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On-farm Tree Planting and Management Guidelines for Medium to High Potential Areas of Kenya

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Abstract

This review paper presents guidelines which stakeholders use in addressing on-farm tree planting configuration, establishment, tending, silvi- cultural management, management of pests and diseases, challenges and opportunities as practiced in the medium to high potential areas of Kenya. The tree planting configurations discussed includes blocks planting (woodlot), boundary, compound planting, home/fruit gardens, trees intercropped or mixed with pasture, trees on riverbanks and roadside. Participatory monitoring and evaluation techniques have been highlighted. The main challenges facing tree planting activities include culture and attitude of local people, land and tree tenure, inadequate technical support, lack of recognition and integration of technical information and indigenous knowledge, capital and labour shortages, lack of appropriate incentives measures, damage by domestic and wild animals, conflict over trees on the boundary and policy and legal issues. This guideline targets forest managers, extension agents, students and other practitioners in policy and day to day decision making processes in Kenya.

Key Words: guideline, extension, on-farm, configuration, tree planting, challenges

Introduction

Kenya's land covers an area of 582 650 km^2 (Njuguna and Baya, Un-dated) and spreads over a wide range of ecological zones. Over 80% of the population is settled on only about 20% of the land mostly considered to be medium to high potential. The local communities opts for various land use systems depending on socio-economic factors such as population density, access to markets, levels of education, infrastructure and support services, farming practices, the tenure situation, culture and traditions and government policies (Tengnäs 1994). Agroforestry, social forestry, community forestry, village forestry and farm forestry are all terms used to describe tree growing that is undertaken mainly outside gazetted forest areas. These terms are often used to describe very similar activities, but have slightly different theoretical meanings. Farm forestry can be regarded as almost synonymous to agroforestry, but it may include large scale private plantation, an activity falling outside the definition of agroforestry.

The country's farmlands are located within the high and medium potential areas, which constitute 9.9 million hectares and where two thirds of the population resides. These areas are characterized by high humidity, fertile soil and other conditions favorable for plant growth. The high-potential area corresponds to agro-ecological zone II while the medium-potential zone falls under zone III (MENR 1994). Therefore, farm forestry is developed under three broad

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land use systems namely agro-silvi-culture, silvi-pasture and agro-pasture.

Farmlands and settlements contain on average about 9.3 m^3/ha of wood biomass with an annual growth rate of 0.5 m^3/ha. The wood biomass stock of 9.3 m^3/ha can comfortably be raised to 27 m^3/ha without adversely affecting agricultural production (MENR 1994) by increasing the current annual on-farm tree planting rate by 50%. This can be achieved by inducing farmers to grow and manage trees by:

- Strengthening of community based institutions;
- Provision of extension services;
- Provision of research and technical support services; and
- Provision of incentive packages for tree growers.

The potentials and benefits associated with on-farms tree planting include improved family nutritional status, improved income and employment for the family, improved environment, reduction in poverty and gender related conflicts.

On-farm Tree Planting and Management

Tree configuration

In Kenya, on-farm trees are planted under different configurations. Trees such as eucalypts and cypress are not friendly to crops and farmers tend to plant them by the roadside, degraded sites, rocky areas, riverbanks, and hilltops. *Grevillea robusta* is fast growing species that yields good timber for interior use and is commonly planted by farmer in varied eco-regions. Trees are planted as:

