PART 11

TREE SEED EDUCATION FOR FOR MULTI-PURPOSE TREES ON FARM LAND

PROPOSED CURRICULUM FOR AGRICULTURAL AND FORESTRY TECHNICIANS

Justification

While the human population and demand for tree products and services are increasing rapidly in Sub-Saharan Africa, the natural forests are shrinking. This is creating opportunities for accelerating the propagation of multipurpose trees on farmland. The demand for planting materials is rising without a matching of the quantity or quality in supply of the species sought by farmers. Tree science is taught to forestry technicians in forestry colleges, however, as indicated in Part 1 of this report, the current curricula do not include the socio economic, indigenous knowledge, cultural or entrepreneurial training modules required to facilitate the functioning of decentralised seed distribution systems. In many countries, trained agricultural technicians form the bulk of frontline extension staff (in NGOs, govt and private sector) and play a major role in sharing and developing agricultural technologies with farmers. As expounded in Part 1 of this report, a survey carried out in 2003 revealed that colleges of agriculture do not currently provide tree seed education. With the intensification of agroforestry practices by farmers, it is imperative that the whole range of knowledge from tree seed biology to tree seed enterprises and on-farm tree management be taught to all agricultural and forestry technicians. In this way, extension staff will be better able to address farmers expressed needs for tree seed, tree seed sourcing and management. Farmers will have improved access to knowledge pertaining to the importance of tree seed quality, as well the entrepreneurial and business association skills that are required in increasingly decentralised tree seed and seedling systems. Knowledge exchange and learning on tree seed handling and management will help to increase farm productivity and contribute to natural resource conservation.

Objective

The objective of this curriculum is to incorporate aspects of tree seed knowledge into agricultural curricula for technical colleges, and to adapt the content of tree seed science curricula currently taught in forestry colleges.. The colleges produce extension officers who train and advise farmers on all aspects of production and conservation. The ultimate goal is to provide technical support to farmers' efforts to intensify tree planting and management. Enhanced technician knowledge and skills in tree seed and seedling management will help to reduce risks in tree planting schemes.

Curriculum synopsis

The proposed tree seed modules for both agriculture and other natural resource

programmes are as summarized in Table 1. Some agricultural colleges already teach some aspects of crop seed science. The selection of topics and emphasis should therefore take into consideration the contents of existing curricula. We recommend that tree seed science and technology studies be linked to the crop seed studies to form one continuous course. The suggested contact hours may therefore be adjusted according to the identified gaps in current education programmes.

Forestry colleges already teach many on the topics identified in these modules. However, the module on tree seed enterprises, and especially the community-based approaches are lacking. Some sub-topics are new to forestry education. A curriculum is a dynamic instrument which should be reviewed from time to time. We recommend that every five years, colleges review the content of their tree seed curricula, as they, hopefully also review the rest of the programme. The balance between theory and practicum may be adjusted according to needs. Each practical hour is equivalent to two hours of field work.

Table 1. Summary tree seed curriculum

Module code and title	**Summary of module content**	**Contact hours**
TS1: Concepts and principles of on-farm tree management	Concepts and principles of tree management on farm, Selecting species and seed. Seed quality assessments. Determining needs	30
TS2:Tree seed biology	Aspects of tree seed biology Morphology of fruit, development and maturation of seed. Longevity and dormancy	35
TS3: Seed collection, handling and storage	External factors influencing seed production and factors to consider prior to seed collection, seed sources, equipment / tools for seed collection, Seed collecting, handling of fruits and seed between collection and processing, Seed processing and storage, Seed dormancy and pretreatment	35
TS4: Germination, vegetative propagation and nursery management	Seed germination management, orthodox and recalcitrant seeds, seedling development, nursery establishment and management. Other tree propagation methods: vegetative propagation– cuttings, grafting, marcotting, layering. Propagule handling techniques.	35
TS5: Phytosanitation	Phytosanitary issues – prevention, treatment and control pests and diseases	20
TS6: Community-based tree germplasm management and enterprises	On farm germplasm handling. Establishing seed orchards and germplasm management at farmer and community levels. Farmer to farmer germplasm exchanges and related challenges. Tree Seed business. seed handling technologies, storage and longevity, pricing, and socio-economic considerations. Tree seed markets, access and pricing	30

Upon completing the six modules students will be able to:

- Identify with farmers groups their needs for tree products (subsistence and sale) – and advise on species, sourcing and quality of propagation materials (incl. seeds) to meet the farmers objectives.
- Understand and explain the importance of high quality tree seed
- Be conversant with important aspects of tree seed biology
- Plan and implement local tree seed collection for different species
- Handle processing and storage of tree seed
- Develop and manage tree nurseries from seed and through vegetative propagation
- Provide guidance to farmers and private entrepreneurs on nursery management skills specific to business enterprises (e.g stocking rates, comparative pricing, record keeping)
- Identify pest and diseases affecting seed and propagules
- Improve on the existing traditional tree seed technologies
- Help farmers and local entrepreneurs establish tree seed and seedling enterprises
- Establish and nurture contacts with tree seed institutions to keep abreast of new developments and share such knowledge to farmers; and
- Design and implement tree seed and seedlings programmes in support of on farm tree management.

8.4 Sequencing of topics

Most of the topics identified and elaborated in these modules were proposed by staff, students and extension officers met during a survey carried out in 2003. Sequencing of topics is based on the knowledge that preceding modules form pre-requisites for subsequent topics. In other words modules with the content that is applied in other modules are covered first. Therefore it would be best to follow the sequence of module (codes) in teaching even in cases of short courses.

8.5 Selection of materials and methods

Most agricultural colleges visited do not have basic materials (e.g. ?....)needed for implementation of these modules. Where possible relevant materials should be made available besides, many of the modules can be taught easily if staff members improvise. Teaching methods would be based on lectures, field and laboratory practicum and group discussions. However, at certificate level the modules should be more practical (40% theory and 60% practical) than at diploma level (50% theory and 50% practical).

MODULE TS1. CONCEPTS AND PRINCIPLES OF ON-FARM TREE MANAGEMENT (30 hours)
(NB. Each practical contact hour is equivalent to two hours of field or laboratory work)

Learning objectives	Topics	Sub Topics	Contact hours		Remarks
			Theory	Pract.	
Upon completing this module, the learners should be able to: • Understand and share the values of tree farming • Understand farmer's views and traditional values of trees • Identify high quality tree seed • Recognize the traditional tree seed technologies • Understand and apply policies relevant to tree seed • Evaluate the demand and supply of tree seed	Introduction to tree management on farms Traditional tree values and indigenous technical knowledge Species selection criteria Policy and Legal framework regarding trees and seed Assessing tree seed demand	-Trees and livelihoods -Trees and landscape rehabilitation -Basic agroforestry practices -Tree products and services -Farmers views, value and traditions -Land and tree tenure regimes (in the locality of the college) -Indigenous tree seed technical knowledge -Species identification -Local methods of tree propagation -Acquiring high quality tree seed -Importance of good quality seeds in raising tree crops -Seed origin and longevity -General legislation on plants -Policy and regulatory elements relating to germplasm (seed zone, seed sources orchards, distribution and marketing, import and export, quality controls) -Identify farmers tree products needs and targets, and tree species preferences. -Surveys of local forest product markets, seed and seedling supplies, and markets -	4 3 5 3 3	2 2 4 0 4	Examples should be drawn from species most familiar in the surroundings of the college Visit farmers to appreciate their needs and value systems for trees Lectures from seed companies and field visits Hands on familiarization. Laboratory and field exercises with common species in the area Regulations and policies of the particular country plus few other examples Farmer interviews , group interviews, tree product market surveys, seed and seedling supply surveys. Tree nursery entrepreneur interviews
		Total	18	12	

MODULE TS2. TREE SEED BIOLOGY (35 hours)

Learning objectives	Topic	Sub Topics	Contact hours		Remarks
			Theory	Pract.	
Upon completing this module, the learners should be able to: • Apply appropriate terminology used in tree seed biology	Introduction to seed biology	-Definitions and terminology in tree reproductive biology - Reproductive age and environmental factors	3	2	Field practicum in collecting and identifying tree species in the local area by students
• Understand the physiology and practical challenges of managing trees for flower, fruits and seed production	-Flower structure and fruit development in trees, fruit types	-Angiosperms, gymnosperms flowers and their main features -Flower parts and their functions -Pollination and fertilization -Hermaphroditic, monoecious and dioecious trees -Fruit types, morphology and classification	7	3	Student should have an opportunity of handling as many types of exotic and indigenous tree flowers, fruits and seeds
	-Ecological impact on fruits and seed production, seed physiology	-Seasonality and periodicity of flowering and fruiting -Physiology of seed maturation -Moisture content and maturation -Dehiscence and abscission	6	3	Students should relate this knowledge to indigenous knowledge of the specific locality and build on or improvise this knowledge for use by farmers
• Advise farmers on tree fruit and seed maturation	Seed development and maturation and dispersal, Seed dormancy	-Seed morphology and development -Key features in the identification of seed - Dispersal mechanisms, recalcitrant seed -Animal dispersal (zoochory), Water dispersal (hydrochory) -Mangroves, rain forests, climax forest species, Pioneers, Savannas and other seasonal forests, montane species	7	4	
		Total	23	12	

