analysis)

1. Outline of training course

(1)Name of course "DNA analysis" (J14-21601)

(2)Period From May 18th to June 14th 2014

(3)Participants Mr. OMONDI Stephen Fredrick, Mr. MUNGAI John Gicheru

2. Results

(1)Achievement

-Trainees obtained necessary skills of DNA analysis using microsatellite markers. (determination of genetic type using SSR marker)

-Trainees obtained skills of data analysis.

-Trainees studied about population genetics and conservation ecology.

(2)Main contents

Period	Contents	Organization
May 19	Briefing	JICA-Tsukuba FTBC
May 20~23	Training of DNA analysis	FTBC
May 26~30	Training of Data analysis	FTBC
June 2	Courtesy call to FFPRI, FTBC	FFPRI FTBC
June 3~6	Lecture and training of subtropical species breeding	FTBC-Iriomote
June 8~9	Facilities tour Lecture of DNA analysis	Nagoya Univ
June 10	Visit of wood processing plant	Gihu (Kuniroku)
June 11	Visit of NIAS Gene bank	NIAS(Gene bank)
June 12~13	Final presentation and evaluation	FTBC

3. Evaluation

(1) Composition

Lectures at FTBC were composed with data analysis procedure and rechecking of experimental procedure they had learned so far. Trainees obtained skills of data analysis, genotyping software, basic knowledge of statistics analysis, and analysis training using some soft wares. In addition, they studied genetic resources and evaluation.

At FTBC-Iriomote, trainees obtained skills of clonal propagation and hybridization of *Acacia mangium* which belong to project target. They also studied about breeding of *Calophyllum inophyllum*, raising seedling and afforestation of useful tree species in Yaeyama district. Dr.Tomaru, professor of agricultural research division at Nagoya Univ gave courteous lecture about genetic conservation such as how to take advantage of analysis method using DNA marker. Mr. Kunii, director of Kuniroku CO., LTD kindly allowed

them to visit precut factory tour. He also gave them a lecture about Japanese forest industry and timber supply system. Visiting Gene bank at NIAS (National Institute of Agrobiological Sciences) made them consider the importance of mass conservation and application of genetic resources.

(2)Training period・contents

Trainees obtained experimental skills by the training up to last year. Then this year, they obtained skills of data analysis and necessary basic skills.

(3)Facilities, training materials

FTBC provided necessary facilities for trainees. Lectures prepared and provided necessary training materials.

4. Selection of trainee

(1)Requirement

Responsible counterparts are selected as trainees.

(2) Attitude of trainees

Trainees attended the training course with eager interest and understood how to take advantage of skills for the project.

5. Application of training result

(1) Training result

Trainees needed to learn necessary information and skills because they are immediately supposed to start the work for the project after returning to Kenya.

In addition, they studied Japanese advanced efforts for the future protection of genetic resources with the problem of biodiversity which is supposed to be necessary in future Kenya.

(2)Application

The outcome of this training is directly affected to the progress of the project. KEFRI is research institutes that stand in the leadership position in East Africa of molecular biology research, so spreading effects of various techniques to the East African countries are expected.

6. Environment of trainee

Trainees studied Japanese well and tried to communicate with FTBC staff. They studied hard though the training program was quite tight.

7. Other remarks

None

Appendix 5-3-3 Report on Training in Japan (Breeding Theory)

1. Outline of training course

(1)Name of course "Breeding Theory" (J14-21602)

(2)Period From May 18th to June 14th 2014

(3)Participant Ms.MUNYAO Damaris Mwende,Mr.MATIEKA Pius Ondieki

2. Results

(1)Achievement

-Trainees rechecked basic theory of tree breeding.

-Trainees checked management technique for seed orchards. They confirmed the remaining 20 plus trees selection procedure out of the 100 plus trees. They also made sure the scheduled progeny test forest with short-term expert.

-Trainees visited some facilities and plants to learn about future extension of tree breeding.

(2)Main contents

Period	Contents	Organization
May 19	Briefing	JICA-Tsukuba FTBC
May 20~26	Lecture of breeding theory Training of pedigree breeding	FTBC
May 27~29	Field exercise of progeny test forest Visit of test forest	FTBC Yaita
May 30	Presentation and evaluation	FTBC
June 2	Courtesy call to FFPRI, FTBC	FFPRI FTBC
June 3~6	Lecture and training of subtropical species breeding	FTBC-Iriomote
June 8~9	Facilities tour Lecture of DNA analysis	Nagoya Univ
June 10	Visit of wood processing plant	Gihu (Kuniroku)
June 11	Visit of NIAS Genebank	NIAS(Genebank)
June 12	Final lecture	FTBC
June 13	Visit of afforestation area, forestry facilities	Forest training support center

3. Evaluation

(1) Composition

Trainees rechecked the curriculum which consists from general guidance of tree breeding. Lectures at FTBC were based on the real schedule what they need to do with new test forest in future. In addition, lectures were composed with pedigree management and training using data of test forest in FTBC. They also got training of progeny test by measuring wood quality at test forest.

At FTBC-Iriomote, trainees obtained skills of clonal propagation and hybridization of *Acacia mangium* which belong to project target. They also studied about breeding of *Calophyllum inophyllum*, raising seedling and afforestation of useful tree species in Yaeyama district. Dr.Tomaru, professor of agricultural research division at Nagoya Univ gave courteous lecture about genetic conservation such as how to take advantage of analysis method using DNA marker. Mr. Kunii, director of Kuniroku CO., LTD kindly allowed them to visit precut factory tour. He also gave them a lecture about Japanese forest industry and timber supply system. Visiting Gene bank at NIAS (National Institute of Agrobiological Sciences) made them consider the importance of mass conservation and application of genetic resources.

(2)Involvement

Trainees tried to solve the problems on the project management, so that it makes easier to manage actual seed orchard and test forest. They also resolved many problems and specific issues in accordance with the progress through the presentation.

(3)Training period・contents

Training period and contents were suitable.

(4)Facilities, training materials

FTBC provided necessary facilities for trainees. Lectures prepared and provided necessary training materials.

4. Selection of trainee

(1)Requirement

Responsible counterparts are selected as trainees.

(2) Attitude of trainees

Trainees attended the training course with eager interest and understood the step-up for the coming fiscal year.

5. Application of training result

(1)Training result

Trainees needed to learn necessary information and skills because they are immediately supposed to start the work for the project after returning to Kenya.

Contribution to promote the project by management of seed orchard and seedling for progeny test forest in the future can be expected.

(2)Application

The outcome of this training is directly affected to the progress of the project.

6. Environment of trainee

They seemed to enjoy life in Japan. However, they had difficulties in finding good meals with cost performance by price condition.

7. Other remarks

One of the trainees came down with fever, but she recovered by receiving outpatient visits and accomplished the training.

Appendix 5-3-4 Report on Training in Japan (Extension)

1. Outline of training course

(1)Name of course "Extension"（J14-21603）

(2)Period From June 1st to June 28th 2014

(3)Participant Mr.MAKEE Albert Luvanda、Mr.WEKESA Linus Chesoli

2. Results

(1)Achievement

-Trainees obtained wide knowledge of forestry through facility tours.

-Trainees obtained necessary skills of hybridization and clonal propagation for drought tolerance tree breeding.

(2)Main contents

Period	Contents	Organization
June 2	Briefing Courtesy call to FFPRI, FTBC	JICATsukuba FFPRI FTBC
June 3~6	Lecture and training of subtropical species breeding	FTBC-Iriomote
June 8~9	Facilities tour Lecture of DNA analysis	Nagoya Univ
June 10	Visit of wood processing plant	Gihu (Kuniroku)
June 11	Visit of NIAS Genebank	NIAS(Genebank)
June 12	Final lecture	FTBC
June 13	Visit of afforestation area, forestry facilities	Forest training support center
June 16~17	Lecture of breeding theory	FTBC
June 18~20	Lecture of using wood Visit of saw mill, wooden houses	FFPRI Kamisu,Tsukuba
June 23~24	Lecture of promotive extension Lecture and sight survey of dissemination model	Forest Training Institute, Japan Wood Products information & Research Center
June 25	Visit of saw mill	Ibaraki Prefecture wood federation of cooperatives
June 26	Visit of saw mill	Hanawa(Kyowa)
June 27	Final presentation and evaluation	FTBC

3. Evaluation

(1) Composition

In order to master breeding skills for drought tolerance, FTBC gave them complement training and lecture. Training curriculum consist of visits from the top to bottom for further contribution of project. They visited Forest training support center and Ibaraki prefecture wood federation of cooperatives. They studied about forest management system and

promotion of regional material use there. They also learned about timber processing system and timber yield at sawmills in Kamisu and Hanawa. Visiting construction sale of wooden houses and furniture store in Tsukuba and Tokyo gave them opportunity to understand marketing procurement and extension of forestry.

Lectures about timber processing, weather resistance and market research were given by wood utilization department of FFPRI. In addition, lectures at Forest Training Institute and Japan Wood Products information & Research Center consist of wood statistics and information.

At FTBC-Iriomote, trainees obtained skills of clonal propagation and hybridization of *Acacia mangium* which belong to project target. They also studied about breeding of *Calophyllum inophyllum*, raising seedling and afforestation of useful tree species in Yaeyama district. Dr.Tomaru, professor of agricultural research division at Nagoya Univ gave courteous lecture about genetic conservation such as how to take advantage of analysis method using DNA marker. Mr. Kunii, director of Kuniroku CO., LTD kindly allowed them to visit precut factory tour. He also gave them a lecture about Japanese forest industry and timber supply system. Visiting Gene bank at NIAS (National Institute of Agrobiological Sciences) made them consider the importance of mass conservation and application of genetic resources.

(2)Involvement

Trainees obtained necessary skills of drought tolerance tree breeding by practical training. In addition, they made presentation and evaluation on the last day of the training.

(3)Training period・contents

Training period and contents were suitable.

(4)Facilities, training materials

FTBC provided necessary facilities for trainees. Lectures prepared and provided necessary training materials.

4. Selection of trainee

(1)Requirement

Responsible counterparts are selected as trainees.

(2) Attitude of trainees

Trainees attended the training course with eager interest.

5. Application of training result

(1)Training result

Trainees needed to learn necessary information and skills because they are immediately supposed to start the work for the project after returning to Kenya.

In the future they will do the market research, making training materials for farmers in Kenya and implementation of the third-country training

(2)Application

The outcome of this training is directly affected to the progress of the project.

6. Environment of trainee

They seemed to enjoy life in Japan.

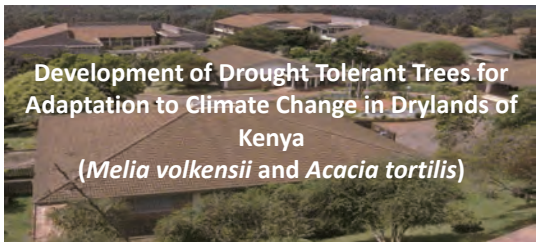
7. Other remarks

None

Appendix5-2-5　研修生によるプレゼンテーション

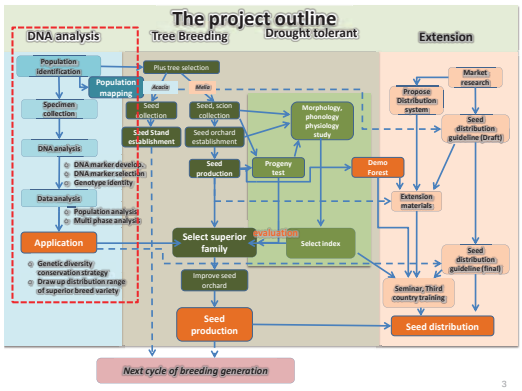
研修期間中、研修員は、下記により研修成果などについてプレゼンテーションを実施した。

Appendix5-2-5-1　Training report of DNA analysis course “Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya”

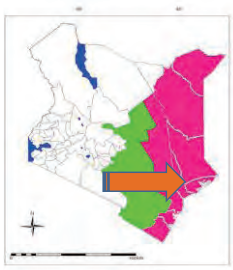


Stephen Omondi, John Gicheru

FTBC Forest Tree Breeding Center　KEFRI　JICA



Broad Objective



Melia volkensii
Improve on drought tolerance

Acacia tortilis
Understand the genetic diversity and population structure

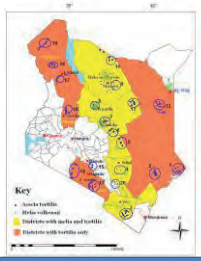
Enable selection of plus trees for improvement of livestock fodder and enhanced drought tolerance

PROJECT DESIGN MATRIX

Accomplished activities

Populations sampled

	Melia volkensii	*Acacia tortilis*
1	Taveta	Voi
2	Voi (a and b)	Kibwezi
3	Mwatate	Kitui
4	Kibwezi	Mwingi
5	Kitui	Bura
6	Mutha	Isiolo
7	Mwingi	Wamba
8	Galana	Marsabit
9	Isiolo	Kajiado
10	Wamba	Machakos
11	Marsabit	Nguruman
12	Meru	Kerio-Valley
13	Embu	Meru
14		Lokorio
15		Kakuma
16		Lokichogio



- DNA isolation (Old seed orchard, New seed orchards)
- Acacia tortilis DNA isolation
- Primer screening (Acacia tortilis- 10 markers)
- Melia seed orchard genotyping

2014 Training

Objectives of the training

1. PCR analysis of Melia samples (14 populations)
2. To genotype *Melia volkensii* populations
3. Molecular data analysis
4. Use of pigtail markers

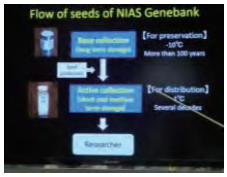
Management of genetic resources

Seed and pollen collection and storage

Storage at the right temperature moisture

Propagation through cuttings

Field collection and establishment of seed orchards

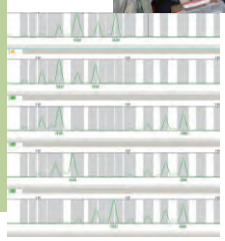


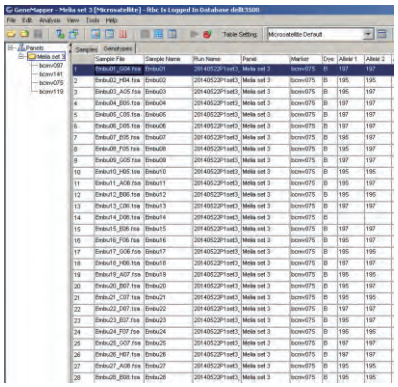
Storage facilities and automation system at NIAS GeneBank

Genotyping of Melia samples

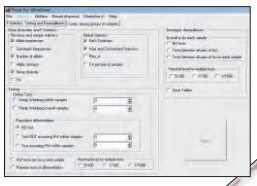
Melia PCR analysis

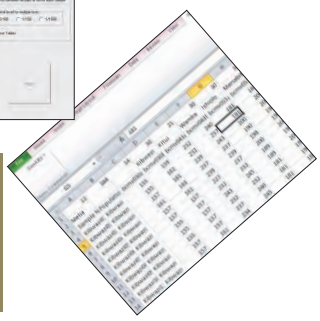
using 12 microsatellite markers





Genotype data ready for export and analysis



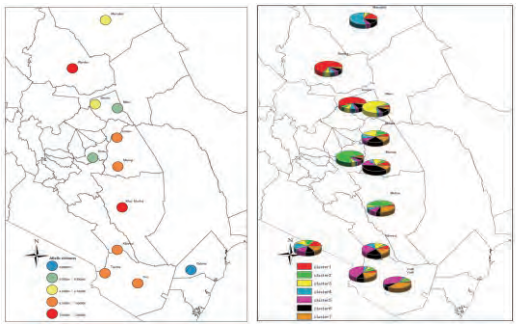


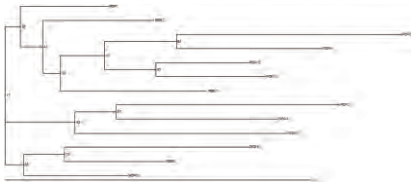
Data organization for various analysis

1. GenAlEx 6.5.01
2. Structure 2.3.4
3. Fstat 2.9.3.2

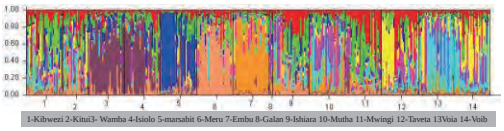
Preliminary results (Melia population genetics)

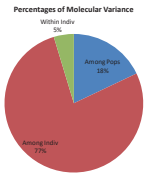
Population	N	Na	Ne	Nr	Np	Ho	He
Kibwezi	30	7.6	4.1	6.8	4.0	0.749	0.729
Kitui	21	7.0	4.2	6.9	3.0	0.706	0.734
Wamba	30	**8.0**	**4.5**	7.2	**6.0**	0.708	0.727
Ishiolo	30	7.7	3.8	6.7	4.0	0.721	0.706
Marsabit	30	7.1	3.9	6.6	2.0	0.642	0.693
Meru	30	6.7	4.1	6.3	2.0	0.767	0.726
Embu	30	6.5	4.0	6.2	3.0	0.696	0.716
Galana	3	1.8	1.6	0.0	0.0	0.486	0.322
Ishiala	30	7.7	4.0	6.8	2.0	0.697	0.723
Kitui Mutha	30	7.8	4.4	7.1	3.0	0.759	0.745
Mwingi	30	7.8	4.3	7.0	4.0	0.707	**0.738**
Taveta	30	7.7	4.1	6.9	1.0	0.735	0.719
Voi (a)	29	**8.0**	4.0	**7.3**	4.0	0.698	0.717
Voi (b)	30	7.6	4.0	6.8	3.0	0.648	0.699

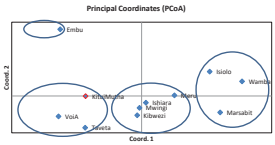


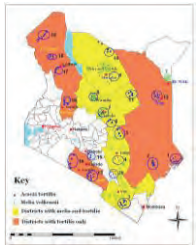


Cluster analysis

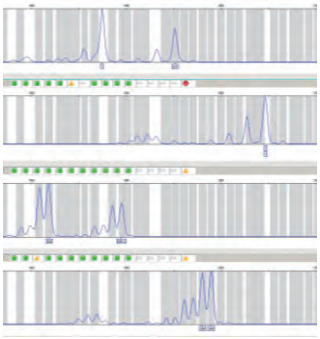








Pigtail primer (reduce stuttering-noise)



Wood processing FFPRI

Wood engineering

Wood preservation

KUNIROKU HOME COMPANY

Kuniroku precutting center

Iriomote Tropical Tree Breeding Technical Garden

Hybridization of *Acacia mangium and auriculiformis*

Calophyllum inophyllum

Grafting experiments using different techniques

C. inophyllum natural populations

Mangroves along Nakama river

Nagoya University

Pollen dispersal patterns in *Fagus crenata*
- Pollen migration in wind pollinated species
- Wind pollination promote outcrossing

Activities for the year

- Genotyping of Melia plus trees (80)- Kitui seed orchard
- *Acacia tortilis* primer screening and production of primer note
- Leaf sampling of the remaining *Acacia tortilis* populations
- DNA isolation
- DNA analysis
- Training on the use of GeneMapper software

Arigato gozaimashita

Appendix5-2-5-2 Training report of breeding theory course “TREE BREEDING THEORY”

PROJECT ON: DEVELOPMENT OF DROUGHT TOLERANT TREES ON ADAPTATION TO CLIMATE CHANGE IN THE DRY LANDS OF KENYA

COURSE TITLE: TREE BREEDING THEORY
PRESENTED ON: 2014/05/30

By: Damaris Munyao And Pius Matieka

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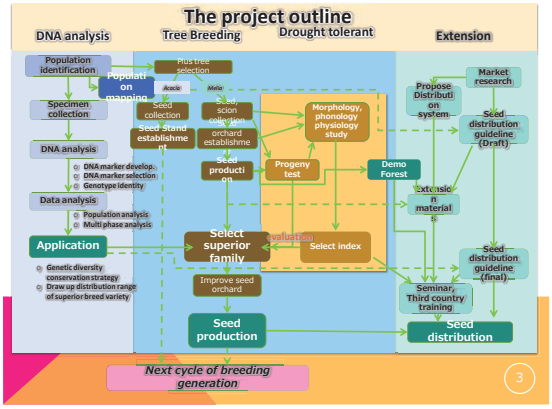


Seed Orchards at Kitui and Kibwezi (15 Months old

Kitui seed Orchard

Kibwezi seed Orchard

Tower site at Kitui orchard

Cont: Implementation

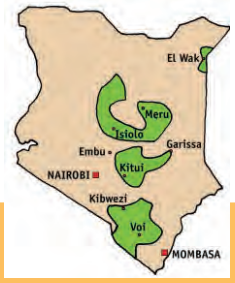
- The project is jointly implemented by the government of Japan and Kenya
- The project was initiated in July 2012 and is expected to continue for a period of 5 years.
- The project overall goal is to be realized through the following components
  - Tree breeding system
  - DNA analysis
  - Establish Progeny test sites
  - Extension

Why Grow Melia

- Altitudes between 150 M - 1700 M above the sea level
- Mean annual rainfall of 300-800mm
- Rotational period of 10 –15 years
- High value timber
- Termite resistant

Chapter 1 : Introduction

Distribution of Melia in Kenya



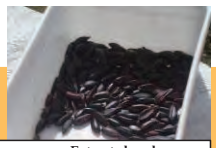
7

Melia Propagation Process

Melia fruits

De-pulped nuts

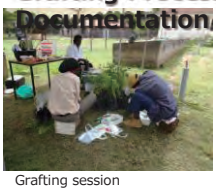
Melia Nut cracking



Extracted seeds

8

Grafting Process and Documentation



Grafting session nursery

Grafted seedlings in the

Removing of suckers

Tagged seedlings for

9

Challenges in raising seedlings

- Moisture.
- Growth of the root stock.
- Pest and diseases.
- Temperature.
- Heavy rains affecting the shades

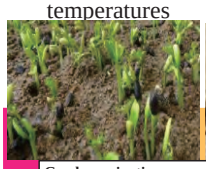
Infested Melia seedlings by Red spider mites

Collapsing shade due to heavy rains

10

Control Measures

- Alternative seedbed was sought to improve germination
- Roofing metal frames were made to shade the young seedlings from heavy rain
- High voltage bulbs were installed to improve temperatures



Good germination

Metal roofs

High voltage bulbs

11

Challenges in the Field

Melia affected by gummosis

Damage caused by winds

Topsin paste application after damage.