- Blocks (woodlot): The common trees under this planting arrangement include *Eucalyptus spp, Grevillea robusta, Casuarina angusetifolia, Acacia mearnsii* and *Cuppressus lucitanica*.
- Boundary: Common species include *Eucalyptus species, Cupressus lucitanica, Markhamia lutea, Croton megalocarpus, C. macrostychus. Euphobia turicalli* and *Dovyalis caffra*.
- Compound planting: Common species include *Warbugia ugadensis, Ficas thonningii, F. benjamina, Teminarlia mentalis, C. megalocarpus, Bambusa vulgaris, Melia azedarach, Schinus molle, Prunus africana* and *C. macrostychus*.
- Home/fruits gardens: Fruit trees commonly grown by farmers in the high to medium potential areas include; mangoes, avocados, guava, citrus, plums, pears, peaches, loquats, pawpaws, and strawberries (Gachanja and Ilg 1990).
- Trees intercropped or mixed with pasture: *Acacia species, Leucaena leucocephala, Calliandra spp*. and *Sesbania sesban*.
- Trees on riverbanks: Farmers should seek the assistance of extension agent before planting any tree on river banks or riparian ecosystems. Indigenous species should always be given priority. Where exotic species are considered for planting then they should be located 50 m away from the river or riparian ecosystem.
- Roadside: Common species include *Jacaranda mimisifolia, Spathodea nilotica, Senna siamea* and *Delonix regia*.

Tree establishment

The following should be observed during tree planting:

- The planting site should be cleared of debris and if possible the debris burned to give way to staking which is followed immediately by pitting and thereafter planting.
- Adopt appropriate tree spacing of 1×1 m to 10×10 m subject to climatic conditions, species, intercropping and other farmer's preference.
- A hole of 30-40 cm deep and equally wide should be dug for each seedling. The planting pits should be dug two weeks in advance to allow adequate moisture build up before planting.
- The top soil (occur within 15 cm depth and is rich in humus) should be separated from the subsoil (occur below 15 cm depth). Separation allows the top soil to be put back first since it is usually more fertile. The soil should cover the seedling upto the collar but not higher to avoid choking the plant.
- Ensure seedlings attain a height of about 30 cm when they are planted for high survival rates.
- Ensure timely planting of healthy seedlings to minimize on the risk of attack from pests and diseases.
- Prioritize tree planting to food crop growing to ensure high chances of good survival and growth of seedlings.
- Subject the seedlings to stress through a hardening process, which facilitates their chances of survival.
- Deliver seedling to the planting site a few days in advance to allow for adjustment to field conditions.
- Plant more seedling than necessarily required to give

room for casualty especially for trees meant for experimental purposes (Rao 1994).

• Avoid overgrown seedlings which are easily damaged during handling and may have lost vigour due to many root-pruning operations and too small root compared to the shoot.

• Seedlings grown in pots should not be carried by the shoot but rather by holding the pot to avoid accidental separation of the soil from the seedling.

• Farmers should be assisted in deciding which species are less water consumers and more environmentally friendly (Kimwe et al. 1994).

• After planting the seedlings, the soil must be pressed well to remove all air spaces, which might lead to the death of the seedlings.

• Ensure all polythene and other seedlings containers are removed and if necessary buried at the site to remove the risk of being consumed by livestock.

• Ensure post planting care, which include watering (in exceptional cases where enough water must be used), weeding and soil loosening, mulching, protection from animals and against fire, pruning, thinning, harvesting, processing and marketing; and

• The extension agent should discourage mulching practices using grass and weeds to discourage fire damage and/or pest and disease attack (Tengnäs 1994).

Tending

Several tending regimes can be adopted to reduce competition for nutrients and moisture and dramatically enhance growth. The following tending methods could be adopted depending on the prevailing circumstances:

• Slashing.

• Total weeding.

• Spot weeding.

• Application of fertilizer or manure when necessary.

• Encourage mulching to help retain moisture and suppresses weeds though it may attract termites.

• Strip cultivation.

• Avoid fresh manure which will scorch the young seedlings once it starts decomposing.

• Protect trees against damage from physical, chemical and biological agents to ensure successful tree establishment [(Mbote and Fahlström 1992) and (Kimwe and Noordin 1994)].

• Ensure soil loosening and working up to prevent moisture loss during rainy season

• Consider a fire line of 4 metres around the woodlot.

• Retain the best shoot when a tree has several shoots which competes one another to allow faster establishment and growth.