MODULE TS3. SEED COLLECTION, HANDLING AND STORAGE (35 hours)

Learning objectives	Topic	Sub Topics	Contact hours		Remarks
			Theory	Pract.	
Upon completing this module, the learners should be able to: • Use factors that favour seed production • Plan and implement seed collection activities for different species • Carry out seed documentation • Share information and support tree farmers on seed management • Collate, use, improvise and share local approaches and tools for handling tree seed • Handle fruits and seeds of different species commonly used in particular localities with care	Factors affecting seed production	-Climatic variation and the reproductive behaviour of trees, Inbreeding barrier -Pollination or fertilization failure -Closed flowers or cones -Genetic quality of seeds -Reproductive habits of species common in the locality	4	0	A wealth of knowledge exists in many local situations e.g. for trees and shrubs used for different purposes. This knowledge should be incorporated into what is being taught for combined practical applications
	Factors to consider, tools and processes of seed collection	-Review legal issues related to seed collection (Permits, licenses) -Alternative propagation possibilities -Species/provenance choice and criteria, sampling -Calculating quantity needed by species and timing -Factors influencing choice of collection method -Identifying mother trees -Tools, logistics and field records -Safety in seed collection -Practical field transportation, processing and storage - Where, when and how to collect	7	3	Impart such knowledge to other stakeholders. -Improvise this with local knowledge for practical application. -Interpret this knowledge for practical applications Species consideration should be based on local species on demand. Quick surveys around institutions should show the species on demand and how the local people handle the situation
	Seed quality management	-Natural, selected, seed orchards, seedling seed orchards, clonal seed orchards -Flower and fruit assessment -Methods of assessing reproduction -Criteria and methods for assessment of seed quality - Maintaining viability of seed - Hygiene and contamination	5	4	Determine the strengths and weaknesses of local knowledge and strong cases be made for improvising In most situations, the knowledge on tree seed for

	Seed Dormancy Principles and practices of seed documentation, Managing and sharing tree seed information	- Drying of fruits and seeds -Seed extraction from dry indehiscent fruits -De-pulping of fleshy fruits, threshing -Determining optimal harvest time -Considerations for recalcitrant seed Orthodox seeds, non-pulpy seed - Care during transportation of seed and conditions of temporary seed depot and storage -Methods fro breaking dormancy -Managed seed sources -Importance of documentation -Seed certification -Codes and accession number systems -Seed documentation and data systems, -Updating and maintenance of data -Data management -Seed source records, collection and handling records, seed testing records seed stock and dispatch records Manual data systems, computer database systems -Information exchange -Identification of institutions dealing with seeds	3 4	2 3	some species are known, especially when they are used for particulars purposes e.g. as nuts, medicine etc. Efforts should be made to build on the local knowledge. Though National Tree Seed Centres were established in many countries, their services did not manage to reach community level. The Centres continue to provide quality and regulatory control, but increasingly germplasm supply to community level is decentralised and conducted by a multitude of service providers and farmers groups and associations. There is need of strong linkages/ creation of functional networks with National Tree Seed Centre and farmers interested in tree seed/small scale nursery entrepreneurs and tree seed dealers
			23	12	

MODULE TS4. GERMINATION, VEGETATIVE PROPAGATION AND NURSERY MANAGEMENT (35 hours)