12

Achievements up to 2014

- 80 candidate Melia plus trees have been selected.
- 2 seed orchards established both in Kitui and Kibwezi and a total of 5000 seedlings planted
- Progeny test sites already selected
- Seed collection for progeny sites completed

13

On going Activities

- Selection of remaining 20 candidate Melia plus trees
- Completion of planting of the 2 orchards to be finalized
- Establishment of progeny test sites

14

Cont: Assignments in the Project - Kitui Orchard:

Documentation	Keeping records of the selected plus tree
	Keeping and recording the number of grafted seedlings
	Tagging the grafted seedling for planting
	Harmonizing records of the planted seedlings in the field

15

Chapter 2: Assignments In The Project - Kibwezi Orchard:

Activities	Height measurement 
	Diameter measurement At 50 cm from the grou 
	Survival rate monitoring
	Supervision during planting in the field

16

Chapter 3: Course Training Contents

- General briefing on tree breeding was done
- Challenges facing tree breeding in Japan
- The Gene Bank establishment
- Use of Excel for Database Management
- Use of PowerPoint for presentation
- **Database establishment/Management**
- **Testing wood density by use of Pilodyn**

17

Database and Management of Clone /Family

- **Its very important to establish a database.**
- **Original data is the master data**
- **In the case of FTBC the data is categorized as follows**

➢ **Progeny test site data**
➢ **Plus trees Data**
➢ **Genetic resource Data**
➢ **Nursery Data**

19

Cont: Challenges In Data Management

- Mix up of Data
- Loss of data

Measures Taken

- Doing DNA analysis to correct any mistakes done during data collection

21

Cont" Use Of Excel

- **Learned how to copy documents send in PDF format to excel and edit it, then save it in PDF format.**
- **You can do the following to your Data**

➢ **Filtering**
➢ **Sorting**
➢ **Get average**
➢ **Getting Maximum height**
➢ **Getting minimum Height**
➢ **Correlation**

22

Raising of seedlings through cuttings

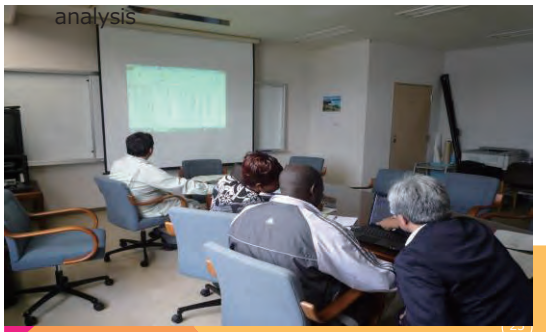
- KEFRI tried raising Melia seedlings through cuttings, using forest soil but was not successful
- As a result more trials have been done at FTBC to determine the correct medium for use
- Its recommended that use of medium sized particles of soil is the best

23

24

Practicals

Collected data in the established site and did analysis



25

Cont: PowerPoint Presentation

Learned use of PowerPoint for

26

Wood Density Testing By Use Of Pilodyn

- **Visited a progeny test site in Nishi – Nasuno and did wood density measuring**
- **Wood density is measured at 1.2 M (breast height)**
- **During measurements one is not supposed to move the equipment until the readings is taken.**

27

Measuring wood density in the progeny site

28

Chapter 4: Conclusion

The skills learned will be useful in our work by:

- **Establishing a Database**
- **Seed orchard Management**
- **Use of excel for Data analysis**
- **Establish Data storage system and updates**
- **Measuring wood density using pilodyn**

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THANK YOU FOR YOUR KINDNESS

Arigatou gozaimashita

30

Project on: Development of drought tolerant trees on adaptation to climate change in the dry lands of Kenya

Course Title: EXTENSION

Presented by:
Albert Luvanda and Linus Wekesa

Takahagi FTBC on 2014/06/27

Contents

1.0 Introduction

Drylands Areas in Kenya

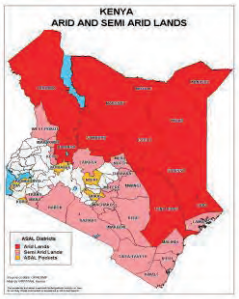
- Kenya diverse in ecological set-up with **dryland accounting for 84**% of its total land area
- Drylands characterized with **low and erratic rainfall** with extreme temperatures
- Crop and plant productivity have high occurrence levels of extreme failure **limiting livelihood options**
- **High poverty levels** with majority having annual per capita income level of Ksh. 13,964 that is below absolute poverty line of Ksh. 14,868
- There is **extreme pressure** on to sustain peoples livelihoods NR

Maize crop wilting due to rain failure

Charcoal burning to eke a living

Poverty Levels in the Counties

- Mandera (85.7%)
- Wajir (84.4%)
- Garissa (54.5%)
- Isiolo (63.1%)
- Marsabit (79.3%)
- Kitui (62.5%)
- Machakos (57%)
- Makueni (63.8%)
- Tana River (75.4%)
- Samburu (77.7)
- Tharaka Nthi (36.9%)



Challenges in ASAL

Key challenge and maybe a source of solution is:

How can we sustainably utilize ASALs natural resources to improve rural livelihoods and minimize the negative impact on environment

Contribution of KEFRI and Partners in Generating Solutions

- Research and development initiatives
  - Carrying out action research
  - Generation of innovations
  - Developing appropriate technologies
  - Formulation of developmental projects
  - Mobilizations and capacity building
  - Implementation of developmental initiatives

Key Drylands Natural Resources

- Rangelands with valuable tree species – Melia, Acacia etc
- Valuable minerals – coal, limestone, rubies, construction stones,
- Wildlife and rare species

2.0 Extension in Kenya

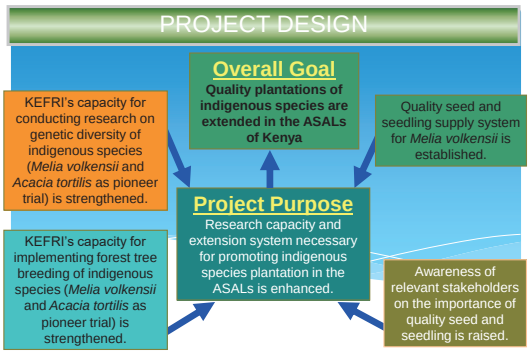
9

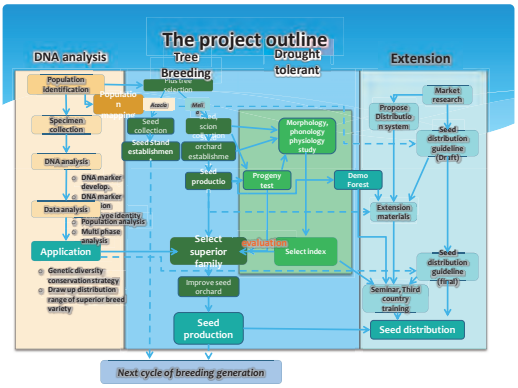
FARMER-FARMER EXTENSION STRATEGY

- FFE is a social forestry extension strategy initiated by SOFEM project promoted in the drylands for
- Others include **Farmer Field Schools** by Intensified Social Forestry Project (ISFP) and **Forestry Enterprise Development and Promotion**
- Termination of forest extension projects
- The National extension staff: farmer ratio stands at 1:1,500
- Offers farmers, technical knowledge/ training lacking in indigenous knowled

Farm forest extension activities

- Identification of core farmers
- Profile survey
- Designing farm forests
- Training core farmers
- Monitoring established farm forests
- Develop FFE guideline for Ext. agents
- Facilitation /training extension agents
- Develop training materials
- Seed and seedling information
- Facilitate cost sharing system





Project Implementation

- Project is jointly implemented by the governments of Japan and Kenya
- Project initiated in July 2012 and is expected to continue for a period of 5 years.
- Project overall goal is realized through the following components:
  - Tree breeding system
  - DNA analysis
  - Establish Progeny test sites
  - Extension

Chapter 3: Responsibilities in line with project work

15

What are our assignments in the Project?

- Luvanda_san
- Wekesa_San

Roles: April 2014 ~ March 2015

- Conduct market research: To review, analyze and document the current status of seed and seedling production and distribution of *Melia*, as well as utilization of timber
- Analyze data and write technical reports
- Develop, produce and distribute guideline on high quality Melia seeds and seedlings
- Establish on-farm Melia demonstration plots
- Prepare and distribute training materials

Roles: April 2015 ~ March 2017

- Technical advice to farmers and other stakeholders
- Seminar for stakeholders and NGOs
- Information for training, including cost-sharing
- Distribution of brochures
- Pilot distribution of quality seeds and seedlings
- Monitoring and evaluation of pilot activities
- Revise and finalize seed distribution guideline

Chapter4: Brief findings of the market survey *Melia volkensii* enterprises

19

Key information about Melia volkensii (Mukau)

A ten year old Melia tree on-farm

Discs from eight year old Melia

Melia timber split by power-saw

Distribution of Melia volkensii in Ken

Melia growing

- Altitudes between 150 M - 1700 M above the sea level
- Mean annual rainfall of 300-800mm
- Rotational period of 10 –15 years
- High value timber
- Termite resistant

Key Market Survey Observations

- Four main enterprises were identified:
  - seeds,
  - seedlings,
  - round-wood and
  - timber
- Market Players identified:
  - Producers
  - processors
  - traders
- Melia timber processing mostly by power/chain saw and to a small extent pit saws
- Melia enterprises have a great potential to improve the livelihoods of communities

Processing by pit saw

Melia Products/Enterprises

Melia fruits

De-pulped Melia nuts

Melia Seeds

Melia seedlings

Melia timber in the market

24

Melia furniture

25

What are the key identified enterprises?

Enterprise	Cost-Benefit ratio
Seed	4.24
Seedlings	1.87
Round-wood	1.12
Timber	1.90

Melia Challenges to be tackled by Extension

- Low and unpredictable market supply of Melia products
- Pest and diseases
- Lack of skills in propagation
- Low levels of value adding

Chapter 5: Lessons learned from this training course

- Basic information about Japan
- Flow of forestry activities from Upstream to down stream
- Reference organizations

Basic information about Japan

1. Forestry industry in Japan: Our understanding

- National forestry cover is 67%
- Plantation forests are dominated with Cedar and cypress and form 40%
- 70% of lumber is imported
- The policy is to have 50% self reliance in lumber
- Forest ownership:
  - Private (77.1%)
  - Public (19.3%)
  - Others (13.6%)

2. Key Players and Roles: Our understanding

- Government
  - National Government
    - Ministry of Agriculture, Forestry and Fisheries
      - Forestry Agency – Policy and guidance
      - Forestry and Forest Products Research institute
        - Forest Tree Breeding Centre - Research
  - Prefecture Government
    - Forest Services – Forest management and conservation
    - Municipalities – Facilitation and coordination
- Cooperatives – Forest management and conservation
- Private companies – Value adding and marketing
- Individual farmers – Forest management and conservation

Flow of forestry activities from Upstream to down stream

1. Visit to Afforestation Area Operated by Forest Agency

(1) What we witnessed
- Different forest establishment patterns demonstrated including:
  - Mosaic
  - Multi-storey

(2) What we learnt for our job
- Forest management systems (mosaic giving better results)

Mt. Tsukuba Forestry

2. Wood products Manufacturers Association

Ibaraki Prefecture Wood Federation of Cooperative

(1) What witnessed

- Owned by 600 members and implements government policy on use of local wood
- Provide an avenue for marketing of logs from members, national government and private company at a fee.
- Conducts wood/logs auction twice per month for saw millers

(2) What we learnt for our job

- Improved marketing of logs through cooperatives
- Better prices through auction

3. Ibaraki Wood Products Cooperative

Training on log harvesting

(1) What we learnt

- The training Center is owned by members drawn from Ibaraki Pre-fecture
- Conduct training and certifies power-saw operators
- Trainees are drawn from wood companies and individuals

(2) What we learnt for our job

- Training and licensing operation of forestry machinery
- Safety and quality control of products

4. Wood processing industry

4.1: Chugoku Mokuzai Sawmill Company

Part of sawmill facilities

(1) What we witnessed

- One of largest sawmill in the world
- Use Douglas Fir imported from US
- Timber production
- Lamination {Beams}
- Chips production
- Electricity production
- Timber seasoning
- Forestry
- Import wood

(2) What we learnt for our job

- Combination of efficiency and recovery
- Lamination of the wood for improved
- Utilization of wastes – sawdust, barks, offcuts, shorts, shavings etc

4.2 Kyowamokuzai Co. Ltd.

(1) What witnessed

- Use domestically sourced wood
- Use Cedar and cypress
- Domestic consumption

(2) What we learnt for the job

- Implementation of government policy on use of local wood
- Combination of efficiency and recovery
- Lamination of the wood for improved
- Utilization of wastes – sawdust, barks, offcuts, shorts, shavings etc.

5. House Construction industry using Wood

5.1 Kuniroku Home in Gifu

(1) What we witnessed

- Involved in forestry management, precutting of timber and construction

Construction

Pre-Cut

(2) What we learnt for our job

- Involvement of the private companies in forestry management
- Vertical integration approach in business – forest management, pre-cut and construction
- Putting the customer's interest first

5.2 Housing Companies in Tsukuba City

(1) What witnessed

- Located in a housing park
- Use pre-cut timber to construct houses
- Use 100% local wood
- Work in collaboration with the prefectural government

Ibaraki Ken Minami Wooden Housing

(2) What we learnt for our job

- Model housing park
- Promotion of government policy on local wood
- Final designs are tailor made for the customer

6. Furniture Company

Visited IDC OTSUKA Furniture: Good sleep factory

(1) What we witnessed

- Specializes in the marketing of assorted furniture from the local and international market
- Some of the wood used include Oak, Walnut, Cherry, Cedar, Teak, Rubber, etc

(2) What we learnt for our job

- Market segmentation
- Promotion of tradition assorted artifacts
- Emphasis on quality and durability for the upper market

Reference organizations

The following organizations enriched our understanding of the forestry industry in Japan

R1: Forestry and Forest Products Research institute

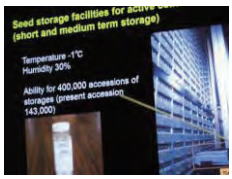
- Coordinating body for forestry research
- Visited and received presentations from:
  - Wood processing unit
  - Laboratory for wood engineering
  - Welcoming meeting from FFPRI management
- Visited and received presentations from Research Department of Wood Utilization

R2: Forest Tree Breeding Research Centre

- Hosting Institution for the training
- Welcoming party led by Vice President
- Presentations on DNA analysis
- Presentations on tree breeding
- Extension theory
- Lectures, visits to demonstration sites and exercises on grafting techniques at Iriomote Tropical Tree Breeding Technical Garden
- Propagates seeds/seedlings improved through its breeding projects and disseminates them to recipients including government, cooperatives and the private for practical forestry

R3: Gene Bank

- One of largest gene banks in the world
- Play an important role in conservation
- Collection and documentation of genetic material
- Characterization
- Propagation
- Preservation and utilization
- Data/information and materials provided on request
- Presentation on principle of genetic resource preservation



R4: Iriomote Sub-Tropical Forestry Breeding Centre

Improvement of *Callophyllum oniphyllum* for typhoon tolerance

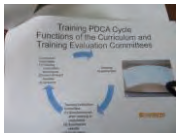
Fruits seedlings nursery in Iriomote

R5: Visit and Lecture at the Nagoya University

- Visited Agricultural Science School
- Hosted by Prof Tomaru, Graduate School of Biological Sciences
- Presentation on focus of graduate school and its practical orientation on training and research in forestry breeding
- Visit to the lab facilities
- Presentations on application of DNA in research and conservation
- Demonstrated on how DNA analysis could be applied in genetic diversity analysis and conservation of endangered species

R6: Forestry Training Institute in Hachioji City

- Planning: needs assessment, resource mobilization, curriculum and schedule development
- Training: Trainee and trainers identification, site visits, group discussions and feed back
- Training evaluation using questionnaire
- Curriculum review where necessary



R7: Japan wood-products Information and Research Centre

- Collection of data on wood trade statistics (Prices, exports and imports)
- Provide information on wood trade statistics to consumers, government and industry
- Dissemination of information wood trade statistics: Exhibitions, seminars, consultancy services, etc

R8: Religion and conservation

Visit to Mt Takao

- Nature conservation and religion
- Nature and eco-tourism
- Nature and Water catchments
- Tokyo City View
- History, culture and conservation at equilibrium

Chapter 6: Way Forward

Way Forward

- Skills learned will be useful in our work by:
  - Finalising the Melia market chain report
  - Development of the Melia seeds and seedlings guidelines
  - Creating awareness on the importance and value of Melia volkensii
  - Scaling up the growing of Melia volkensii
  - Sharing the experiences with the project technical staff

Arigatou Gozaimashita

Appendix 5-4 Training in Japan 2015

Appendix 5-4-1 Report of training in Japan (Project Management)

1.Outline of training course

(1) Name of training course "Project Management"

(2) Period 6 Jul. 2015～13 Jul. 2015

(3) Participants Mr.MUGO EMILIO NDWIGA、
Dr. NGURE BERNASRD KIGOMO

2.Results

(1) Achievement

- The trainees studied advanced techniques of tree breeding of Japan.
- The trainees studied contribution of tree breeding for wood utilization and forestry extension in Japan.

(2) Schedule and contents

date	Contents	Organization
7 Jul	Briefing Courtesy call to FFPRI and FTBC	JICA Tsukuba、 FFPRI FTBC
8 Jul.	Lecture of tree breeding Observation of facilities and plus trees in FTBC	FTBC
9～12Jul.	Observation of private nursery, progeny test site, saw mill and Japanese traditional house	Naka city, Shirosato town, Nasukogen city, Nikko city and Chiba city
13 Jul.	Courtesy call to JICA HQ and Forestry Agency	JICA HQ Forestry Agency

3. Evaluation

(1) Lecture and observation

Lecture and observation were appropriate for the trainees to study forest, forestry and forest management in Japan.