Silvi-cultural management

Trees are managed through protection, weeding, and other cultural practices. The mode of tree management undertaken depends on types of trees planted, the intended end uses, spacing and planting sites. The decision to timely manage trees depends on the growth habits, local tree management practices, socio economic value placed on the tree species and the end products. Intercropping helps trees through weeding, fertilizer, fencing and protection given to the crops. Low tree survival may be due to poor or non-existent management techniques (protection and weeding). The fast growing seedlings should be planted within rows of crops to receive maximum care and benefit.

Pruning

Pruning is undertaken at the end of the dry season to serve the following purposes:

• Increase light reaching crops;

• Check on the spread of pests and diseases;

• Promote straight stem growth;

• Give room for mechanized farm operations; and

• Improve growth rate of trees and better quality (valuable) poles or timber while providing immediate products.

Pruning should be done to a maximum height of two thirds of whole tree to reduce competition from trees growing to adjacent cropland. To achieve the best results:

• Use the right and sharp tool such as pruning saw to minimize on damage to the tree.

• Cuts should be slanted to prevent water entry and rotting.

• An East-West planting layout would avoid shading and thus reduce the pruning frequency.

• Plant trees such as *Calliandra spp* that have characteristically deep and intensive roots, which will not compete with crops and are fast growing, easy to establish and fix nitrogen that is ideal for soil improvement and land rehabilitation (Kimwe 1993).

• Ensure pruning of lateral roots within 0.5m radius from the stem and to a depth of 0.5m that may compete for nutrients; and

• The farmer should carefully weigh the cost of pruning against the anticipated gains before making the right decisions. If the value of the tree products is greater than the value of the lost crop yields the farmer should forget about the root pruning (Mbote and Fahlström 1992).

Thinning

Thinning is undertaken with the following goals:

• Reduce the tree population per unit area through cutting down or uprooting of a number of selected trees.

• Helps in controlling of diseases and pest outbreak and spread.

• Obtain intermediate tree products like poles, fuelwood and stakes; and

• Create room for other farming activities.

Coppicing

Coppicing involves making clean angled cuts at 15-50 cm high without damaging the tree bark. Coppicing is done towards the end of the dry season just before crops are planted. Coppicing can be done once the trees are 3-4 m high (9 months to 2 years old) depending on species and location. Repeated coppicing is done as needed and is used to:

• Regenerate trees.

• Provide useful products such as fuelwood, sticks, mulch or fodder; and

• Reduce competition between trees and crops for light, moisture and nutrients.

Pollarding

Pollarding is done to remove the tree crown where both the branches and the top (at a height of between 1-15 m) are removed. The pollarding intervals could be 1-3 years and are carried out at the end of the dry season with the aim of:

• Providing continuous products from the upper storey,

• Quality improvement made to the trunk for timber production.

• Minimize shading [Getahun and Reshid 1988; Mbote and Fahlström 1992; Tengnäs 1993; Kimwe and Noordin 1994].

Management of common tree pests and diseases

On-farm tree pests and diseases are a big problem to the farmers. Common on-farm tree pests and diseases could be categorized as:

• Defoliators.

• Parasitic nematodes.

• Bacterial.

• Sap suckers.

• Borers.

• Fungal.

• Viral.

• De-barkers.

• Root feeders; and

• Environment induced problems.

Remedial measures in controlling pests and diseases include:

• Biological.

• Chemical (diathion, dieldrin, chlorobenzilate, fenethion, dimethoate, diazinon among others); and

• Cultural (pruning, pollarding, etc.) measures.

• Apply ash or used engine oil or cow-dung to cut down on cost, minimize on termites attack on young trees and reduce soil acidity, which tends to retard tree growth. Ash blocks the tracheae of termites and they suffocate.

• Avoid insecticides and other preventive chemicals which are expensive, rare on the market and dangerous to handle.

• Encourage use of leaves of *Azandrichta indica*, *Cassia siamea* and *Lantana camara*, or finely chopped stems of *Euphorbia tirucalli* which act as termite repellents.