Learning objectives	Topic	Sub Topics	Contact hours		Remarks
			Theory	Pract.	
Upon completing this module, the learners should be able to: • Understand and deal with factors affecting germination • Apply techniques for tree seed germination • Practice different methods of overcoming dormancy (pretreatment) • Plan and implement a tree nursery project using local materials • Know and deal with common nursery pests and diseases • Train farmers in seedling production • Identify markets for tree seedlings	Seed dormancy and pretreatment	-Definitions, types of dormancy: innate, induced, and enforced dormancy; embryo, seed coat, double and physical dormancy -Significance of dormancy -Dormancy as a survival strategy -Different methods to break dormancy: mechanical scarification, hot water, heating or burning, acid pretreatment, other chemicals, biological methods -Selection of pretreatment method	5	3	This module provides practical skills to enable the learner to overcome technical and logistical problems in tree planting. It is necessary to use as many species as possible in this module, including indigenous tree crops. Relate strongly to local or indigenous knowledge
	Germination and seedling establishment	-Definition of germination -Epigeal and hypogeal germination -Stages in seed germination -Factors affecting germination -Morphological development during germination and early seedling stage -Germination as influenced by seed quality -The importance of moisture, aeration, light, substrate, sowing depth and other factors in germination	5	5	
	Vegetative propagation	-Cuttings, grafting, layering -Simple mist propagators -Cloning principles and practices -propagule multiplication	4	5	
	Tree nursery establishment management	-Selecting a nursery site -Direct sowing of seeds -Seedling prick out and transplanting -Managing light, shade, watering,	4	4	

		fertilizers, pruning, hardening off or conditioning -Measures to control pests and diseases -Book keeping -Simple budget and its control -Using local knowledge and materials -Marketing seedlings			
		Total	18	17	

MODULE TS5. PHYTOSANITATION (20 hours)

Learning objectives	Topic	Sub Topics	Contact hours		Remarks
			Theory	Pract.	
Upon completing this module, the learners should be able to: • Identify seed and seedling problems posed by pests, pathogens and diseases • Understand and apply acceptable methods of preventing and controlling pests and diseases, • Be conversant environmental issues in the use of agrochemicals	Phytosanitary problems and seed treatment	-Terminology -Seeds as attractants of pests and diseases -Susceptibility of seeds to pests, diseases and injuries -Pests and pathogens in relation to seed quality -Seed insects -Infection by fungi, virus and by bacteria -Prevention of insect and fungal attack -Seed health testing methods -Control measures -Safety precautions in using pesticides	10	7	Certain seed species are easily attacked by insects, while others are quite tolerant or resilient (can recover easily). In few cases, chemical treatment is necessary. There are local examples or experiences which can be used to demonstrate these particular cases. Efforts should be directed towards building on local experiences.
	Transfer of planting materials and associated regulations	-Rules and regulations in movement of plant materials, quarantine regulations -Phytosanitary certification	3	0	
		Total	13	7	

MODULE TS6. COMMUNITY-BASED TREE GERMPLASM MANAGEMENT AND ENTERPRISES (35 hours)

Learning objectives	Topic	Sub Topics	Contact hours		Remarks
			Theory	Pract.	
Upon completing this module, the learners should be able to: • Establish working contacts with tree Seed Institutions, within and outside their countries	Tree Seed information sourcing	- updating information on tree seed -Sources of publications on tree seed issues - Tree Seed institutions: National, regional, and global (including FAO, DANIDA, ICRAF and CIFOR) - Networking and training -Research findings	4	2	A wealth of information can be obtained from different institutions just by requesting for it. Tap into development agencies that work on tree-related projects.
• Link farmers to tree seed and seedling markets • Devise simple and affordable innovations for farmers, and local entrepreneurs to manage tree seed enterprises	Designing tree seed and seedling projects and enterprises	-Extension methods relevant for tree seed -Sources of funds and micro-credit for tree-related programmes -Factors to consider in tree seed programmes -Basic elements of tree seed programme design -Costs and benefit analyses under different assumptions and scenarios -Cost reduction innovations	7	3	Link tree seed enterprises to other on-going projects in the vicinity, especially crop and animal enterprises Encourage tree seed and seedling entrepreneurs to group together to better oversee quality and pricing of their product
• Support local communities to develop and implement tree seed and seedling projects • Evaluate and advise farmers on market conditions for tree seed/seedling enterprises	Marketing tree seeds and seedlings	-Private and communal ownerships and challenges -Seed storage and longevity management -Understanding the seed market chains and decentralised distribution networks -Carrying out market surveys - Competition and risk management strategies -Market access and pricing, record keeping	10	3	In most countries, forest services have activities in community Forestry, social forestry and agroforestry. Develop links with them.
	Community organization	-Forming business associations and sel-help groups	2	4	

		-Ownership and rights of members -Tasking and quality supervision -Transparency and conflict management - Small scale Business advocacy and lobbying			
		Total	23	12	