(2) Lecture, practice and presentation

The trainees exchanged of wider opinions concerning forest, forestry and forest industry in Japan with officers of Forestry Agency and researches of FFPRI.

(3) Period, schedule and contents

Period, schedule and contents of training course were appropriate for the trainees.

(4) Training material, facilities

Necessary information and facilities were provided to the trainees.

4. Trainees

(1) Qualification

Project Director and Director of Extension department in KEFRI, who are in charge of Project activities, were nominated for the trainees.

(2) Motivation for the training

The trainees took positive attitudes and were very polite in all lectures and observations.

5. Application of the training result

(1) Concerning the result

All studies can contribute to project extension activities that will be the most important matter in the project.

(2) Application method of the result

The result of training, especially a field of extension, contributes directly to progress of the project

6. Circumstance of training

The trainees satisfied living in Japan such as accommodation, transportation and foods.

7. Other remarks

None

Appendix 5-4-2 Report of training in Japan (Extension)

1. Outline of training course
   (1) Name of training course "Extension"
   (2) Period 24 May. 2015～20 Jun. 2015
   (3) Participants Mr. KAMONDO, Bernard Mwaura , Mr. ANGAINE,Peter Murithi
   Ms. ODUOR MUGURE, Nellie, Dr. NGORIARENG Clement Pkiyeny

2. Results
   (1) Achievement
   - The trainees studied advanced techniques of tree breeding of Japan.
   - The trainees studied the distribution system of improved seedlings in Japan through observation of seed orchards, private nurseries and private forest with sustainable management.

   (2) Schedule and contents

Date	Contents	Organization
25 May	Briefing Courtesy call to FFPRI and FTBC	JICA Tsukuba、 FFPRI FTBC
26～27 May	Lecture of tree breeding Observation of facilities and plus trees in FTBC	FTBC
28～29 May	Observation of seed orchards, saw mill	Ibaraki Forestry Technical Center, private saw mill
1～4 Jun.	Study on activities of Tohoku regional breeding Office, observation of private nursery, saw mill and private forest	Tohoku regional breeding Office, Omori nursery, Seed orchard of Iwate pref., Koiwai Farm
5 Jun.	Observation of coastal forest restoration project	Sendai district Forest Office
9～10 Jun.	Forest conservation in semi-tropical area	Yaeyama forestry corporative, JIRCAS
11 Jun.	Study in Iriomote tropical tree breeding technical garden	Iriomote tropical tree breeding technical garden
12 Jun	Move to Fukuoka from Iriomote	Fukuoka
13～14 Jun.	Writing reports	Fukuoka
15 Jun.	Study on drought tolerant research	Kyushu Univ.
16 Jun.	Observation of plantation site of Japanese Melia	Kumamoto forestry and extension center
17 Jun.	Observation of furniture factory using hard wood	Okawa furniture factories area

18 Jun.	Move to FTBC from Kumamoto	Takahagi
19 Jun.	Presentation of the result in the training course	FTBC

3. Evaluation

(1) Lecture and observation

Lecture and observation were appropriate for the trainees to study forest, forestry and forest management in Japan. Program was organized appropriately to understand a total system of forestry, wood industry and wood utilization.

(2) Lecture, practice and presentation

Practice of propagation technique such as grafting was introduced to study basic breeding techniques in FTBC.

(3) Period, schedule and contents

Period, schedule and contents of training course were appropriate for the trainees.

(4) Training material, facilities

Necessary information and facilities were provided to the trainees.

4. Trainees

(1) Qualification

Project staff of Extension department in KEFRI and a chief officer of extension in KFS were nominated for the trainees.

(2) Motivation for the training

The trainees took positive attitudes and were very polite in all lectures and observations.

5. Application of the training result

(1) Concerning the result

All studies can contribute to project extension activities that will be the most important matter in the project.

(2) Application method of the result

The result of training, especially a field of extension, contributes directly to progress of the project

6. Circumstance of training

The trainees satisfied living in Japan such as accommodation, transportation and foods.

7. Other remarks

None

Study trip report

- Participants
  - Angaine Peter- KEFRI-Seed Centre
  - Kamondo Bernard - KEFRI- Central Highlands Eco Region Research Programme
  - Nellie Caro Oduor - KEFRI – Forest Products Research Centre
  - Ngoriareng Clement - KFS- Extension Forestry-Drylands

1

The participants

2

Presentation format

- Topical subjects
- Each participant will handle a topic
- Questions and clarifications welcome
- Application in the Kenya situation

3

Overview of Presentation

1. Background information
2. Genetic resource conservation/preservation
3. Tree breeding and Propagation Techniques
4. Seed and seedling production and distribution
5. Forestry in disaster management and rehabilitation
6. Wood processing and utilization
7. Lessons learnt and application in Kenya
8. Appreciations

4

Background Information

The trip is courtesy of the on going project on "Development of drought tolerant tree species for climate change mitigation in the Arid and Semi Arid Lands of Kenya". (*Melia volkensii* and *Acacia tortilis*)

- A five year project - 2017
- Implemented in partnership
- Selection of plus trees, established seed orchards and progeny tests

5

Genetic resource conservation/preservation

- Genetic resource conservation progress
  - General Japanese forest information
    - ✓Man made and natural forests vs diversity/productivity
    - ✓Need for seed transfer zones
  - Establishment of FFPRI, FTBC
    - ✓Tree breeding
    - ✓Collection&Conservation of genetic materials, ODA,

6

Types of genetic resources conserved

1. Populations of plants
2. Individual plants
3. Seed and pollen

Conservation methods

1. In- situ
2. Ex- Situ

7

Conservation cntd

INSITU

- ◆natural forests 670 Stands
- ◆Forest protection of natural forests - 7 categories

Ex- Situ

- ◆Plantation stands
- ◆Pollen and seed preservation
- ◆Vegetative materials for endangered species and elite
- ◆Arboretum plants for individuals

8

Ex-situ conservation

9

Tree breeding in Japan

✓5 Breeding regions (Hokkaido, Tohoku, Kanto, Kanzai, Kyushu)

Process of tree breeding

✓Plus tree selection

✓Establishment of Seed orchard & Scion gardens

✓Progeny testing

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Tree Breeding in Japan

Objectives of tree breeding in Japan

Breeding objective	Species
1. Early maturing trees	Pine, Cedar
2. Improvement of wood properties	Cedar, Melia, Acacia hybrids
3. Nematode resistant varieties	Red pine and Black pine
4. Low pollen varieties	Cedar
5. Snow sweep resistant varieties	Cedar
6. Resistant to wind/typhoon	Calopyllum sp

Objectives of tree breeding beyond Japan

Support tree breeding work in other countries e.g. Kenya (*Melia volkensii* project) as part of adapting to climate change

11

Activities and achievements

Fast growing Trees

12

Activities and achievements

Improvement of wood properties

Achievements

- Variety of high CO_2 fixing cedar variety (high wood density) (41 varieties)
- Less twisted wood varieties of larch (229 varieties)

13

Activities and achievements

Resistant varieties to nematode and snow damage

- Selection of 375 varieties of pine and 42 cedar varieties that show resistance
- Testing for resistance through repeated inoculation and selection of clones that resist infection (pine)

14

Nematode inoculation tests

15

Activities and achievements

Low pollen bearing cedar varieties

16

Techniques that support tree breeding

Molecular techniques in tree breeding

Phenology studies in tree breeding

Propagation techniques

17

Some important facilities visited

- Genetic analysis and molecular lab
- Glasshouses for propagation of preferred selected materials
- Glasshouse for propagation of nematode resistant red pine clones
- Field plots for testing of nematode resistance
- Field plots to enhance seed production in Larch
- Miniature seed orchards

18

Production and Distribution of High Quality Germplasm

- Extension of improved varieties, seeds and seedlings

FTBC
↓
Local Government
↓
Seedling Producers
↓
End Users

19

TREE BREEDING (FTBC)

20

PREFECTURE SEED ORCHARD

21

PREFECTURE SEED ORCHARD

22

SEEDLING PRODUCERS

23

Forestry for disaster management and rehabilitation

SENDAI DISTRICT

- Adversely affected tsunami degraded sites
- The embankments constrution works
- Restoration afforestration activities
- Conservation of biological diversity sites
- Collaborative restoration sites with NGOS
- The 1000 hope escape upland grounds

24

Rehabilitation of pine forest

25

Kyushu University

Exposure to the Kyushu region prestigious institution and its efforts in forest development

- ✓The institution was established 1903
- ✓Has 16 faculties, 18 graduate schools, 11 U/Graduates
- ✓Sits on 40 ha of land
- ✓Currently relocating to a 271 ha of land

26

New campus and Greenary work

- Elaborate landscaping being carried out
- Mordern housing constructions undertaken
- Soil stabilization on the slopes being done
- Existing displaced trees being transplanted
- Use of old stumps and coppices
- Mature trees translocated wholly
- New species introduced to enrich biodiversity
- Conservation of the rich biodiversi adhered

27

Windbreak

28

Rehabilitation work

- Bamboo vegetation being replaced with broad leaved trees
- Keya beach restoration
- A once black pine forest damaged by wilt
- Replanting of the site carried out
- Protection wind breaks erected
- Embankment constructions set up

29

Application in Kenya

- 580, 000 Sq. Km area
- Population 42 Million people (3% birth rate)
- 1 National Government
- 47 County Overnments
- 80% ASALS
- 6.99% tree cover
- Plantations /Indigenous
- Ownership rights: Govt, Counties, private

30

Wood Processing and Utilisation

- Wood processing in Japan is largely operated through forestry cooperatives.
- The cooperatives visited were:
  - Ibaraki Prefecture forestry cooperative
  - Koiwai farm (Iwate Prefecture)
  - Kawai saw mill (Iwate Prefecture)
  - Yaeyama forestry cooperative (Okinawa prefecture)
- In utilisation, both cooperatives and private actors are involved. The utilisation entities visited were:
  - Makuhari Housing Park (Tokyo)
  - Otsuka Kagu Furniture (Tokyo)
  - Hiraizumi (Chusonji Temple) in Murioka
  - Seki Kagu
  - Okawa and veneer and fancy plywood - Tomato Company (Kyushu region)
  - Morita Interior

Ibaraki Prefecture forestry cooperative

- The forest owners bring their logs to the facility.
- About 90% of the wood d elivered are thinnings

Makuhari housing park
Ceilings and a room upstairs

10/21/2015

Kitchen and

10/21/2015

- To counteract shrinkage as the wood dries, a crack of 10cm is
  made in the centre of the on one side of the column,
- The depth is half way deep.
- The timber has now attained 15% moisture content.

10/21/2015

Otsuka Kagu showroom

- This is a retailer company where many manufactu rers sell them their products.
- Their customers are mainly people moving or relo cating to foreign countries
- The company has a system where if a competitor is selling an identical item at a lower price, then they will meet that price.

- The designs are modern and casual that range in sizes, they ar e simple and coordinate easily.
- The timber used in the furniture are both locally found such as the broad leaved species of *Zelkova serrata* and *Japanese oak* and the species from other countries such as *Canadian maple*.
- Other designs on display included Japanese furniture showing l ocal craftsmanship using traditional techniques.
- These show techniques that are passed down through gene-rat ions of skilled craftsmen to create elegant and class

Otsuka Kago

Koiwai farm

Handy crafts from the shop

10/21/2015

Appendix 5-5 Training in Japan 2016

Appendix 5-5-1 Report of training in Japan (Extension)

1. Outline of training course
   (1) Name of training course "Extension"
   (2) Period 20 Jun. 2016～15 Jul. 2016
   (3) Participants Mr. MUKOLWE,Michel Onyango, Ms. KANYORORO Josephine Wanjiku
   Mr. NJOROGE John Maina, Mr. ONGERE Allan Ojwang
   Mr. RUKUNGU James Chomba, Mr. GONDO Anthony Mwangi

2. Results
   (1) Achievement
   - The trainees studied advanced techniques of tree breeding of Japan.
   - The trainees studied the distribution system of improved seedlings in Japan through observation of seed orchards, private nurseries and private forest with sustainable management.

   (2) Schedule and contents

Date	Contents	Organization
20 Jun.	Briefing Courtesy call to FFPRI and FTBC	JICA Tsukuba、 FFPRI FTBC
21～22 Jun.	Lecture of tree breeding Observation of facilities, plus trees plantation site and seed orchard in FTBC	FTBC
23～24 Jun.	Observation of seed orchards in prefectural gov., private nursey and wood furniture	Ibaraki Forestry Technical Center, Omori nursery, Otsuka furniture
27～28 Jun.	Study on Forest conservation in semi-tropical area	Yaeyama forestry corporative, JIRCAS
29～30 Jun.	Study in Iriomote tropical tree breeding technical garden	Iriomote tropical tree breeding technical garden
1 Jul..	Courtesy call to Forestry Agency	Forestry Agency
4 Jul..	Measures for trial plantation of Japanese Melia	Kinki-Chugoku regional national forest office
5 Jul.	Observation of Melia plantation site	Kyoto prefectural Univ.
6 Jul..	Tree breeding activities in Kansai regional breeding office	Kansai regional breeding office
7 Jul..	Observation of seed orchards, private nursery and saw mill	Okayama forestry institute, Toyonami forest nursery, Innosho forestry Co. Ltd1
11～12 Jun.	Promotion of forestry in local areas	Ino Town in Kochi Pref., Kochi forestry technical

		center, Makino Garden
13 Jun.	Observation of saw mill	Otoyo saw mill Co Ltd.
14 Jun.	Move to FTBC from Kochi	Stay in Takahagi
15 Jun.	Presentation of the result in the training course	FTBC

3. Evaluation

(1) Lecture and observation

Lecture and observation were appropriate for the trainees to study forest, forestry and forest management in Japan. It is considered that The program was organized to understand a total system of forestry, wood industry and wood utilization. Study on extension system of seed and seedling in Japan was especially useful for all participants who are in charge of forestry extension in Kenya

(2) Lecture, practice and presentation

Practice of propagation technique such as grafting was introduced to study one of basic breeding techniques in FTBC.

(3) Period, schedule and contents

Period, schedule and contents of training course were appropriate for the trainees.

(4) Training material, facilities

Necessary information and facilities were provided to the trainees.

4. Trainees

(1) Qualification

Project staff of Extension department in KEFRI and a chief officer of extension in KFS were nominated for the trainees.

(2) Motivation for the training

The trainees took positive attitudes and were very polite in all lectures and observations.

5. Application of the training result

(1) Concerning the result

All studies can contribute to project extension activities that must be the most important matter in the project and also making suitable material for farmer's school or third country training.

(2) Application method of the result

The result of training, especially a field of extension, contributes directly to progress of the project

6. Circumstance of training

The trainees satisfied living in Japan such as accommodation, transportation and foods.

7. Other remarks

None

Appendix5-5-2　研修員によるプレゼンテーション

Report

Country Specific Training on: Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya

18th June to 17th July 2016

Compiled by:

Michael Mukolwe Josephine Wanjiku	John Maina Njoroge Alan Ojwang Ongere James Chomba Rukungu, Anthony Mwangi Gondo

July 2016

Acknowledgement

The participants to the Extension training course thank the Government of Japan through Japan International Cooperation Agency (JICA) for making it possible for us to attend this important course through the generous provision of financial resources and logistical support.

The Forest Tree Breeding Centre (FTBC) is greatly acknowledged for hosting us during our stay in Japan. The facilitators from FTBC who include the CEO, research scientists and other technical staff are highly appreciated for freely sharing research results on past and on-going activities through well-structured lectures, hands-on practicals on grafting and visit to relevant experimental and demonstration sites.

We are also grateful to other agencies, institutions and companies that gave us audience out of their busy schedule and shared with us their vision to improve the environment and livelihood of the communities. We cannot forget the staff of JICA Centres in Tokyo and Tsukuba who ensured our stay at the International centres was as comfortable as possible, hence making us feel home away from home.

Farmers and community cooperatives who freely shared with us their successes, challenges and opportunities in forestry are appreciated. The Mayor of Ishigaki Mr. Yoshitaki Nakayama and Mr. Ishigaki Sousei of Yaeyama Forestry Cooperative are equally appreciated.

Great thanks also go to Mr. Hiko Inadome, our Training Coordinator, who was always there to give us the much needed guidance through; translations of the lectures, guiding us through the complex transport systems. We truly felt safe and appreciated in his company.

We are also grateful to the Director KEFRI and Director KFS for allowing us to participate in this important training. We have learnt important lessons in forest breeding and extension which can be applied in Kenya.

To all who made our stay in Japan comfortable, we say Asante sana!.

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Introduction

Background

The Constitution of Kenya 2010, stipulated that the country should attain a tree cover of 10%. Currently, the tree cover stands at about 7% of which approximately 3% is under state gazetted forests. The forests are managed as plantations of exotic species and the other parts comprise of conservation areas with indigenous forests. The possibility of attaining this minimum required tree cover falls within the privately owned farms and drylands of Kenya, which are expansive. This calls for concerted efforts in forestry extension to achieve the 10% Constitutional requirement.

Kenya's drylands make up 84% of the country's total land surface and support about 9.9 million Kenyans, or approximately 34% of the country's population. The drylands support over 80% of the country's eco-tourism interests and upto 75% of Kenya's wildlife population. The drylands are difficult environments prone to climate change. Livelihood options are limited as crop production is risky, making food insecurity and poverty levels high. The main economic activities for communities in the drylands are mainly livestock rearing and tree-related activities. Common indigenous trees growing in Kenya's drylands include, Acacia spp. and *Melia volkensii* (Melia) valued for fuelwood and quality timber production. The dark heartwood of Melia compares favourably with highly prized hardwood species of Camphor (*Ocotea usambarensis*) and Meru oak (*Vitex keniensis*).Melia is also fast growing and adjusted to dry conditions, and therefore, has potential to help communities in dryland of Kenya adapt to climate change through provision of multiple goods and services. However, due to its high value, Melia has been over-exploited for its desirable characteristics such as straight stem form, fast growth and quality timber production for furniture industry.

The project on the Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya was started in Kitui in 2012 to conserve and promote planting of *Melia volkensii* (Mukau) of wide genetic diversity. This is a collaborative venture between GOJ through JICA, FFPRI/FTBC and Kyushu University and GOK. The main institutions involved in this project in Kenya include KEFRI and KFS.

KEFRI is charged with the responsibility of undertaking research on breeding superior Melia trees that give better performance in terms of growth and timber quality and tolerant to dry conditions expected due to climate change. KFS is mandated to undertake forestry extension with core functions being to promote and give advice to farmers on *Melia volkensii* tree growing and management on-farm, promote dryland forestry as well as promote participatory forest extension methodologies such as Farm Forestry Field Schools (FFFS), and on-farm plantation management as a business.

Purpose of Country Specific Extension Training

The country specific training on Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya undertaken by the six officers from KEFRI and KFS had the broad objective of strengthening knowledge and techniques for extension of improved seed/seedlings production, management and distribution.

It is envisaged that the participants will acquire and enhance knowledge and skills to; propagate improved *Melia volkensii*, establish clonal and progeny seed orchards, and develop distribution pathways for improved superior *Melia volkensii* varieties in the drylands of Kenya. Following the proven performance of *Melia volkensii* in the drylands, it is hoped that its propagation and establishment will not only enhance the general tree cover in the drylands but also improve the livelihoods of the rural communities as it has potential to help populations adapt to climate change through protection of land against impacts of flooding such as soil erosion, act as carbon sinks, and they also provide opportunities for poverty alleviation through creation of alternative income generating opportunities.

Briefing at JICA Tsukuba

Briefing and orientation at JICA Tsukuba was conducted by Mr. Saito who was organised with everything well thought.