• Pesticides should be used carefully to kill insects, weeds and fungi while ensuring farm animals remain healthy.

• Carefully read the instructions that accompany the pesticide and in the event of doubt, seek professional help (Mailler 1981).

• Termites and ants damage the roots of trees and insecticidal treatment and sterilization of the planting sites is recommended.

• Grass hoppers and larvae on the other hand are known to skeletonize the leaves and defoliate the plants and can be controlled by spraying with insecticides.

• Spraying of seedlings with fungicides or dipping the

seedlings in a solution before planting is practiced (Rao 1994). Fungal damage of Acacias and bamboo are common and controlled using fungicides before planting.

• Avoid planting of monocultures, if diseases and pests have to be checked; and

• Use of any chemical should be considered as the last option.

Participatory monitoring and evaluation

Monitoring, evaluation and impact assessment are much easier if the farmers keep the following farm forestry records:

• Sowing date.
• Germination date and rate.
• Pricking out date and number.
• Planting date and number.
• Weeding date.
• Harvesting date.
• Quantities for domestic use and sales; and
• Measurements of outputs and outcomes.

During monitoring, evaluation and impact assessment, observation provides a means of gauging the effects farm forestry has on the landscape, on production and on social and economic relations [(Ongugo 1996) and (Emerton et al. 1996)]. Take regular notes on direct observations and information provided by farmers (Tengnäs 1994). Evaluation of farm forestry should be based on intermediate indicators since trees take a long time to grow and mature. The number of seedlings produced in the nursery is a poor indicator of success in farm forestry. Some of the indicators mostly used in the monitoring, evaluation and impact assessment exercises include:

• Tree cover (area).
• Number of trees and survival.
• Increased on-farm fuelwood and/or fodder supply.
• Time spent on collecting the products.
• Improved household income.
• Decreased expenditure on farm inputs e.g. fertilizer; no external supply of fuelwood.
• Increased crop yields.
• Decreased soil erosion.
• Improved family nutritional status.
• No outstanding fee balances.
• No pending bills.
• Boundary disputes.
• Number of technologies being practiced.
• Scale and rate of adoption/adaptation of new technologies.
• Number of trainees or visitors.
• Attempt to produce on-farm planting materials.
• Improved tree, animal feed or crop management levels.
• Rate of new planting.
• Type of trees being planted.
• Change in land use system.
• Farmer's improved knowledge on tree management.
• Number of enquiries made by neighbors.
• Improved water conservation.
• Amount of inputs (time, money, land, labour and management).
• Meetings attendance.
• Increased leisure activities.
• Increased workload.
• Number of handouts.
• Type of media used, remarks made and questions asked.
• work plan developed and follow-up activities; and
• Effect of too much shade.

Constraints in Farm Forestry Development

The challenges affecting the development of farm forestry are technical, political, administrative, social cultural, economic, biological and environmental in nature and occur in isolation or in combination thus making the situation more complex. The constraints include:

• Culture and attitudes of the local people: Women perform 80% of the workload of smallholder agriculture, which employs 70% of the labour force (Njuguna and Baya Un-dated). In many parts of the world, it is a matter of honour that a man be recognized as head of household even though he may be absent because of death, divorce, migration or abandonment [(FAO 1989) and (Wekundah et al. 1993)]. Where there is strong cultural norms on gender division of labour, working with the household as a unit, is the best option [(Ong'ayo et al. 1992) and (Wekundah 1994)]. It is important to evaluate the farmers' social, cultural and economic background, specific needs, problems and experiences before initiating farm forestry development activities [(Kimwe 1993) and (Emerton et al. 1996)].

• Land and tree tenure: The land has been over-burdened, leading to decrease in fertility and productivity per unit area (Kimwe et al. 1994). Land use and tenure reflect status, inheritance patterns, family and community structure, and national policy. Women may attach high value to the land close to the house, but it may be difficult for them to obtain the rights to use it (FAO 1989). Removal of land tenure and other obstacles and adoption of appropriate incentives measures is recommended to stimulate on-farm tree planting [(MENR 1994) and (Emerton et al. 1996)].