- The team was taken through a personal health lecture by Ms. Tsunoga and - cautioned about mosquitoes and how to prevent malaria. White long sleeved clothes were best for protection against mosquito bites.
- The team filled in Medical cards, handed in E-tickets and received JICA's Corporate Cash cards and instructions. Basically instructions were on how to use the card, and checking the balances and withdrawals.
- Among the items that were a must to carry at all times for identification were: Passport, Medical card, JICA badge and Emergency assist card.
- The team was informed that Japan had 47 Prefectures just like (Kenya had 47 Counties (County Governments). Tsukuba City is located in Ibaraki Prefecture.
- Useful web sites recommended for getting information included JICA Facebook and the Statistical handbook of Japan.
- The briefing highlighted Japanese customs and manners, as following: Punctuality (Be at the venue at least 5 minutes before the scheduled time); Bowing (slight and deep depending on the person one was interacting with. Slight bowing usually in informal ceremonies and deep bowing in formal ceremonies); Remove shoes before entering a Japanese house; Japanese love noodles, which they eat slurring their mouths so should not take offence. They are conscious of the environment protection policy, hence manage their own plastic bags as appropriate policy for environmental protection.
- Japan applies 3Rs: Re-use, Reduce and Recycle.
- The population is about 127 million people, and the country has an area of 377,873 km^2.
- The team was introduced to the Training Coordinator Mr. Hiko Inadome, fondly referred to as Hiko-san.

Kenyan Extension Course Team meets the Director General FFPRI

Courtesy Call on Mr. Saboshi Watanabe, Vice President Forest Products Research Institute (FFPRI)

The Vice President highlighted the following:

- Appreciated a happy collaboration with Kenya on the *Melia volkensii* progeny test project as many scientists from FTBC are seconded to the project.
- Pointed out that propagation had started and it is usually a difficult stage even in Japan.
- Growth rate of *Melia azadarach* in Japan was very slow making propagation difficult. But in Kenya due to the faster growth evaluation can be done earlier.
- Japan cedar trees are harvested after 50 years. This is long, but FTBC had developed ways of reducing this period to about one third.
- Tree cover in Japan is presently about 67% - 70%.
- Not many young people were involved in forestry mainly due to the low wages paid by the industry.

The Director General, FTBC poses for a photograph with the Kenyan team

Courtesy Call to the Director General Forest Tree Breeding Centre (FTBC)

- The team had a brief meeting with the FFPRI Director (forest ecologist and silvilculturalist).
- Forestry research was over a century old (1905) in Japan. The institutions undertaking research have undergone several periods of restructuring and transformation to what it is today. The three focus areas include; forest research, forestry research and wood utilisation. International collaborative research is also an important component with each area addressing specific research attributes.
- The team watched a documentary of the works done by the institution. A hand-out on the same was provided. FFPRI is engaged in research and development of forest science through the following:
  - Development of forest management technologies and systems for forest and forestry revitalisation.
  - Labour saving and cost reducing technologies for reforestation that include, weeding when necessary as opposed to weeding every year.
  - Mixed confers hardwood forest that do not need clear cutting
  - Establishment of wood production technologies to increase and ensure sustainable domestic wood demand by ensuring efficient logging and wood distribution, Former is achieved through mechanization of forestry practices.
  - Improved technologies for processing sawn timber and reliable structural wood. Promote use of wood residues. Recycling and re-use of waste wood mainly from construction in urban areas.
- Research on biodiversity.
- Forests are kind of green dam as they store water and protect the watersheds.
- Trees act as carbon sinks. Cedar takes up 40% of CO_2 while Pines take up 11% of CO_2, so the two species take up more than half of CO_2.
- There is need to protect forest as they are habitat for wildlife-mammals and birds.
- Natural positive effects of forests include forest bathing, forest odour and sounds on human wellbeing. Use of tannins to absorb harmful substances from the air.
- Restoration of endemic ecosystems and endangered species such as those of birds.
- Forests are shrinking everywhere, hence the need for satellites and remote sensing.
- Need to nurture forest and harvest timber – management for utilisation.
- The team also visited the tree identification library where samples of timber from various trees are preserved. Over 30,000 specimens and genetic coding of the specimens are done.

The laboratory where genetic material are conserved

Explanation in a gene bank laboratory

2.0 Presentations and Field Visits

Outline of Tree Breeding in Japan - Dr. Hiroshi Hoshi, Director General of Breeding Department

- Appreciation that forests/trees are a green resource that should be conserved/preserved and sustained.
- Tree breeding is an important component for any successful forest and forestry plan with a goal of achieving sustained supply of domestic wood to an increasing demand for the product.
- Central to tree breeding is the supply of superior seed and seedlings.
- An increase in wood demand implies a need for an equally rapid supply measure which can be activated by the aid of tree breeding.
- A comprehensive tree breeding initiative will ensure early growth, low cost and demand effective management through weeding and short rotation. Effecting low cost entails reduced weeding cost which is attributed to early growth.
- The net effect of successful tree breeding initiative should be reflected in increased production/supply of superior seed and seedlings, reduced afforestation cost, meeting wood demand and increased income.
- Initiative in modern tree breeding in Japan is attributed to Prof. B. Lindquist whose use of plus tree selection (1952) propelled the process of producing superior seed and seedlings.
- Forest Agency (FA) endorsed this initiative through its notification on "Implementation of breeding programme using plus tree selection in Japan (1954), upon which plus trees selection started in national forest and subsequently private forest.
- The establishment of Forest Tree breeding Centre (FTBC) may be associated with the 1952 (Prof. Lindquist) and 1954 (FA) initiatives as well as to institutionalise the tree breeding activities in Japan. However, FTBC has since 2007 been integrated as a constituent Institute of the Forest and Forestry Products Research Institute (FFPRI).
- Today, an elaborate network of tree breeding in Japan is in place (Fig.1).
- Delineating breeding regions, centres and offices for site and tree specific needs as well as area administrative organisation is imperative in addressing genetic diversity and differentiation.

- A total of 9,145 plus trees (cedar 3,670, cypress 1,058, Larch 538) have been selected since 1954.
- Seed orchards (in 428 sites covering 895 ha) and Scion gardens (in 146 sites covering 178 ha) have been established since 1957.
- Progeny tests have been established to evaluate plus tree performance for improvement of seed orchards and choosing crossing materials for the next generation since 1964.
- F1 field test has been established to select 2nd generation plus tree in 107 sites covering 67 ha since 1984. Excellent early growth, hence savings on weeding costs has since been realised.
- Japan hopes that by 2020 50% of wood used in the country will be from domestic sources.

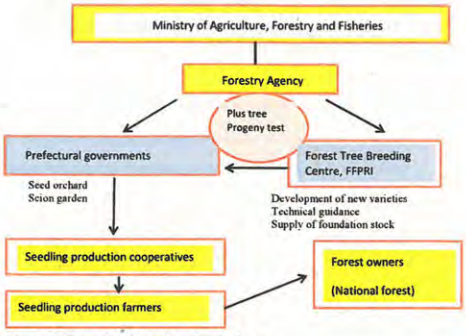


Figure 1: Network of Tree Breeding in Japan

- Other on-going tree breeding initiatives include:
  - i) Improvement of wood properties particularly for cedar.
  - ii) Breeding of high CO_2 fixing cedar variety to address global warming.
  - iii) Breeding of snow damage resistant cedar variety, for less twisted wood.
  - iv) Breeding for pine wilt nematode resistance, which has resulted in heavy financial losses to forest owners as affected trees are cut down and disposed. To-date, 225 red pine and 171 black pine varieties have been identified from which 24 seed orchards of red pine and 42 of black pine have been established. In addition, 362,000 resistant seedling varieties of red pine and 628,000 of black pine from the orchards (982,000 pine seedlings) have been planted along the sea shores.

  - v) Coping with pollen allergy which affects about 25% of the people in Japan is a major socio-medical concern. It is severe in spring. Breeding of pollen free or less pollen producing cedar and cypress varieties is in seed orchards and by use of biotechnology. Isolation field for assessment of safety in transgenic plants/male sterile varieties (2 cedar varieties) have since been developed as DNA analysis technique is being used.
  - vi) Weeding is important in the first 5 years but if trees bred grow fast they will overshadow the weeds minimising need to weed and consequently reducing cost of plantation management.
  - vii) Shortening rotation age from 50 years to about 25-30 years. In such scenario, breeding lowers cost of plantation management.

Application of Lessons Learnt

- The output and outcome of breeding in Japan finds application in the context of growth, resistance, environment, and application of biotechnology for dryland species (Melia, Acacia) and medium to high potential area species.
- Appropriate selection and handling of plus trees is key to breeding forest trees for different reasons.

The Progress of Forest Tree Genetic Resource Conservation during the Last Four Decades in Japan – Dr. Masatoshi Ubukata

- Broadly, the presentation highlighted the general information of Japanese forest, introduced Forest Tree Breeding Centre (FTBC), and described the genetic bank project with respect to in-situ and ex-situ conservation strategies.
- It could be concluded that Forest Tree Genetic Resource Conservation has progressively evolved through compressive evaluation and institutional reforms processes to incomparable levels.
- Two broad classification of Japanese forest are recognised by their biological diversity and productivity of wood, namely; conifers and hardwoods.
- The main conifers species include Cryptomeria, Larix, Chamaecyparis and *Pinus densiflora*, among others. Fagus, Castanopsis, Zelkova and Quercus comprise the main hardwood trees.
- Man-made conifers forest and natural forest of hardwoods comprise the main forest production systems. A characteristic of man-made conifers forest is their low biological diversity, while the reverse is same for the natural forest.
- It is appreciated that a combination of geographic and biophysical factors contribute to the type of forest, tree cover and forest tree breeding initiatives observed in Japan. About 1,327 indigenous tree species are known to Japan, placing the collection to the 3rd largest found in a warm temperate zone.
- Forest cover in Japan is 25 million ha out of 37 million ha of land, of which man-made forest comprise 10 million ha. However, it is observed that the natural forest component is limited when secondary forest is excluded.
- Reforestation and seed transfer zones are important aspects of sustaining Japan's forests.
- Key reforestation species included Cryptomeria, Cypress and Larch. It was observed that while age distribution of plantation is described as normal, a potential decline in annual reforestation area from 0.3 million ha to 20,000 – 30,000 ha presents a concern.

- In order to avoid failure of reforestation, seed transfer zones should be determined and delineated using empirical results of reforestation.
- It was observed that FTBC was a constituent research centre of FFPRI engaged in:
  - i) Forest tree breeding.
  - ii) Collection and conservation/preservation of genetic materials.
  - iii) Cooperation in forest tree breeding in developing countries.
- In addition, FTBC stands out as the only forest tree gene bank in Japan with the largest stock of **woody plants**. Currently, FTBC has in its stock about 33,000 stains comprising 23,000 individuals (vegetative plants) and 10,000 seed/pollen (germplasm). However, the largest **plant** gene bank in Japan is located at National Institute of Agrobiological Sciences (NIAS).
- A five decade chronological evolution and reform initiatives have propelled the development of FTBC to an institution of excellence. In particular, the gene bank project for forest tree species has focused on systematic collection/preservation/supply of breeding materials of:
  - i) Potentially useful species.
  - ii) Endangered species.
  - iii) Natural monuments.
- The key approach to the undertakings is through elaborate surveys and collection of seed and scions as well as propagation and preservation through grafting and rooted cuttings. A key parameter in this initiative is evaluation of traits by measurement.
- A combination of the characteristic of trees and appropriate conservation strategies are important in ensuring success in conservation of genetic resources. The strategies used include '*in-situ*' and '*ex-situ*', 'germplasm' and 'vegetative', 'individual tree' and 'population'.
- The strategies constitute the main **genetic resource conservation system** for forest tree species in Japan depending on the type of resources. For example, *in-situ*' and '*ex-situ*' conserve population of plants in man-made forest; *ex-situ* for individual plants as in arboretum with clone or family identity while germplasm (seed/pollen) are preserved in archival facilities.
- In addition, forest tree **genetic conservation resource stands** equally play an important role to conserve genetic diversity within species and species distribution, where over 325 stands comprising 106 species (either endangered or major forestry species) have been designated in different regions in Japan. In such stands, forest operations are allowed only to maintain genetic diversity or regeneration of the specific species.
- Cryptomeria is the most widely distributed and common plantation species in Japan. Studies on the species geographic variation using DNA makers are on-going. It is expected that the findings will be used to formulate the species conservation strategy, among others.
- Information/data base matrix on the status of forest tree genetic resource conservation/preservation inform of vegetative plants (e.g. *Zelkova serrate* and Cryptomeria japonica at FTBC Arboretum), tree seed and pollen (e.g. *Pinus densiflora* and *Cryptomeria japonica*) as well as tree seeds (domestic conifers, and hardwoods foreign confers and hardwoods is equally comprehensive.

- The forest gene bank programme has conserved/preserved 5,983 lots of domestic conifers seeds (54 species) and 1,794 lots of domestic hardwood seeds (582 species).
- Most conifers tree seed are stored at -20°C and hardwoods at -2°C under dry conditions in specialised facilities. Specialised storage conditions under experiments are at -160°C.
- The forest gene bank programme has conserved/preserved tree pollen 2,440,983 lots of domestic softwood pollen (23 species) and 154 lots of domestic hardwood pollen (18 species).
- All tree pollen is stored at -80°C under dry conditions in specialised facilities.
- The forest gene bank programme has conserved/preserved endangered tree species and monuments of which 36 species (e.g. *Morus boinensis* - mulberry and *Pinus almandii*) are preserved at the clone archives with tissue culture and controlled pollination, respectively.

Explanation about the work in the work in the gene bank

More information on gene conservation

Demonstration on genetically modified technology application in a green house, FTBC

A seed orchard of Cedar at FTBC in Takahagi

Application of Lessons Learnt

- Forest tree genetic resource conservation is not only important but inevitable in Kenya given the impact of state of forest cover, degradation, increasing demand for wood and non-wood products, as well as the challenges imposed by adverse biophysical factors on environmental resilience and vulnerability of local communities to climate change.

- FTBC has done a lot which Kenya could emulate though with modification and supported by a strengthened forest tree breeding capacity and policies.
- Collaboration between KEFRI and FTBC in aspects of forest tree genetic resource conservation particularly on drought tolerant tree species (*Melia volkensii*) should not be taken for granted. Melia in Kenya is synonymous with Cryptomeria in Japan, hence should be subjected to all relevant genetic conservation/preservation research protocols to ensure and expand its production and role as a key wood producing tree species in the dryland of Kenya and beyond.
- That Forest tree genetic resource conservation has potential to contribute to establishing effective adaptation measures to global warming.

Extension of Improved Varieties of Seeds and Seedlings – Dr. Motoki Takayashiki

- Extension of improved varieties of seeds and seedlings is a key mandate of the Extension section of FTBC.
- Japan is administratively divided in 47 prefectural governments and 1,718 municipalities (cities, towns and villages).
- The system of forest tree breeding is based on delineating breeding regions, centres and offices for site (climatic) and tree species/variety specific needs as well as area administrative organisation.
- The flow of production/distribution/improvement of new tree varieties (stains-grafted seedlings or seeds) from FTBC/FFPRI through Prefectural governments (establish seed orchard and scion garden) to forest owners (for plantation development) is well established and elaborate.
- The seedlings or scions produced/distributed include: *Cryptomeria japonica* (Sugi/Japanese cedar; *Chamaecyparis obtusa* (Hinoki/Japanese cypress); *Pinus densiflora* (Red pine/Akamatsu) and *Pinus thumbergii* (Black pine/Kuromatsu).
- The elaborate flow of production/distribution/improvement of new tree varieties is in itself a strategy and basic plan that is informed by the roles played by MAFF, FA and FTBC. FTBC's is expected to engage and cooperate with the Prefectural government in dissemination of developed new varieties (establishment of seed orchards and scion garden) as also strengthen their capacity (conduct conferences).
- Forest Seed and Seedling Act is in place to ensure/enforce compliance – registration, secure seeds from known origin and quality, labelling, notification of seed distributor, marketing through appropriate channel (using and producing recommended stains (seed, seed orchard and scion garden).
- Exceptions to compliance in case of research, trial plantation outside of the species' designated area are subject to: i) developing and exhibition forest, ii) planting pine nematode resistant varieties and growth comparative studies. The approval is granted by Government to MAFF to effect the request.
- FTBC is expected to implement the Amendment of the Act on Special Measures for Promotion of Thinning in support of the compliance by:
  i) Applying for registration of "Specified Mother Tree" from the Elite Tree that has excellent growth from Prefectural government or private sectors.

  ii) Producing and distributing the seedlings from the registered "Specific Mother Tree" in response to requests.
  iii) Conducting technical supports to the receivers of the seedlings.

The flow of beneficial trait from the Plus trees to Elite trees

Application of Lessons Learnt

- Extension will:
  i) maintain appropriate production, distribution and marketing of quality seedlings.
  ii) lower afforestation cost for sustainable forest management by selecting fast growing seedlings.
  iii) Contribute to forestry conservation in collaboration with stakeholders (prefectural governments, producers and end users).
- Instruments of Regulation and Compliance are inevitable.
- Kenya stand to benefit from the Japanese experience as it has 47 counties and could use Melia as a pilot case.
- KEFRI in collaboration with KFS should assist county governments to identify sites for demonstrating the selected superior Melia species for planting and seed production.
- KEFRI in collaboration with JICA supported Project on drought tolerant species should would to identify and register Melia farmers for quality seed and seedling production, and an elaborate marketing strategy to ensure follow-up and compliance.

Tree Breeding – Dr. Hisaya Miyashita, Senior Researcher

Introduction

Breeding is a universal technology applied in improvement of trees and other plants. Developed countries such as USA and Canada do a lot of tree breeding work in development of forestry. In Kenya highland crop trees such as cypress have under gone breeding. However, indigenous species such as Melia are currently under research to breed high yielding varieties.

Project Title: Breeding Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya

Breeding of *Melia volkensii* for growth and drought tolerance.

Distribution of *Melia volkensii* in Kenya

About 85% of Kenya is classified as Arid and Semi-Arid Lands (ASALS). Such areas are characterised by low rainfall and high temperatures. Due to low crop productivity, woodland and trees offer major livelihood sources in these areas, leading to extreme pressure on natural resources especially trees. *Melia volkensii* is one of the major indigenous trees found in north and south eastern Kenya.

Fig. 2 *Melia volkensii* distribution in Kenya

Selection of Melia

- Selection for improvement of *Melia volkensii* was based on its ability to produce high quality timber and its high market value. For breeding purpose mother tree selection was based on visual appearance straight tall bole, and therefore the history of the trees was not known. To-date, 100 Melia plus mother trees have been selected and used to establish clonal seed orchards in Kitui and Kibwezi. Each tree is replicated 30 times giving a total of 3,000 trees.

- To gauge potential for high productivity of selected mother trees, progeny trials have been established in a wide range of sites. Such sites are set on farmers' field or in institutions.
- Species screening for drought tolerance, growth performance and genetic diversity of Melia is underway. DNA analysis will support development of genetic diversity conservation strategy and draw up distribution range of superior breed varieties.
- Tree Breeding -involves seed from identified mother trees, seed and scion collection, clonal seed orchard establishment; seed production; progeny trials. The orchard and progeny tests will give rise superior planting materials, improved seed orchard and seed production.

Mass propagation

- This process focuses more on accumulation of quantitative traits other than quality.
- First generation - selection of Plus trees - collection of scions and propagation, and establishment of clonal seed orchard. In 2-3 years, Melia produces seeds from the orchard. These seeds go to forestry activities through production of seedlings.
- 1.5th generation- seeds from clonal seed orchard are put into a progeny trial for further evaluation and improvement. Good material from the progeny test is selected for establishment of clonal seed orchard. This is also known as backward selection. The progeny test is done simultaneously with clonal seed orchard trials.
- Good materials from the progeny are selected and bred as this gives rise to breeding population (forward selection). This then gives rise to 2nd generation of Plus trees.
- Management of the seed orchard; It must be kept free of weed, diseases and pests .Trees should be controlled through pruning and cutting lead stem to allow for horizontal branching at low heights.

Melia seedlings in FTBC, Takahagi

Potted Melia seedlings in a greenhouse at FTBC, Takahagi

Some observations/way-forward

- Some trees in the orchard to have poor growth probably because they were moved to new sites.
- 12 progeny trial sites have been established. Same trees have been established in all the 12 sites. If a tree is doing well in all sites this will be selected as a good material.
- The progeny sites are also expected to show some trees performing better in some sites and not in others. However, for trees to grown within a certain site/County they must have shown good performance within that county.
- Within each project county 3 ha of seed orchard (800 trees) will be established with seeds from the progeny test.
- Improved seed production and supply will be enhanced within the Counties once seed orchards are established.
- It is important for tree breeding information to be shared for continuation of breeding and further selection.

Genetic and Reproductive Studies for Future Orchard Management - Dr. Michinari Matsushita

Definition of terms

Genetic diversity was defined as total number of genetic characteristics in the genetic make-up of a species. This can affect growth, survival and reproduction potential, potential for evolution and breeding.

Genetic differentiation was defined as quantified genetic variation between and/or among groups.

Importance of species - site matching

- Genetic differentiation will validate or support species site matching. e.g. Japanese beech adapted to cold side on Japanese sea side was planted on the pacific side which is warmer. The species showed slow growth, indicating it was not suited to this warmer site.
- Success of tree planting will greatly depend on a species genetic diversity and differentiation. For instance, before introducing Melia to other countries in Africa it is important to carry out species-site matching in the target countries to find out which Melia provenance is best suited to that country. Provenances include species from north, middle or southern part of its range in Kenya.
- It was realised that Meru and Embu Melia provenances selected for clonal seed development had low genetic diversity. Decision on whether or not to promote these provenances for up scaling cannot be made on 1st generation progeny as some desirable quality may be expressed later.

Application in Kenya

- Kenya has now acquired knowledge on molecular techniques, therefore research on other indigenous trees could be undertaken to increase the number of drought tolerant, indigenous species being promoted.
- Breeding is long term but there is need to make farmers appreciate benefits of using improved tree genetic resources/ material. This can be achieved through

training, joint development of plantation /demonstration plots at county levels and identifying niche markets for Melia wood and wood products.

Grafting - Mr. Kobuta

Reasons for grafting

- Shorten fruiting /seeding period e.g. Case of Japanese tree species/ Melia in Kenya.
- Ensures product is similar to the mother tree.
- For low pollen/non pollen Japanese cedar through clones/grafting.

Procedure

- Major tools and materials required for grafting include: - knife, grinding stone and grinding stone holder, water, grafting tape, strings, cutting board and plastic bags.
- Always soak a grinding stone in water.
- Stabilise grinding stone through holder or placing on waste cloth when in use.
- Sharpen the front side of the knife first. Ensuring the grinding stone remains wet.
- Grind out warpage on the back side of the knife.
- Select scions from the target tree species. Identify scions that are free from pests and diseases, those that are the younger not seeding.
- Harvest identified scion using a secateurs. Cut the scion to about 10 cm. Remove lower leaves to about 5 cm.
- Trim the bottom end of scion by making a wedge shaped.
- Place the trimmed scions in water to ensure they do not dry.
- Cut the top side of the root stock.
- Strip some of the leaves around the grafting area of the root stock.
- Make a slit in the root stock by using your thumb to push down the blade. As the stem of the root stock may be hard, make the slit towards the edge not in the middle of root stock.
- Insert the scion in the root stock slit ensuring the cambiums of the scion and root stock touch each other.
- Wrap around the stock and scion by using a grafting tape.
- Cover the grafted portion with leaves or folding upwards leaves from the lower side of the root stock and covering with a polythene bag tied loosely at the bottom of the root stock.
- Secure the grafted portion with a piece of string.
- Cover the graft with a plastic bag, and use a piece of string to tie up the bag.
- Place grafted seedling in the nursery and monitor for signs of new shoot growth.

Way forward

1. Need to train more staff from KEFRI and KFS to be conversant with grafting for Melia orchard development in counties.
2. KEFRI and KFS to collaborate in training more staff on grafting at institutional and county level through in country training programme
3. Develop simple guidelines/manuals on grafting techniques for use by extension agents/technicians in counties.

Ibaraki Prefecture Forestry Research Institute

Introduction

Ibaraki Prefecture Forestry Research Institute (IPFRI) is located in Ibaraki Prefecture. This Prefecture has a forest cover of about 30%, which is lower than the national average. Of these, 76% are private and 24 % public forests. Ibaraki Prefecture has three main regions, namely: Mountains suitable for forestry; Plains maintained for livelihood activities such as farming and settlement; and Coast suitable for pine forest due to its tolerance to sea water and sands while acting as windbreak.

Mandate and activities of the Institute

- IPFRI was established on 20th December, 1955 for the purpose of conducting research. Over the years it has undergone different changes and presently it has three divisions, namely:
  - i) Silviculture Department - dealing with research on forestry production and breeding.
  - ii) Forest Environment Department - dealing with research and survey of forest environment conservation.
  - iii) Mushroom and special products Department - dealing with research and surveys on mushrooms production, harvesting and special forestry products.
- The institute also has an extension section that promotes extension projects.
- The institute has a total area of 33.0 ha of land, which is well planned and demarcated. It has a conducive working environment to conduct research for various situations.
- Since the Japanese cedar is very important for the construction industry, a lot of breeding work is being done by the institution to continuously improve the genetic makeup of the species. Trees are being improved for fast growth and straight bole. Plus trees are identified, a process that has continued for over 50 years.
- Grafting is also done to increase seedling numbers, orchards are developed and elite trees identified. Seed orchards are established for elite trees. Plus trees are further tested for superiority through progeny trials. Some orchards are managed in miniature form where trees are sprayed with gibberilic acid to induce early seeding at 4 years as opposed to a 10 year waiting period of ordinary seed stands. Such treated seed-trees have a life span of 10 years.
- Research on low pollen varieties of cedar to manage the problem of allergy which affects a considerable number of Japanese is also being undertaken. Low pollen cedar varieties can have less than1% of the ordinary Japanese cedar.
- A lot of work has been carried out by the institute to address the challenge of nematodes affecting the red and black pines. Artificial inoculation of pine nematodes is undertaken identify varieties resistant to nematodes. Such varieties are shared with FTBC for further improvement. The black pine is mainly planted by the Prefecture government, who replace all nematode affected trees with resistant varieties. Red pine is mainly planted by private farmers who have not yet reached the stage to replacing infected trees.
- The Institute has a responsibility of distributing superior tree seedling to farmers for planting. They give through farmers cooperatives.

Lessons Learnt Which Kenya Can Adopt

1. The Institute has invested in well-equipped tree nurseries where propagation is carried out.

2. Development of seedling production technologies using multi-cavity containers.
3. Establishment of miniature seed orchards, these have considerably reduced the time taken in production of seeds (Ordinary orchards takes 10 years).
4. Plantations of elite trees, the second generation plus tree have superior growth and quality resulting from hybridization of plus trees having proven superior growth. Elite trees will significantly reduce the costs of weeding due to their fast growth.

An expansive nursery to accommodate large number of seedlings

Seedlings production technology using multi-cavity containers

A water system with an automatic timer for watering the seedlings. Less manpower is used

Miniature seed orchard

Visit to Mr. Ryuichi Oomori's Tree Nursery

- Ibaraki Prefecture Forestry Research Institute (IPFRI) works with a cooperative called Ibaraki Prefectural Forestry Seedling Cooperative. It has a total membership of 38 households (HH) of which 18 HH have active members, which is attributed to their part-time and other professional engagements.
- The cooperative receives training and improved seedlings from the research institute for distribution to its members. The members of the cooperative also undertake private tree breeding in their nurseries. Mr. R. Oomori also works closely with the IPFRI and is a member of the Evaluation committee for superior varieties and techniques.
- The Kenyan team visited and interacted with Mr. R. Oomori, who is one of the farmers and a member of the cooperative and Mr. Keiji Hayashi, cooperative advisor. It was observed that the cooperative members focus on raising Cedar and pine seedlings. They mostly use the system of raising seedlings without pots (bare-root). Although the use of pots (container) for seedlings production has recently been introduced, it has yet to be popular. Non-potted seedlings take 3 years in the nursery while potted ones take two years. There is need to promote container-grown seedling as smaller area will be require, it involves less labour, seedling mature earlier and it is technology friendly, which may enable young people to develop interest in tree nursery.

Mr. Ryuichi Omori's Private Nursery Ibaraki Prefectural Seedling Cooperative

- The cooperative is tasked with the responsibility of seeking for markets (buyers) for members. They consult other prefectures which need superior varieties of seedlings for planting. Buyers include contractors, out sourced by the national government to carry reforestation in national forest areas. To avoid over production, the government makes an estimation of seedlings to be planted, and the cooperative members produce the required number.
- The members of the cooperative have invested in modern watering system like the one shown below.

Picture showing extensive tree nursery owned by a private forest farmer

A farmers' cooperative nursery with a modern watering system

Lessons Learnt and to Apply

1. Most of the lessons learned are also applicable in Kenya. However, it take 4 years to raise and tend seedling in the nursery before out-plant in Japan. In Kenya it lasts 3-4 months.
2. More awareness and sensitisation will be carried out especially establishment of forest cooperatives.
3. The involvement of the County Governments in supporting farmers to be involved in Melia tree breeding and plantation establishment through cooperatives is another key point that will be promoted.

Visit to Seki Furniture Company Limited in Tokyo

Observations made

- The show room (Furniture shop) is situated in Central Business District of Tokyo on the 5th floor of Shinjuku Park tower, occupying approximately 900 square feet. The other wing of the floor is shared by another furniture shop of a different company. The company (Mokuba) has some other branches within Tokyo City.
- The company deals with high quality furniture for those who can afford good quality products, they say "combination of 'extraordinary wood' and 'extraordinary craftsmen' produces 'the best of the best', hence guaranteed products".
- They use mostly imported timber especially from Africa, South America, USA and Europe. From the year 2014, they left timber import because of the new regulations in the exporting countries discouraging timber export.
- They have their own workshop, which is reputed as having the best quality wood/timber and equipment in Japan.
- For good quality timber products, wood is air dried for 3-5 years. Little quick drying is done in kilns
- Timber is used in its natural state thus the bark is removed and even the wrinkle marks left after the bark is removed are not planed, the wood colour is also left natural and some are reinforced by artificial same colour for brightness. The Natural splits and holes in the wood are left the way they were unless extreme is when some reinforcement is neatly done.
- The final products are mainly table tops (legs are made of steel) are produced by planning, removal of bark and application of varnish. They also sell chairs.
- The prices of final products (items) displayed range from ¥ 450,000 to ¥ 3,500,000.
- Most of their clients are the newlywed couples and members of the society with good income.
- The clients are given guarantee of 20-30 years for repair.
- They sell mostly on week-ends (Saturdays and Sundays), selling an average of ten items per month. Sales are very good on weekend when people are free to do shopping.

Visit to ICD Otsuka Furniture Company in Tokyo

Observations

- This is another furniture shop also located in Tokyo town with similar items as Atelier Mokuba (about 30 minutes' walk from Mokuba Show room).
- The prices were also competitive.
- It had various items bought from the various furniture manufacturers which they market at the shop.
- Customers could also order the type of furniture they want and made according to their taste.
- Generally, most of the observations are the same as Mokuba but the Otsuka company show-room was wider.
- They also had additional items as wall units.

Price tag on one of the finished tables

Priced table tops behind the group, finished tables and chairs, and visiting Kenya team and three attendants

A finished table with the top showing the actual natural colour of the wood

Highly prized quality dining tables

Application/lesson learnt

- From the two furniture shops, it was apparent that wood in Japan is very highly valued not only for the big demand in the construction industry but also in the furniture industry. The people are willing to pay the highest price for valued items according to the Japanese people taste.
- Quality and good workmanship are key drivers in a competitive wood industry no matter the business location.

- Kenya could develop Melia trees and products for the international market to have return on investments. Melia timber has an appealing colour that could be the marketing point for the world market
- Furniture industry encouraged to produce high value timber products.
- Value addition to raw forest products should be made by the exporting countries to create employment for their people hence make them appreciate forests and their products, and for the importing countries like Japan to reduce the bulkiness hence cost of transport.
- Some of the accruing profit should be ploughed back for conservation of forests where the wood came from.
- Alternative quick growing trees like Melia and others that give same products in shorter period should be natured (research).

Japan International Research Centre for Agricultural Science (JIRCAS)

Climate change and environmental degradation have been deeply affecting sustainable production in agriculture, forestry and fisheries. Thus JIRCAS seeks to contribute solutions to global food and environmental problems as well as to the stable supply of agricultural, forestry and fishery products and resources.

JIRCAS has been conducting collaborative projects in developing tropical and subtropical regions to provide solutions to international food supply and environmental problems through technology development. The Institute has accomplished research on heat and salt tolerance of leguminous crops, efficient management of tropical fruit farms, and integrated pest management of tropical-origin diseases and insects.

The station is also responsible for promoting new technological advances on agricultural crops and conserving the genetic resources of tropical and subtropical fruit trees. Research in JIRCAS include:

- **Rice**. The biggest project in Africa is the development of NERICA rice (New Rice for Africa), an upland rice which is hybrid between the African and Asian variety, breed through genetic transformation technology. The African variety has great resistance to various stresses that include drought tolerance, blast residence and P deficiency, while the Asian is high yielding.
- **Sugarcane development**; A cross between sugarcane and Erianthus is being developed mainly for production of biomass and bio-ethanol. Erianthus was selected as is fast growing, and deep rooted,
- **Maize:** research on soil productivity improvement for enhanced maize production.
- Tropical fruits: include mangoes and passion fruits being bred for less acidity.
- **Yam**; has great economic potential in West Africa and will be bred for improved productivity The identification of the valuable traits, including higher tolerance to drought, insect pests and diseases, are the variables applied for used for breeding programmes in African countries particularly, Nigeria. JIRCAS has no on-going project with Kenya.

- Due to deforestation and forest degradation in the tropics in search of agricultural land, appropriate countermeasures based on the causes must be found that address the following fundamental issues on how:
  - Much potential harvest is allowable for a healthy regeneration of a rich forest.
  - We can improve techniques to support the survival of newly established stands in degraded areas.
  - We can use the forests sustainably.
  - We can utilise the harvested plantation trees efficiently.
- The biggest challenge is development of management techniques that promote the use of forests sustainably as response to causes of deforestation and degradation.


A group photo outside JIRCAS offices


One of the participants inside a Mango orchard


Different tree species planted for preservation including *Tamarindus indica*


Pawpaw fruits are one of those being studied by JIRCAS

Yaeyama Forestry Cooperative (YFC)

Yaeyama Islands Forestry Cooperative is one of the 629 cooperative societies in Japan. It is also one of the five forest cooperatives in Okinawa prefecture. It was approved by the Government in 1977. Forests in Yaeyama Islands occupy 30%, which is low by Japanese standards, hence the need to create Yaeyama Forestry Cooperative to increase the forest cover. The YFC is composed of 95 regular and 184 associate members who are drawn from the three neighbouring Islands, namely; Ishigaki, Taketomi and Yanaguni.

To be a regular member one must have in possession at least 0.3 ha of forest while an associate member pays a certain amount of money as membership fee. The Cooperative is managed by a board of management chaired by the Ishigaki Mayor.

The YFC facilities belong to the Prefectural government but entrust to the cooperative to carry their activities and ensure benefits to the members, which include:

- Afforestation and reforestation.
- Planting and replacement of windbreaks along the coast.
- Seedlings production.
- Pests and disease control.
- Thinning operations and windfall removal.
- Management under the watch of FTBC.
- Charcoal production.
- Timber production.
- Training of forest personnel.
- Protection of birds, animals and sea wildlife as Ishigaki is a tourism island.
- Protection of seas, rivers and scenery from erosion.
- Guiding members to write proposals to secure relevant Prefectural government contracts or financial support to undertake activities in their forests.

The YFC's charcoal production activities were limited, it was interesting that the kiln used made a recovery of 40%. This is packaged into 3 and 5 kg cartons ready for the market.

Besides the use of Prefectural owned facilities members also get subsidy from the prefectural government as an incentive. The YFC also act in the interest of farmers because the farmers are not experts in forest management.


Discussion with Yaeyama Forestry Cooperative (YFC) officials


Type of charcoal kiln used by YFC


Charcoal threshing machine


Meeting with the Mayor of Ishigaki Mr. Yoshitaki Nakayama who is also the chairman of Yaeyama cooperative


The mayor of Ishigaki who is the chairman of Yaeyama cooperative addressing members during the annual general meeting


One of the Kenyan participants, shares experience during the annual general meeting

Iriomote Tropical Tree Breeding Technical Garden (ITTBTG)

Dr. Chigira Osamu, Director ITTBTG

Location of Iriomote Island

ITTBTG is situated in Iriomote Island, south-west part of Japan. The Island has an area of 29,000 ha with sub-tropical forests occupying 90% of the total land area. Though the population is only 2,300 people, Iriomote Island is a major tourist destination in Japan receiving an average of 350,000 tourists annually due to its favourable climate, despite the typhoons and high rainfall. Iriomote island is famous for the many endemic species of flora and fauna, in particular the mangroves and the Iriomote cat. The island is prone to damage by salty sea water and typhoons with average of 4 typhoons occurring annually.

Activities of ITTBTG

The ITTBTG was established in 1996 with main of objective of breeding tropical tree species. Research on forest tree breeding has been undertaken on the following:

- Development of forming and pruning technology for scion garden of Acacia.
- Development of clonal propagation technology for Acacia and Eucalyptus species.
- Evaluation of seed storage period of Acacia and Eucalyptus species.
- Development of a manual on tree breeding technology of fast growing tree species.

Recently, the Institute has been undertaking research in collaboration with a private wood company and Kyushu university on Acacia tree species in the following areas:

- Examination for inducement of tree form of Acacia *auriculiformis*.
- Investigation on flowering period of Acacia species.
- Artificial pollination system of Acacia species.
- Examination of pollen germination after storage as *Acacia mangium* and *Acacia auricuriformis* do not flower at the same time.

All these are aimed at producing a superior acacia hybrid. *Acacia mangium* is fast growing but is prone to heart rot disease, while *Acacia auricuriformis* is slow growing but resistant to heart rot. So the objective is to produce a hybrid of the two species which is fast growing and tolerant to heart rot and can be used mainly for paper making.

Other research work being done in this station, include:

- Breeding study on windbreak performance in *Calophyllum inophyllum*.
- Propagation technology in useful domestic tree species.

Calophyllum inophyllum is also useful for ornamental purpose, timber production, cosmetic and medicine. Candidate plus trees were selected in Taiwan, Fiji and Japan. Selection gave parent material with wide genetic diversity. Progeny seed stand has been established where controlled pollination is being undertaken. Use of this technique as opposed to use of cutting ensures that wide genetic diversity in maintained.
Preliminary results showed that Taiwan provenance were doing better in terms of height growth compared to Japanese provenances. A challenge in breeding is how to use such good genetic resource as a country may not discard own genetic material.


Grafting lessons


Practicing grafting

Tropical Trees Garden

There is a tropical tree garden at ITTBTG. Different tree species found within the tropics and subtropics of Africa and Asia are managed. About 200 different tree species were planted in this garden but currently only about 40% are surviving due to effects of typhoons and establishment problems. The Garden acts as a gene bank for the various tree species planted for biodiversity conservation.

Propagation through air-layering is also undertaken on some of the species within the garden. Some of the tree species at the Garden include: *Eucalyptus camaldulensis, Eucalyptus urophylla, Eucalyptus grandis, Tamarindus indica, Mangifera indica,*

Citrus species, *Averrhoa carambola* (star fruit tree), Ficus species, *Jacaranda mimosaefolia*, and *Delonix regia*, among other species.

Iriomote Wildlife Centre (IWC)

This centre is located next to the Tree Breeding Centre. It is managed by Iriomote-Ishigaki National Park. IWC attracts many tourists every year. The centre is mandated to do the following:

- Research and study to monitor the present status of wildlife in the island ecosystem.
- Planning and promotion of conservation projects for endangered wildlife species e.g. the Iriomote cat (*Felis iriomotensis*), a species endemic to the island and a symbol of wildlife in Iriomote.
- Visitor services to inform about nature and culture of the island and wildlife conservation such as:-
  - Wide collection of photos and artifacts of wildlife in the forests.
  - Wide publicity on the endemic flora and fauna species.

Iriomote Wildlife Centre and wildlife conservation in Japan faces a number of challenges, specifically on the Iriomote cat. They include:

- Traffic-related accidents to wildlife by motorists.
- Diseases transmitted to wildlife from domestic animals.
- Habitat reduction due to fragmentation.
- Predation by feral dogs.

However, measures put in place to address the challenges include:

- Wildlife notice boards for motorists to take great care in wildlife habitat areas by driving at speed 40 km per hour.
- Treatment services for such injured wildlife.
- Capture, clinical observation and radio tracking.
- Photo traps in areas where the cats are common to study their behaviour.

Lessons Learnt from Iriomote Visit

1. Demand-driven research to address real life issues such as windbreaks for reducing effects of typhoons. Viability of inter-country collaboration in development of tree breeding techniques and involvement of the private sector in collaborative research work.
2. Relevance of grafting tropical hardwoods for superior seed production within short period.
3. Importance and need for genetic and biodiversity conservation through botanical gardens, gene banks.
4. Development of simple and effective artificial pollination methods between *A. mangium* and *A. auriculiformis*.
5. Hands-on experience (Dos and Don'ts) in top and side grafting exercise of indigenous hardwoods (broad leaved trees) by all participants.
6. Need to document the richness in culture, endemic and other species of flora and fauna in an area.
7. Elaborate transport system and infrastructure for ease of transportation of people and goods (road, air and water).

Field Trial Visits at FTBC Iriomote

- The field trial sites were an integral component of on-going research activities at the FTBC Iriomote.
- It was noted that Japan is recognised as the 4th World Disaster rated country. Agents of disaster include strong winds and typhoons, heavy snow, floods, earth quakes and landslides, among others. Therefore, forest tree breeding aimed at coping with these agents is a priority. Heavy and fast weed growth is also a serious management issue because of the high weeding cost involved. Fast height growth, light, and moisture preference among other traits are target of research.
- Ability to withstand strong winds and typhoons; resistant to breakage; by strong winds, tolerance to salty water from the sea, prevailing water levels, soil moisture and pH, low temperatures hence cold shock, capacity for fast tree growth in order to outcompete weeds, and ability to act as wind break to protect sugarcane plantations, are some of the key parameters evaluated at the trial site.
  - Key species under trials include *Calophyllum inophyllum* and *Acacia mangium*. Besides their service functions, *C. inophyllum* is also valued for it strong wood properties, essential oils and medicinal use. However, its growth is limited to the southern-most part of Japan though with global warming it could spread northwards. The species is now being grown along coastal areas of Kenya.
  - The trial site species are derived from progeny seed, whose traceability can be verified while spacing is at 2 x 2 m.
  - Mangrove species and ecosystems were also under study such mangrove physiology, and assessing useful genes for salt tolerance. They were also noted to be prone to typhoon damage. Common species, which are also found in Kenya included, *Bruguiera, Avicenia marina* and *Rhizophora* species.

The Annual General Convention of the Yaeyama Forestry Cooperative

- The Kenya team appreciates the recognition, invitation and honour extended to be in attendance at the 39th Annual General Convention of the Yaeyama Forestry Co-Operative at the Okinawa Ishigaki Hotel Miyahira.
- The meeting was chaired by His Worship the Mayor of Ishigaki City Mr. Yoshitaka Nakayama and deputised by Mr. Ishigaki Sousei. The chair welcomed and introduced the Kenya team as Government of Kenya officials who through JICA and FTBC had visit and interacted with the Co-operative's officials at their facilities located in Banna South on its activities, achievements, challenges and opportunities.
- The Kenyan team appreciated the opportunity to learn and the honour to address the audience, expressing that the meeting was a good idea and with that comes a better idea. Thus their success was founded on members' capacity to reflect on their past activities, achievements and challenges as well as their application of lessons learnt to build on their future success.
- Noting that membership was categorised as either regular or associate, the team chided the members to introduce yet another category of "honorary member" to accommodate attendance of future teams to YFC conventions.
- It was observed that the deliberations were timely, documented, each member in attendance provided with a printed copy of the deliberations, patience and

concurrence on past and planned activities. These are vital lessons that Kenyan cooperatives could emulate.

Lessons Learnt

1. Integrate a multidisciplinary approach to breeding Melia and other key species for their identified and potential benefits as well as their ability to address current identified environmental challenges.
2. Appreciate that the results may not be realised in the short term but commitment and consistency are crucial in any endeavour.
3. Breed for various characteristics. Melia could be bred for fast growth, straight stem, wood characteristics, drought tolerance, and genetic diversity.
4. Trees are an integral part of many agricultural based activities such fish, windbreak for crops, over various ecological service such stabilising land against wind and soil erosion, values which can be used create awareness for intensifying tree planting of improved varieties.

Forest Agency – Courtesy Call, Mr. Koji Hongo, Director General, Private Forest Department, Forest Agency

- The Director General appreciated that the team from Kenya was in Japan to learn about tree breeding and was happy that lecture on same had been given while the group visited FTBC at Takahagi.
- Two-thirds ($^2/_3$) of Japan is covered by forest, which is favoured by the warm - wet climate. However, like in Kenya much of forest is being lost due to change of land to agriculture and settlement. The loss is due to the large and increasing human population, which stands at more than 100 million people. Much of forest in Japan is now only found in the mountain, which is important water catchment area, hence the need to conserve these forests.
- Though the climate, challenges and drivers for deforestation in Japan and Kenya are different, the principle of afforestation by the two countries is similar. The forests in the two countries are also utilised for livelihood. Therefore, the two countries can share information on conservation and sustainable use of forests.
- Breeding takes long but the fruits are improved forestry status. Tree breeding will influence afforestation policy direction. In Japan, the pine and cedar species have been selected and bred for planting in the mountains for ecological and economic purpose. The species haven been bred for fast growth, which is expected to change profitability of tree growing. In Kenya, Melia and Acacia, species suitable for drylands have been selected for reforestation programme in Kitui and counties with similar climatic conditions.
- Director would be happy if this training is useful for Kenya through passing knowledge that would contribute to improved livelihood of communities in Kenya.

Lessons Learnt

- Forest cover in Japan is over 67% which has been achieved through conservation and reforestation by use of improved tree varieties. The link between research and forest development especially tree breeding and extension has contributed a great deal to the high forest cover in Japan.

- Forestry is a very important sector as it addresses challenges brought about by climatic disasters and other natural calamities such as earth quakes, snow, typhoons are all addressed by use of forests and trees.
- Research is advanced, stable and evolving due to application of high technological processes. As participants the knowledge of practice has been improved through visits to trial sites, seed and clonal orchards, institutional and private tree nurseries, and carrying out practical activities such as grafting.
- Research results should be used for improving communities' livelihoods. In case of Melia, the on-going collaborative activities and knowledge sharing between Kenya and Japan will help drive forestry development in the dryland of Kenya.
- Japan has 47 Prefectures, which are the consumers on forestry research from FTBC. Similarly, Kenya has 47 Counties, in which KFS will drive extension, hence the need for greater links in research-extension continuum to ensure adoption of forestry technologies.
- Results of collaborative research work between Kenya and Japan will be shared in many countries in Africa through the TCTP and SADC Block to enhance mitigation and adaptation to climate change in Africa.
- The tree-based products displayed at MAFF's Forest Agency was a clear manifestation of an existing and potential capacity to produce a range of useful tree products by the wood based industries at different levels.

Kinki-Chugoku National Forest Regional office, Forest Agency

- A branch of the Forest Agency equivalent of KFS's Conservancy headed by Head of Conservancy (HoC).
- A warm welcome and courteous background address by Mr. Kazuhiro Baba, Director General of the Regional Office.
- The location of the Regional Office and its 4 District offices relation to other regions of Japan was outlined.
- The Regional office administers 320,000 ha of the National forest in the area covering Kyoto, Okayama and Kyushu.
- The focus is on *Melia azadarach* whose desirable characteristics are expressed by fast growth, straightness and good economic returns.

The team appreciated the welcome and opportunity presented to training in Japan and visit to the Region. The team looked forward to understanding how the Japanese were doing better in forestry issues and would be grateful share experiences on how to plant and treat *Melia azadarach* with respect to the changing forestry situation in Japan.

Discussion with Director General Kinki-Chugoku National Forest Regional Office, Forest Agency. On the table are various forest products that they assist farmers to get markets

Overview of the Planting Trials for the Fast Growing Species
Mr. Hideaki Takai - Director Department of Forestry Operations

Kinki-Chugoku Regional Forest Office National Forest has offices in 14 prefectures, served by 455 members who include 40 district forest officers. National Forest covers an area of 320,000 ha with natural forests comprising 46% which include protected forest reserves, cultural heritage forest, religious places and volcanic mountain areas. Plantation forest covers an area of 47% with Sugi (*Cryptomeria japonica*, Japanese cedar) and Hinoki (cypress) as main species.

Both species are softwoods and generally mature at about 50 years, during which time they are thinned twice. Currently, softwood plantations are not attractive to forest owners due to: high labour cost involved e.g. frequent weeding when the crop is young; and low price for softwood timber. Lower prices are attributed to competition from imported hard wood timber, which is cheaper, and the changes in ex-change rates. Japan has about 67% forest cover. There is need to develop profitable forest management models so that so that monetary value is attached to these forests. The endeavour will consequently attract forest owners to invest in tree farming. Hardwoods have a high market demand. However, these species are only harvested from natural forests, which could lead to over-harvesting. There is therefore, need to have plantation species that can meet demand or replace hardwood in the markets.

Sample of a product from Melia azadarach wood

Group photo with Director Department of Forestry Operations

Fast Growing Species (FGS)
Fast growing species will help investors to have shorter payback time as opposed to waiting for 50years for trees to mature. In the past, thinning were profitable in Japan but currently there use is limited to biomass production or paper making, which is less valuable.

Demand for hardwood is still high especially for external and internal finishing, furniture or craft making. Softwood is usually used for structural work. It is currently not very easy to import hardwood especially from tropical countries, therefore, Japan need to develop its own forest plantations by using fast growing species.

Trials on FGS - to reduce costs of forest management through reduction in number of weeding by selecting for fast growth are being undertaken. Rainfall and temperature in Japan is favourable for tree growing.

Testing *Melia azadarach* (Sendan, Persian lilac)
Melia azadarach is naturalized in Japan as it was introduced in over 400 years ago. It is fast growing, producing good quality timber after 20 years. Melia timber is useful as thin slices that can be used to laminate other species. Species has good market appeal as it resembles mahogany or *Zelkova serrate*, both species are rare to find.

Challenges to Growing *Melia azadarach*
- Inadequate seed as species in not found in plantations but in ornamental gardens. The only plantation forest of *M. azadarach* is at Kumamoto, However, it is a first generation plantation. The genetic material for the Melia being planted is unknown so the characteristics of the grown trees will vary.
- Damage by wild deer and frost. In Kenya, the tree is reported to have die-back during the dry periods.
- Research is relatively new in Japan. However, the species is thought to have good potential for wood production. Genetic potential is not known.
- *M. azadarach* is not used for timber production in other Asian countries. In Kenya, the species is not grown for timber but medicinal and ornamental value.

Appealing Attributes for Growing Melia in Japan include:
- Rapid growth, especially in the early stage.
- Easy seedling production.
- Good site adaptability in a variety of climate and soil conditions in Japan.
- Easy silviculture.
- Free from insect attack, pest/diseases or animal damage.
- High quality timber with a good mark value.

Lessons for Kenya
1. Explore possibilities and performance of establishing *Melia azadarach* as a plantation species for on-farm cultivation.
2. Melia is fast growing and has good timber qualities that can be exploited, especially in veneer making which add value to other wood products. Due to potential uses of Melia, Kenya could also start seed collection to establish a seed orchard of the species to conserve material of high genetic value.
3. To avoid die back Melia species could be promoted in cooler climatic conditions.
4. Need for Kenya to identify fast growing indigenous species other than *Melia volkensii* to meet national and international demand for hardwood. Different species to be selected for dryland and high altitude cooler regions.

Kyoto Prefectural University Research Forest (*Melia azadarach* Test site) Professor Hisashi Miyafuji - Laboratory of Forest Resource Circulatory System, Division of Environmental Science

Background
Kyoto Prefectural University was started about 120 years ago and has a division which deals with research in forestry. The university has 6 well established forest areas within the prefecture. The Ohno forest is one of the 6 forests owned by the university which was developed for purposes of research and education. It covers an area of 402 ha with Japanese cedar (*Cryptomeria japonica*) and Japanese cypress (Hiroki) being the dominant species. The forest also has other indigenous tree species. The university has a centre with established infrastructure where students undertake their field education.

Research on Melia
- The university has embarked on research on *Melia azedarach* (Sendan) which is in the family of Meliaceae. The species, which is naturalised in Japan is fast growing and produces good quality timber after 20 years. Melia timber has characteristics similar to those of Mahogany, making it a high value species.
- Melia seedlings for research by the university are bought from Kumamoto in Kyushu area where they are available otherwise it is a challenge to get seedlings from any other part of Japan. Within Ohno forest, 30 experimental seedlings were planted when they were 1 m tall. The experimental variable include with and without fertilizer (NPK ratio 10:10:10). Data collected include: tree height and diameter of the trees which are collected every month. Data (), on rainfall collected using a rain gauge) temperature using a data logger are also collected.

- The experimental trees are planted in two sites; one site has two, planted 2years ago and the other site which has about 70% slope has 28 trees. Of these 28 twenty (20) were planted one year ago while the other 8 were planted 2years back.
- Preliminary results indicate that trees that were planted with fertilizer were taller and had larger diameter than those planted without fertilizer. At 2 years trees planted with fertilizer had attained an average height of 5.5 m
- The greatest challenge to the survival of Melia tree seedling was damage by Deers. However, the university had taken measures to protect the trees by surrounding them with netted material.
- Melia may also not do well in very cold areas and should be planted in warmer areas.

Kyoto Prefectural University has a tree nursery within its premises where experiments are conducted. As at July 2016, the nursery had about 100 *Melia azadarach* seedlings being used for various experiments by the students.

Melia azadarach planted one year ago

Melia azadarach planted 2 years ago

A Japanese charcoal metal kiln

An over 20 year old *Melia azadarach*

Japanese Charcoal Metal Kiln
The University has a section within the Ohno forest where they conduct demonstrations on charcoal production. They have a Japanese charcoal kiln which is normally used by students to learn skills on charcoal production.

The kilns are made of stainless steel and consist of three interlocking cylindrical sectors and a conical cover. The bottom cylinder has eight air inlet/outlet channels arranged

radially at the base. Kiln operates on reverse drought principle where carbonization starts from the top and progressing on downwards and is aided by chimneys situated around the base of the kiln. The process provides better carbonization control and yield of up to 30% recovery. For effective productivity of charcoal the drum must be filled with wood. The portable kilns are easily movable to sites where raw materials are located. The production cycle is short 16-24 hours.

This technology has already been adopted in Kenya and a programme supported by UNDP supported a number of Charcoal Producer Associations in various regions served by Kenya Forest Service. The only noted challenge is the cost of the Kiln which is about ¥ 200,000-300,000.

Forest Tree Breeding Centre FTBC - Kansai Breeding Station

- Brief welcome by the Director General.
- FTBC – Kansai is located in Tsuyama City, Okayama Prefecture. The Prefecture has a population of over two million people.
- The area generally experiences Mediterranean type of climate caused by surrounding mountains, hence low precipitation. The moisture laden wind that bring rains come from Japanese sea side, which also suffers from great snow fall in winter.
- The Centre serves 19 prefectures and operates on a land area of 19.89 ha.

Major Tasks of the Centre

Development of new tree varieties

- The current material of Sugi and Hinoki being harvested is from F1 generation. The centre has set up trial of F2 generation of the two species to select second and advanced generation plus trees of varieties with better growth, superior wood quality, nematode resistance, superiority in carbon fixation, and less or no pollen production.
- The trees are artificially pollinated to produce second generation materials. Selection is done to identify clones that are good for pollen collection. Once such male clones start flowering the branches with flowers are harvested and put in the greenhouse to accelerate pollen production. The pollen is then used to pollinate specific clones in the clonal seed orchard.
- Seedlings for plantation trees are produced from clonal seed orchards established from the first generation plus trees.
- Seedlings produced are distributed to the Prefectural governments for distribution to the forest owners for planting. The Centre gives the seedlings free to the Prefectural government (the Central government provides funds for research).
- Annual seedlings production ranges from 5,000 to 6,000 of the most popular tree species, namely Sugi, Cypress and the Pines.
- Research work on development of new varieties is done together with the Prefectural governments and other research institutions.

Breeding Pine wood for nematode resistance

- Pine wood nematode (*Bursaphelenchus xylophilus*) causes pine wilt disease. It is spread by the long horn beetle.
- The disease was first noticed around port of Nagasaki in 1905.

- It became epidemic in 1960s in western Japan and spread all over the Japan except Hokkaido area.
- FTBC - Kansai Regional Office has developed nematode resistant pine species (both red and black pines).
- Pine cones are collected from the remaining trees in an area that has suffered nematode outbreak because such trees have shown resistance to nematode attack.
- Collected seeds are extracted and sown in seedbeds. Emergent seedlings are then inoculated with the nematode extract.

Some seedlings will show effects and attack as either dying or dead after some months. The surviving ones are selected for transplanting in seed orchards due to their display of superior and high resistance to nematode attack.

Collection and conservation of forest tree genetic resources

- The centre is also involved in conservation of forest genetic resources for endangered species, natural monuments and/ or trees of community important gene. Collected genetic materials are kept in form of pollen, seeds, and planted trees.(example of a tree spp. found in the royal family compound in Tokyo city), .
- Natural heritage trees found in people's private land can also been preserved on request. Some of these trees are conserved by communities for religious purposes. To conserve such trees the Institute grafts or clones about 5-10 seedlings gives to the owners the bulk of seedlings and keeps about 3 in their centre for preservation.
- The result of conducted trait analysis to gauge potential use of these genetic material and other research findings are posted in the open access data base for wider dissemination.

Further Research Work

- On-going research work is also focused on *Melia azadarach* since the species has been identified as having great potential for afforestation programme in Japan, However, the research is still at the initial stage and no seedlings have been produced for planting/mass propagation.

Lessons Learnt

- Research programmes for National heritage and endangered tree spp. such as special fig tree (Moraceae) and Osiris should be launched.
- County governments to be encouraged to invest in seedlings production to assist the farmers.
- In addition, to *Melia volkensii*, Kenya could explore the plantation potential of *Melia azadarach* in appropriate areas.

Sign board of the office


Clones being produced in the greenhouse


Displaying a rooting hormone used on the clones


Nursery fence to protects against Deers

Okayama Prefectural Technology Centre for Agriculture, Forestry and Fisheries

The station deals with research on the following:

- Tree breeding technology.
- Mushroom production.
- Management of machinery technology.
- Research on containers.
- Cedar with less pollen.
- Protection from deer fence.
- Harvesting technology using wire convers for forest owners.
- Small scale harvesting using winches.
- Students training.
- Extension work.
- Presentation of research findings.
- Creation and maintenance of botanical gardens.
- Planting on walls technology.
- Protection for frost burns for chest nuts using wood chips and bandage.
- Charcoal production technology.
- Timber drying kilns.
- Road damage research by natural disasters.
- Quality of wood products.


Weeding is done by machine to establish new clonal orchards


Production of cedar clones for orchard establishment


A simple charcoal metal kiln used by the prefecture centre


Portable metal charcoal kiln

- The established seed orchards cones are prone to stinking bug attacks which affects the viability of the seeds. They are controlled by spraying chemicals. Pine nematodes are controlled by the use of acetamide chemical.
- The area for cypress tree breeding is rotated every five thus encouraging biological control. Weeding is continuously done as need arises.
- The seed orchard is improved by cutting down non-performers and replacing them with new ones.
- This is the only institute which produce tree seeds in the whole prefecture, thus they must meet the demand. They concentrate on tree major species; cedar, cypress and black and red pine. They base their prices with the germination rate of each species. The higher the rate, the higher the price unlike in Kenya where the price is tagged on collection cost.
- Farmers in this prefecture prefer cypress to pine.
- Red pine resin used to make circuit in cell phones, cosmetics, tyres, paper (in USA and Brazil). In Kenya, resin is harvested from *Pinus elliotii*.
- Charcoal is made from red pine using metal kilns with a recovery rate of 20% and is used to make Japanese salt, by blacksmiths to make agricultural equipment. Portable metal kilns measuring 0.6 m x 0.8 m x 0.5 m have been developed by the institute and can be very useful in our Kenyan situation.

Toyonami Seedlings Cooperative – Mr. Syuzo Nagahata

- Six members form the Nagahata Seeds and Plants Cooperative.
- They source seeds from Okayama Research Institute and they have seedlings throughout the year.
- We were taken through a demonstration using an improvised planting bar.
- Last year they sold 50,000 seedlings to farmers.
- Half of the seedlings in this Prefecture come from this cooperative.
- They have seedlings in recyclable containers and bare-rooted in Swaziland beds.
- They get technical support from the prefectural institute.
- Future plans are sowing the seeds directly in containers to avoid transplanting using green houses.
- It is allowable to move seedlings from north region to southern region but the reverse prohibited.
- Quality of seedlings must be assured and that is why the cooperatives must be registered.
- Nagahata-san has gone a notch higher as Nagahata Seeds and Plants Co. to produce his own seedlings which he sells through the cooperative.

Quality seedlings in the Tayonami Cooperative nursery

The Cooperative chairman shows the plants raised in containers

The challenges faced by the cooperative are: technological transformation and succession after aging.

The Cooperative assists the farmers in:

- Sales coordination.
- Purchase of materials for production.
- Transportation of seedlings.
- Hiring of an accountant.

The rainfall in this region is 2,000 mm annually and well distributed, so no irrigation is required.

Seedlings are transported in batches of 300, which is labeled with one tag and are planted in an area of 1,000 m^2.

Inosho Forestry Company Limited

- The factory has 300 employees.
- They are manufacturers of skeleton material for house construction. The materials especially the beams are made solely of Japanese cypress. These beams of 4 x 4 inches are cut from the middle part of the log.
- The length of the beams depends on demand but range from 4-6 m.
- Across the road the factory has a Branch, which manufactures laminated beams using imported timber from Europe.
- They have a Department which deals with precast wood. The Department cuts and makes joints which are meant to fit instead of using iron nails.
- Another Department produces prefabricated houses.
- They sell their products all over Japan.
- Trees in Japan are planted mostly in mountainous areas making it difficult to harvest even when they mature. This is a challenge for the forestry industry.
- The factory has started a new activity of making poles.
- They get their materials from private forests where they harvest and assist in afforesting the same areas.
- The factory leads in manufacturing of construction materials and is rated 9th in the production of laminated materials.

Sorting out the timber

The finished beams of 4 x 4 inches ready to be delivered in the markets

Visit to Ino-Cho Kamino Museum, Ito Primary School and Ino-Cho Municipality

Ino-Cho Kamino Museum

The museum is located in Kochi Prefecture. It contains various collections of the history and the changes of the Japanese traditional paper (Washi) and the variety (Tosa Washi) produced, which dates back to more than one thousand years. The museum also gives an account of how Washi was used and what role it performed in the community and in general paper manufacturing industry.

Participants practicing traditional paper making as it used to be done

Stage of draining out water in the process of paper making

The curator of the museum explains the history of paper making

Sources of Japanese paper making materials include Mulberry (Koba) and Mitsumata (Oriental paper bush)

The main source of material for the Japanese paper making was plants which included the paper mulberry (Koba) and Mitsumata (oriental paper bush). A collection of the tools used in the handmade paper manufacture which includes handmade screen, cutting tools, silk, frames among other items are also on display in this museum. Contrary to the current conventional way of making paper using the wood, the Japanese paper was made using the bark of the plants.

The process of making paper commenced with getting the fibres from the bark, pulping the fibres by soaking into water and then forming a slur of the fibres and water. The slur is the put on frames which have sieves below to allow drainage of water through gentle shaking. The sieved material is then dried to form the paper.

The frames used determine the size of the paper but after drying the sheets can be cut into the required sizes. Any waste realised while sizing the paper is taken back into the process to make more hence there is no waste.

For many years this paper has been used to make paper screens for doors and windows in Japanese houses. The paper has also been used widely in drawings and art work. This paper contributed to the current day type writing and record keeping through written materials not to forget the development of paper money in the earlier days.

Ino-Cho Kmiya Primary School

This school is located in Ino Municipality in Kochi prefecture and has a student population on 31 students. The elementary school was built during the Meiji period

(1868-1912) but despite this, the school is widely known for being the home of one of the oldest *Melia azadarach* trees in the area. This tree which is believed to have been planted at the end of the Edo period (1603-1868) by the then village headman of Kohnotani is regarded very highly by the school fraternity and the community of Ino City.

The treasured Melia tree seen in the background is a protected cultural asset in Kochi Prefecture

Currently, this tree has a height of 18.8 m and dbh of 102 cm. This tree is the symbol of the school and the anthem of the school recites and celebrates about this tree which on 15th January, 1968 was designated as one of the protected cultural assets of Ino Town and a tree of historic interest in Kochi Prefecture.

Ito Ringyo Timber Company

- This is a family based timber company that specialises in extraction of timber (round wood) from the forests for sale to other timber industries undertaking timber conversion works. According to the President of the company, they specialise only in logging activities and have invested in heavy extraction machinery and the necessary equipment for logging.
- Due to the steep gradients and uneven terrains, crawlers fitted with winches are used for skidding the logs.
- The company also deploys the machinery to open up forest roads to access the plantations deep in the forest areas. Though road construction is expensive, the company receives subsidy of up to 60% on the construction works and the machinery procured for forestry work.
- This company mainly deals with *Cryptomeria japonica* and *Chamaecyparis obtusa* (Sugi and Hinoki) as the major species for house construction works while red pines are used to make pallets for packaging of goods for transportation and export.
- At the forest logging site the following activities were witnessed:
  - Directional felling of selected trees in the thinning plantation.
  - Skidding of the felled logs along the extraction rides.
  - De-branching the logs using a processor machine.
  - Cross cutting logs into the required log sizes of 3 and 4 m.

- Heaping the logs and loading onto the Lorries using loaders.

- The logs are transported into the temporary holding yard where upon off-loading the following activities are done:
  - Sorting the logs into size classes.
  - Separating insect affected logs from the other materials.
  - Separating crooked logs and any damaged logs during transportation.
  - Debarking of the logs.
- The sorted logs are then loaded onto trucks for delivery to the other sawmills for conversion.
- This company is achieving very high recovery because apart from the stump, it sells almost every part of the tree. The branches, twigs and leaves are all sold to the wood chipping companies for paper and chip board manufacture or as biomass for energy.
- Ito Ringyo Timber Company has collaborated with the Municipality and the Forest Agency to establish seed orchard in the forest.

Lessons Learnt

1. Specialisation is necessary in forest operations such as logging.
2. Recognition of cultural assets, innovations and the history of the nation for future generations and development.

The storage bay for logs after harvesting and transporting them from the forest

The small branches and the leaves are collected together to be sold as bio fuel

Use of heavy machinery in extraction of logs from the plantation

Use of heavy machinery in loading logs for transportation to the sawmill

Director of Forest Policy Division explains the establishment of new plantations

Newly planted cedar in the plantation

Forestry Academy, Forestry Technical Centre and Makino Botanical Garden

The Forest Academy

- Development of human capacity is an integral part in providing the necessary knowledge and skills for meeting the demand for forestry and forest products. The wood industries, the forestry cooperatives and related sectors demand highly professional human resource with the knowledge and skills to handle modern scientific equipment, operate heavy-duty multi-purpose machinery, manage facilitates and forest/tree resources.
- The Forest Academy is located in Kochi Prefecture. The prefecture has a forest cover of 600,000 ha, which is 84% of the Prefectural land area. Of these, man-made forest comprises 39,000 ha or 65% of the total forest area with standing volume of 15,700,000 m^3. However, the age class distribution indicates a relatively small reforestation percentage.
- Use of forest resources is driven by an industrial utilisation plan which is defined by five pillars, namely:

Practical lesson on use of power saw in logging by students of the Academy

Participants in the Forest Academy's cedar tree orchard

  - Expansion for production.
  - Concept that all parts of the tree should be used for house construction, as laminated wood, and biomass.

  - Process of production of wood from downstream to upstream, as in distribution and sales.
  - Expansion of demand of wood materials.
  - Human resources development, hence the need to improve Forest Academy.
- The Forest Academy was started in 2015 by the Prefectural Government. The objective was to train highly skilled people who could be engaged in the forest industry after completing the one (1) year course. The Academy had a total of two classed each with 10 students.
- The training programme provided include basic and short-term activities, which are on-going and specialised training which has been planned for. The training consisted of 1,200 training hours. Unlike other training systems, Forest Academy adopted a skills-based approach upon which skill was awarded a certificate, hence a total of 12 Certificates each on successful completion of the course.
- Qualification for admission to the Forest Academy include:
  - Be 18 years or more. Currently the oldest student is 54years old.
  - Have completed junior high school.
- The annual cost of tuition is ¥ 128,000 per student. They also have to buy books and other relevant materials. An all-inclusive cost is ¥ 330,000. However, the Central Government also offers scholarship to eligible applicants of up to ¥ 1.65 million to cater for accommodation and living expenses years, among others, provided the graduate will be engaged in the forestry industry for at least two years. In case of default, the recipient must refund all money offered through the scholarship.
- Employment opportunity for any successful student was 100% assured with the Prefectural government, Forest Companies and Forest Cooperatives.
- The Academy students successfully demonstrated a tactical tree felling practice in a section of the broad-leaved forest that was adjacent to a seed orchard. It was tactical as the trees being felled were not supposed to fall on and demand the adjacent seed orchard of Japanese cedar trees.

Lessons Learnt

1. That in a skill oriented training minimum number of students was critical to ensure that each student received as much attention they deserved to learn, observe and practice the specific skill(s).
2. Some forestry skills-oriented training are risky because they involve use of risk prone tools, equipment or heavy-machinery on steep mountain slopes.

Kochi Prefectural Forestry Technology Research Centre

- Sustainable utilisation of forest and forest resources is an important theme in Kochi Prefecture due to the many benefits derived from the resources and the need for their preservation.
- Of its 4 Divisions, Forest management and Research utilisation were drivers operations contributing to sustainable use, benefits and need to preserve the resources.
- The Research Centre produced and sold seeds from seed orchards to Forest cooperatives who in turn produced seedlings in either as bare-rooted or containers. The Forest cooperatives also sold seedlings to Forest owners for planting. In addition, the Research Centre transported the seedlings to the farmers' sites for planting.

- Producing seedlings in containers is a new development and assessment of performance is a joint undertaking.
- Research initiative on charcoal production was on-going, where production of two types of charcoal, namely: normal and specialised were being tested based on moisture content, temperature, carbon capacity and preference characteristics. The special charcoal despite requiring a temperature of up to 1,200°C presented the all desired qualities – higher density, higher in carbon, no impurities, odourless, smokeless but lower in production and demand high skill or experience to be successful. The regular charcoal requires 600-800°C, moderate skill but higher production.
- Research on strength testing particularly of laminated wood was being undertaken to ensure quality that would meet the needs of construction industry. A set of modern computerized testing equipment is vital in this respect.
- Research on cross laminated timber (CLT) expanded the total use of wood beyond timber, walling panels and plywood for construction and furniture industry, and the biomass.
- Other joint research activities the Centre was involved in included logging, extraction, cross-cutting, loading and transportation, which are heavily-mechanised and high risk field operations. The need for highly skill human resource in all these operations is critical.

Testing on cable strength for the winch at the prefectural forest research technology centre

One of the cables whose properties are being researched on by the centre

Makino Botanical Garden

- The Makino Botanical Garden (MBG) is located in Kochi Prefecture. It is an initiative of the Kochi Prefectural Government, and named after a re-known Japanese Botanist and father of Japanese systematic botany, Dr. Tomitaro Makino (1862-1957). The Garden was opened to the public in 1958 to commemorate his achievements. To-date, the facility is prioritised as an institute of international standing – a research institute – (herbarium and chemical analysis labs) and a special recreational facility.
- MBG is located on a 18 ha of land, with a collection of 3,200 plant species. Of the collection, 1,500 species are attributed to Dr. Makino who was the first to name or collected and introduced the plants. The collections which include; Kochi, Japan

and Japanese traditional plants, as well as South-east Asia, are established in a natural setting or in facilities that are suitable for their growth and management. The MBG setting, facilities, circulation, water courses, and amenities are in harmony with the landscape and plant collection (indoor or outdoor).

- The white blooming *Melia azedarach* L. f albiflora Makino is also grown in MBG. Among the special plant collections are the orchids, particularly the "Houstsu" whose 1990s value was equivalent to the price of gold (1bulb at ¥ 3 million but now down to ¥10,000). The other special collection is a cherry tree donated by His Majesty the Japanese Emperor.
- MBG's research Herbarium plays an important in ensuring that specimen of all living collections are collected and preserved as appropriate. MBG serves as a special a gene bank for *in-situ* and *ex-situ* conservation of plants of different values. To-date, there are about 270,000 identified, mounted, and documented specimen in the Herbarium. It still continues to receive specimen from local volunteers and through international collaboration activities in Asia and America, while there is non-from Africa.
- Receiving and preparing specimen is a delicate process. Due diligence is a requirement to process, document, preserve and ensure that the specimen are free of damage, unwarranted moisture content or pests in storage, hence increase their storage-life. The storage facility is can hold up to 500,000 specimen, hence there are 230,000 places to hold more specimen. This could take about 23 years to accomplish.

Lessons Learnt

1. Need to involve interns and volunteers in the collection, documentation of the collection.
2. Botanical gardens are special a gene bank for *in-situ* and *ex-situ* conservation of plants of different values.
3. Need for due diligence and interest.
4. Need to link Herbarium work to a special chemical analysis laboratory – DNA, active chemical ingredients.

Map showing the design of the Botanical Garden

Preservation of tree specimen inside the botanical garden laboratory

Learning about the various tree species in the botanical garden

Kochi Otoyo Sawmills

This sawmill is situated in Kocho Prefecture Nagaoka-gun, Otoyo City. It was established in 2012 by Meiken Lamwood Corporation, Koch Prefecture forest association, Otoyo City and Kochi material production industry limited. . The sawmilling activities which started in August 2013 were based on a new production system which aims at material production, distribution and timber sales to support efficiency. The sawmill hopes to increase productivity by building on efficient work process, reduce processing costs, enhance cost saving and environmental protection through biomass utilisation. The company produces post foundation beams, Mabashira (stud), lamellass from Japanese cedar and cypress. About 99% of material for timbers is sourced from Kochi Prefecture.

The factory has capacity to hold 4,000 – 5,000 m^3 of wood and projected raw material to increase with time. The factory also has capacity to store processed materials for three months. In 2015, it projected raw wood consumption of 100,000 m^3 but only 74,000 m^3 was processed.

The company employs about 60 employees, of which 55 are locally from Kochi. The company also pays taxes to the town, thus contribute to revenue generation. In Japan, imported wood is cheaper than local wood. Therefore, through such mills the country is enhancing utilisation of natural raw materials, especially from thinnings.

Raw logs in the yard

Debarking process

Sorting and grading of sawn timber

Labelled and wrapped finished products ready for market

Wood processing

Raw logs

Logs brought into the company are sorted out by species (Cedar and cypress) and then by size where length is either 3 or 4 m and diameter 16-36 cm, straightness of log

Timber plant

This included the ring barker where the log is striped off the bark. Bark material is conveyed to a stock yard and the log is conveyed for cutting with the larger side of stem being at the front. Logs facing otherwise are turned before being taken for splitting. This process is to ensure produced beams will be in the same direction in which they were while growing.

Bark along with wood chips and sawdust are used in energy biomass production where they are used for production of steam for power generation. The company generates 20% of its electric power requirement.

Log process

Logs from the field measure about 3,070-3,060 cm long. Both edges of such logs are trimmed to give a log of 3,050 cm. These logs are then dried at either 80^0C or 120^0C. Once dry the log ends are again cut to 3,000 cm long.

The finished products are sorted out by species weight, timber strength and allocated lot number and label. Labels indicate name of product, species, drying conditions, MC % size is it 105 x 105 mm or 120 x 120 mm, length, timber strength, and date of production. Currently, the recovery rate for lumber is about 40-45%. However, the company target is 50%.

3.0 International Symposium

Ecosystem Conservation in Public Forests Forestry and Forest Management in Kenya

Kenyan team sharing information during the symposium

Plenary discussions in the symposium

Background

- Government: National (1) and County Governments (47).
- Governance system: Presidential system, Representative democracy, Republic.
- Policy and Legislation: Vision 2030 (political, economic and social pillars); and New Constitution, 2010.
- The population is about 40 million people.

History of Forests in Kenya

- The importance of forests in Kenya was realized by the colonial government as early as 1900s. The first Forest Department was set up in 1902.
- 1957 that the first comprehensive Forest policy was drawn up.
- Forest policy was revised with a few modifications in 1968. The shamba system (taungya) was introduced.
- KEMP of 1994} which was a new forest dispensation cantered on community involvement, conservation and protection, decentralization and cost benefit sharing was introduced.
- The Kenya Forest Service, a body corporate was established under the Forests Act, 2005, commencing its operations in February 2007.

Mandate of KFS

- To enhance development, conservation and management of Kenya's forest resources base in all public forests, and assist County Governments to develop and manage forest resources on community and private lands for the equitable benefit of present and future generations.
- Mission: Conservation, sustainable development, management and utilisation of the country's forest resources for equitable benefit of present and future generations.
- Current tree cover is about 6.99%.

Conservancies (10) and Ecosystems

Criteria for a Conservancy and Ecosystem:

- Climatic conditions.
- Drainage systems.
- Soil types.
- Geographical feature.

Functions within Conservancies and Ecosystems

- Conserve, protect and manage all public forests in accordance with the provisions of the Act.
- Assist County Governments to build capacity for forestry development on community and private lands.
- Manage water catchment areas primarily for soil and water conservation, carbon sequestration and other environmental services.
- From its mandate and functions, KFS is therefore, both a service provider working with partners and stakeholders for the sustainable management and utilisation of forest resources, and an enforcement agency.

New and On-going Activities

- Capacity development project for sustainable forest management (JICA, GOK-KFS & KEFRI).
- Green schools and commercial tree planting (GOK).

Kenya Forestry Research Institute (KEFRI)

A key partner of KFS.

Mandate

- Conduct research in forestry and allied natural resources.
- Disseminate research findings.
- Establish partnerships and cooperate with other research organisations and in research and training.

Question	Answer
Is there animal damage in forest in Kenya?	In natural forest elephants cause a lot of damage to trees. A such forests are habitat for elephants, they may uproot trees to create paths
What is the major objective of Forest law in Kenya?	Law allow for conservation and utilisation in order to have sustainable forest management
Is *Melia volkensii* grown for wood production and how long does it to mature	Melia mainly grown for its high value and is being selected for fast growth, drought tolerant and straightness. The tree matures within 15 years
Tea factories offer good market for trees on-farm. is this not encouraging over harvesting?	Extension encouraging formers to conserve some trees on farm. Tea factories are being encouraged to plant own fuel plantations, use branches instead of whole trees, use alternative sources of energy to cure tea
How does forestry function within the 47 counties?	County is a new governance system in Kenya. Some forestry functions of the national government are being devolved and KFS is at the stage of training forestry officers of the county government

Forest Management and Ecosystem Conservation in National Forests by SRFMO

Background

Shikoku region consist of four prefectures. Tree planting within the region has been promoted since the 18th Century. Therefore, much of the forest in Shikoku is man-made (60%). Most of the forests are found in Kochi Prefecture.

National forests in Shikoku account for 10% of total land area and represent 13% of forest area in the region. Species distribution is highly influenced by altitude which varies from 0-2,000 m above sea level.

Mission of National Forest Management

- Promotion of public functions of forests.
- Ensure stable forest product supply.
- Contribute to industrial development and improvement of local residents through use of national forest land.

Forest Management Procedures Depend on Status and Position of Forests

- Watershed type - the forests are expected to supply abundant water and are managed through appropriate thinning to give various ages and tree heights.
- Mountain disaster prevention type - these help to control soil erosion and landslides. Only thinning is allowed in such forests.
- Natural maintenance type – left to natural succession, are protected and provide habitat for wildlife and biodiversity.
- Forest space utilisation type – consists of a mixed species. Used for recreation, learning and beauty.

Promotion of efficient forest development

New technologies are tries and include use containerized seedlings, planting of elite trees in plantations to achieve fast growth, cost efficient operation systems that include

good road network even within the forests, and introduction if high performance forestry machinery.

Major challenge in forestry in Japan is from deer damage.

Lessons learnt

1. Japan has about 70% tree cover but rely much on imported timbers which is cheaper. Much of the forest is in the mountain making it difficult to harvest. However, the only proposed strategy to enhance harvesting is through mechanisation of harvesting.
2. Even where private persons own forests that can be used for watershed, soil erosion and land slide protection, the government would purchase such land or offers other incentives to owners so that the forest in not harvested.

4.0 Conclusion

Tree breeding plays a major role in strengthening the improvement of seed/seedling production, management and distribution activities for enhanced realisation of quality wood and adaptation to different conditions. It also ensures conservation of genetic materials for the future.

5.0 Way Forward

1. Enhance the collaboration in breeding Melia species.
2. Identify other potential tree species for breeding.
3. Identify measures to enhance extension services.
4. Regulate the seedlings production industry to ensure quality planting stock.
5. Continue strengthening the capacity building in tree breeding and extension.
6. Capacity building in the timber industry to minimise waste in timber production and increase recovery in charcoal production.
7. Nurture Melia farmers to form forestry cooperatives.

Appendix 6-2-1　“RINSEI NEWS”

○　No.462（published on 12 Jun. 2013）

◆育種センターがケニアプロジェクトをPR

（独）森林総合研究所の林木育種センターは、6月1日から3日まで横浜市で開催された第5回アフリカ開発会議に合わせて、ケニアで進めている「乾燥地耐性育種プロジェクト」を紹介する展示活動を行った。同プロジェクトの概要を解説するポスターとともに、育種樹種であるメリア、アカシアの苗木を並べて、アフリカの緑化に協力していく姿勢を示した。

プロジェクト対象樹種の苗木に関心を示す来場者

また、ケニア森林研究所のベン・チカマイ所長も来日し、サイドイベントで東・南アフリカでの社会林業に関するプレゼンテーションを行った。

育種センターのケニアプロジェクトは、5年間にわたって行われる予定。

○No.466（pubelished on 7 Aug. 2013）

◆ケニアから8名の研修生が来日、最新の育種技術学ぶ

メリアの苗木を使って接ぎ木技術を学ぶ研修生（東北育種場）

（独）森林総合研究所林木育種センターが昨年度から5か年計画で実施しているケニア育種プロジェクト（第444号参照）の今年度の研修が6月10日から7月19日まで同センターや東北育種場、九州大学などで行われた。

ケニアから8名の研修生が来日し、2名ずつ4コースに分かれて、育種理論やDNA分析、増殖技術などに関する専門的な講義や技術指導を受けた。

同プロジェクトは、JICA（国際協力機構）が林木育種センターと委託契約を結んで実施しており、メリアとアカシアの2樹種について乾燥耐性の強い品種を選抜し、現地で採種園や採種林を造成することを目指している。同プロジェクトでは、研修結果を確実なものとするため、講師をつとめた日本側専門家が7月下旬から9月上旬にかけて順次現地入りし、指導にあたる体制もとっている。

Appendix 6-2-2 “The People”

The People Thursday, February 20, 2014

Bio-energy 'could cost us forest cover dream'

THERE WE GO! Japanese ambassador to Kenya Tatsushi Terada unveils 'Development of Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya' project in Tiva, Kitui county. With him is Conservation Secretary Gedion Gathaara. PHOTO: CHARLES MUASYA

By CHARLES MUASYA

KENYA was unable to attain the globally acceptable 10 per cent forest cover because of over-reliance on bio-energy, Environment Cabinet Secretary Judi Wakhungu has said.

She said the country depends on energy derived from charcoal to meet up to 82 per cent of its urban energy requirements.

The Cabinet secretary said 75 per cent of the charcoal is sourced from local woodlands and the rapid expansion of the urban sector would increase the pressure on exploitation of forests to meet energy needs.

Wakhungu said the exploitation of woodlands for domestic use and commercial timber was also impacting negatively on the government's commitment to increase forest cover.

"Severe competition for land between forestry and crop production is also to blame for the diminishing forest cover, which now stands at seven per cent," she said in a speech read on her behalf by the Conservation Secretary Gideon Gathaara during the launch of a research facility on development of drought resistant trees in Kitui yesterday. Wakhungu said the government had opted to focus on promotion of dryland forestry to increase foliage cover.

"Development of dryland forestry gives the only hope to attainment of the 10 per cent national forest cover as envisaged in Vision 2030 to bring Kenya closer to the globally recommended minimum forest cover of 10 per cent," she said.

Functional programmes

The Kitui research project, a collaborative venture between Kenya Forestry Research Institute (Kefri) and the Japan International Cooperation Agency (Jica) has researched and recommended trees suitable for the area.

Wakhungu said in pursuance of increasing dryland forestry cover, especially in Northern Kenya and other arid lands, her ministry had aligned itself to government policies on dryland forestry by developing functional programmes such as the development of drought resistant trees projects.

She said although her ministry had enacted enabling legislation to regulate charcoal and sand harvesting, increment in forest cover cannot succeed without development of supportive technologies and community participation in environmental conservation activities.

The Cabinet secretary lauded the government of Japan for playing a leading role in supporting Kenya in its quest to achieve sustainable woodlands management through development of dryland forestry technologies.

She cited the infrastructural development at the Kefri's Muguga (Nairobi) headquarters and Kitui Regional Research Centre, which were established through a grant extended by Japan in 1985.

Japanese ambassador to Kenya Tatsushi Terada said his government will continue to support Kenya to achieve the 10 per cent forest cover dream.

He said his country's overseas development assistance to Kenya laid more emphasis to water and environment which include the forest sector to mitigate the effects of climate change.

Appendix 6-2-3 “Annual Report of Forest and Forestry in Japan for FY2014”

(4)我が国の国際協力

我が国は、持続可能な森林経営等を推進するための国際貢献として、技術協力や資金協力等による「二国間協力」、国際機関を通じた「多国間協力」等を行っている。

2013年の世界の森林分野の政府開発援助による拠出金8億9千万ドルのうち、我が国は4千万ドルを拠出しており、ノルウェー、ドイツに次ぐ世界第3位の金額を拠出している*139。

(二国間協力)

我が国は、「技術協力」として、JICAを通じて、専門家派遣、研修員受入れ及び機材供与を有機的に組み合わせた技術協力プロジェクト、開発計画調査型技術協力、研修等を実施している。平成26(2014)年度には、パプアニューギニアで新たに森林・林業分野の技術協力プロジェクトを開始した。平成26(2014)年12月末現在、森林・林業分野では、13

資料Ⅱ－39 独立行政法人国際協力機構(JICA)を通じた森林・林業分野の技術協力プロジェクト等(累計)

地域	国数	終了件数	実施中件数	計
アジア・中東・大洋州	17か国	74	11	85
中南米	11か国	27	3	30
欧州・アフリカ	9か国	18	2	20
合計	37か国	119	16	135

注1：平成26(2014)年12月末現在の数値。
2：終了件数は昭和51(1976)年から平成26(2014)年12月末までの実績。
資料：林野庁計画課調べ。

事例Ⅱ－8 ケニアにおける乾燥地耐性樹種の育種プロジェクト

ケニアは国土の約8割が乾燥地・半乾燥地であり、森林被覆率を10%に増加させることを目標としているが、2010年時点では約7%にとどまっている。特に近年では、人口増加に伴う薪炭材の需要増加、過放牧や農地開発等により、森林の劣化・減少が進み、自然環境・生活環境への悪影響が懸念されている。

日本によるケニアでの森林・林業関係の技術協力の歴史は長く、30年近く前から、住民参加による森林管理のための研修や普及活動等に取り組んでいる。しかし近年では、気候変動の影響もあり、乾燥地など樹木の生育環境が厳しい地域では、植林しても十分生育しないケースもある。

このため、我が国では同国政府の要請に応え、2012年から5か年計画で専門家を派遣し、乾燥に強く、成長が旺盛で、木材としての価値が高い樹種や、乾燥に極めて強く、葉や種子が家畜の餌となり、材は炭の原料となる樹種について、林木育種技術により、このような特徴に更に優れた形質を持つ樹木を選抜し、優良な種苗を生産できる体制を整備することとしている。さらに、生産した優良種苗を適切に生産・管理・普及できるよう、ガイドラインの整備や研修を行うこととしている。

このようなプロジェクト活動を通じて、地球規模での気候変動に適応しつつ森林を回復させるとともに、これらの有用な樹木が住民によって広く植林されることにより、将来的には住民の木材利用による生活向上を目指している。


採種園造成に必要な苗木を接ぎ木により生産


採種園

*139 OECD Stat

Appendix 6-2-4　“RINSEI NEWS”

○No. 489（published on 23 Jul. 2014）

ケニア森林研究所副所長らが来日し最先端の育種研修行う

精英樹検定林についての説明を聞くエビィ・ケニア森林研究所副所長

（独）森林総合研究所林木育種センターが平成24年度から実施している「ケニア国気候変動への適応のための乾燥地耐性育種プロジェクト」（第444号参照）の今年度の研修が5月18日から6月28日まで、同センターなどで行われた。ケニアから7名の研修生が来日し、4コースに分かれて育種理論やDNA分析などに関する専門的な知識・技術を学んだ。プロジェクト管理コースでは、ケニア森林研究所のエビィ・チャガラ副所長と、育種技術の発展に向けた意見交換も行った。同プロジェクトでは、今年度から「普及」コース（2名）を新設するなど内容を充実させている。

Appendix 6-2-5　“RINSEI NEWS”

○No.514（published on 5 Aug. 2015）

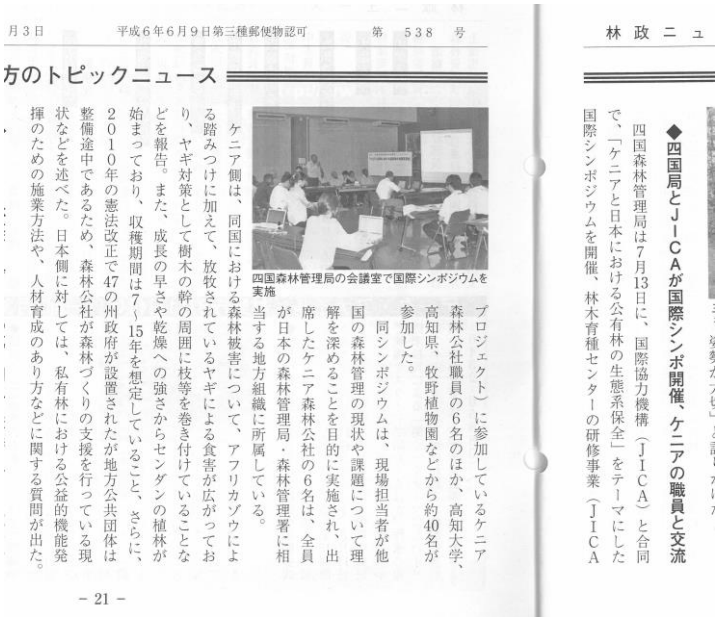
◆ケニア森林公社のムゴ総裁らが来日し視察

熱帯温室で増殖技術を学ぶ

ＪＩＣＡプロジェクト（第444・489号参照）の一環として、ケニア森林公社のムゴ総裁とケニア森林研究所のキゴモ次長らが来日し、7月7～8日に森林総合研究所と林木育種センターを訪れた。ムゴ総裁は「ケニアは、7％弱の森林率を２０３０年までに10％にすることを憲法に掲げている。日本の協力によって乾燥地耐性育種プロジェクトがよい成果をあげつつある」と感謝の言葉を述べた。

Appendix 6-2-6　“RINSEI NEWS” and local pages of newspaper

○”RINSEI NEWS” No.538（published on 3 Aug. 2016）



林政ニュ

◆四国局とJICAが国際シンポ開催、ケニアの職員と交流

四国森林管理局は7月13日に、国際協力機構（JICA）と合同で、「ケニアと日本における公有林の生態系保全」をテーマにした国際シンポジウムを開催、林木育種センターの研修事業（JICA

月3日　平成6年6月9日第三種郵便物認可　第538号

方のトピックニュース

プロジェクト）に参加しているケニア森林公社職員の6名のほか、高知大学、高知県、牧野植物園などから約40名が参加した。

同シンポジウムは、現場担当者が他国の森林管理の現状や課題について理解を深めることを目的に実施され、出席したケニア森林公社の6名は、全員が日本の森林管理局・森林管理署に相当する地方組織に所属している。

ケニア側は、同国における森林被害について、アフリカゾウによる踏みつけに加えて、放牧されているヤギによる食害が広がっており、ヤギ対策として樹木の幹の周囲に枝等を巻き付けていることなどを報告。また、成長の早さや乾燥への強さからセンダンの植林が始まっており、収穫期間は7～15年を想定していること、さらに、2010年の憲法改正で47の州政府が設置されたが地方公共団体は整備途中であるため、森林公社が森林づくりの支援を行っている現状などを述べた。日本側に対しては、私有林における公益的機能発揮のための施業方法や、人材育成のあり方などに関する質問が出た。

－21－

○”NIKKAN MOKUZAI”　（published on 2 Aug. 2016）

ケニア森林公社と交流

四国森林管理局

四国森林管理局（高知市、大山誠一郎局長）はさきごろ、JICA（国際協力機構）と合同で、「ケニアと日本における公有林の生態系保全」についての国際シンポジウムを同局で開いた。同シンポジウムには、ケニア森林公社職員など JICAプロジェクト研修生6人が参加。同局、高知大学、高知県庁などからも40人が参加した。ケニア森林公社職員は、日本でいうところの森林管理局、森林管理署と似た地方組織に属する。

シンポジウムでは、同公社、四国局双方から、管轄する森林管理の概要を報告、次いで質疑を行った。ケニアにおける野生動物による被害の実態については、代表的な動物として、アフリカゾウによる植林木への被害が報告された。食害ではなく、植林木の中を通過するだけで木が倒れてしまうと説明した。

ケニアの森林管理における市町村の役割については、2010年の憲法改正に伴い、47の州政府が設置されたところで、地方公共団体も整備途上にあることから、森林管理は森林公社が支援していると述べた。ケニア側からは、日本は努力して立派な森林資源を育ててきたと評価し、林業に携わる人材育成にも関心を示した。四国局職員からは「生態系保全のために森林経営を適切に実施するのは当然のことだが、ケニアでの取り組みを聞き、新鮮に感じた」との感想も聞かれた。

ケニアの林業事情を知った

○"YOMIURI" (published on 14 Jul. 2016)

2016年(平成28年)7月14日(木曜日) 読売新聞 33 地域

ケニアと日本 森林保全を報告

高知でシンポ

ケニアと日本の森林管理について意見交換する国際協力機構（JICA）と四国森林管理局の合同国際シンポジウムが13日、高知市の四国森林管理局で開かれた。

ケニアから研修のため来日した同国森林公社などの職員6人を含む約40人が参加。「ケニアと日本における公有林の生態系保全」と題し、両国の取り組みを報告した。

ケニア側は、ケニアの人工植林や乾燥地帯の植生などを写真で紹介。「森林は、ゾウなどの野生動物のすみかにもなっている。貴重な動物を見に来てください」と話した。

同管理局は、四国の人工林率が約6割と全国に比べて高いことや、温暖な気候や豊富な水の下で植林が進められてきたことなどを説明し、低コストで森林を整備するため、新たな技術も取り入れていることを報告した。

質疑応答では、「動物による森林への被害はあるのか」という日本側からの質問に対し、ケニア側は「例えばゾウは体が大きいから、移動するだけで森林を破壊する」と回答し、参加者を驚かせていた。

○"KOCHI" (published on 14 Jul. 2016)

高知新聞
2016年(平成28年)7月14日(木曜日) 経済 ☆☆ (4)

ケニアの森林事情学ぶ

行政職員招き情報交換 高知市

森林保全に関わるケニアの行政職員を招き、野生動物による森林被害などについて意見交換するシンポジウムが13日、高知市丸ノ内1丁目の四国森林管理局で開かれ、同局職員ら森づくりに関わる人たちがケニアの事例を学んだ。

ケニアの森林面積は国土の6%に当たる347万ヘクタール。国際協力機構（JICA）によると、近年は農耕地の拡大などによる森林荒廃が課題になっているという。このためJICAは、造林に適した品種の普及を支援するプロジェクトを2012年から同国で展開している。

今回は同プロジェクトの一環として、ケニア森林研究所の職員ら6人が6月下旬から日本を訪れ、岡山県の林木育種センターや高知県の製材所などを視察している。この日のシンポジウムには同管理局職員ら約40人が参加した。ケニア森林公社のジョン・ジョロゲ生態系保護官は同公社の取り組みを紹介し、「ケニアには野生動物も多く、森林は貴重なすみかを提供している」などと述べた。これに対し、同管理局計画課の松本康裕課長がニホンジカの森林食害被害などについて報告した。

質疑応答では、ケニアの動物による被害について質問があり、ジョロゲ生態系保護官が野生の象が移動する際、樹木を傷つけていることなど同国の事情を説明した。（安岡仁司）

ケニアと日本の林業行政の課題について意見交換したシンポジウム
（高知市丸ノ内1丁目）

Appendix 6-3-1 “SHINRIN KOZA” (Open lectures on forests in FFPRI, 2013)

独立行政法人 森林総合研究所

平成２５年度 森林講座のお知らせ

多摩森林科学園において下記スケジュールで森林講座を開講します。
森林総合研究所の研究成果を分かりやすく解説しますので、是非ご参加下さい。

深層崩壊と表層崩壊
6月 8日（土）
講師 大丸裕武

自然災害に立ち向かう木造建築
7月11日（木）
講師 青木謙治

ケニアの郷土樹種メリアを乾燥に強くする
8月 3日（土）
講師 宮下久哉

樹木は放射線に強いのか？
9月12日（木）
講師 西口 満

山から木材を伐り出す様々な方法
10月 3日（木）
講師 陣川雅樹

環境にやさしい木製トレイ
11月 9日（土）
講師 高野 勉

森を修復するハンノキ属の樹木
12月 6日（金）
講師 飛田博順

京都議定書と木材利用
1月17日（金）
講師 恒次祐子

樹木の種類を見分けるＤＮＡバーコード
2月14日（金）
講師 吉丸博志

ツキノワグマ、樹皮を剥ぐ
3月17日（月）
講師 岡 輝樹

時　間　午後１時１５分～午後３時
会　場　多摩森林科学園（受付場所：森の科学館）
定　員　各回　４０名（要申し込み、申込多数の場合は抽選）
受講料　無料（ただし、入園料として３００円必要です）

お申し込み方法

電子メールまたは往復はがき、FAXで、各講座開催日の１ヶ月前からお申し込み頂けます。いずれの場合も①受講したい講座名②郵便番号・住所③受講者氏名④電話番号をご記入のうえ、受講希望講座開催日の２週間前必着でお申し込み下さい。それぞれのお申し込み１通に対し、１講座３名までの応募とさせていただきます。
電子メールの宛先はshinrinkouza@ffpri.affrc.go.jpです。多摩森林科学園のホームページもご覧下さい。
なお、抽選の結果は、講座開催日の１週間前にお知らせいたします。

お申し込み・お問い合わせ
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http://www.ffpri.affrc.go.jp/tmk/

ＪＲ中央線、京王電鉄高尾線「高尾駅」北口より徒歩約１０分
※駐車場がありませんので、お車でのご来園はご遠慮下さい。

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