• Inadequate technical support: Ensure the extension agent is equipped with the right information backed with relevant research findings, good co-ordination, avoid duplication, well defined and packaged messages, joint planning and funding of extension work at County and Sub county level, improved infrastructure, easily availability of transport; and appropriate technologies to the farmers. The extension agent needs to be equipped with research information on species and sites matching, on-farm tree arrangements and silvi-cultural management techniques (Tengnäs 1994).

• Lack of integration of technical information with indigenous knowledge: Ensure indigenous knowledge of the habits, uses and husbandry of trees is tapped and used in conjunction with existing technical knowledge.

• Capital and labour shortages: Ensure fair and equitable allocation of resource to tree planting to compete favorably with agricultural crops and livestock

• Lack of appropriate incentives: Encourage the use of incentives to promote tree planting on the farms in simple grants, subsidies, loans and assets for work. The indirect economic incentives include fiscal measures and provision of social factors such as investment in public education, improvement of infrastructure and technical assistance. Non-economic incentives will include establishment of public, private and farmers' institutions to promote farm forestry, guarantee research support to generate technology and guide formulation of policies and enactment of appropriate laws to sustain farm forestry (MENR 1994). Some of the essential components, which lead to cost competitiveness of on-farm trees, include appropriate terrain, soils and climate, shortage of transport, distances to the conversion sites and availability of land for future expansion.

• Damage by domestic and wild animals: Ensure protection of trees through construction of secure livestock cages, individual tree or whole area fencing or tethering the animal's altogether until the seedlings attains a height of 1.5-2 m for goats and 2 m or above for cattle. In areas with extremely high browsing pressure, various materials (Kapok and sisal fibres, *Solanium spp*. extract, clipped wool) are placed round the vulnerable shoots as browsing deterrents. Wool is most effective in reducing the browsing destruction to only 20% of the trees. The method adopted depends on the farmer, though the co-operation and commitment of the neighbors is very important (Mbote and Fahlström 1992).

• Conflict over trees on the boundary: Let the farmers themselves adopt which trees to plant on the common boundaries or establish trees on each side of the border, encourage side and root-pruning, neighbours share the trees on the common boundary and discourage certain species (eucalyptus, cypress and pine) on the boundaries. If the farmer has to go ahead and plant the trees on the boundary, then these trees should be atleast two metres away (Kimwe 1993).

• Policy and legal environment: Policies, which affect the price of farm inputs and basic subsistence goods, may encourage or discourage the production of tree-based alternatives to purchased goods [(MENR 1994) and (Emerton et al. 1996)]. Farm forestry innovators need to be conversant with the policy and legal environment in operation. The regulation limiting further sub-division of agricultural land to guarantee food supply and income for a family unit should be encouraged.

• Other factors: Other factors affecting on-farm tree planting include: poorly motivated extension staff, damage of seeds and seedlings by rodents and birds, limited technical competence in farm forestry, lack of ready markets and marketing information, lack of co-ordination of extension services, limited resources and expensive seedling production (MENR 1994).

The Future of Farm Forestry Development

The success of the farm forestry programme depend on commitment of the farmer to network and collaborate in problem identification, planning, design, priority setting, implementation, monitoring and evaluation. Roles for the various stakeholders must be clearly defined and based on

professionalism, transparency, accountability and sustainability.

The farmers need information on access to funding or credit facilities and markets, improve local infrastructure and readily accessible water points, support in acquisition of cheap means of transport, secure source of on-farm seedlings production inputs, food security, information on market oriented species, guaranteed research and technical support, access to other technologies, dynamic policy and legislative framework and recognition of local institutions.

Farmer to farmer extension must be sought and indigenous knowledge incorporated into the technical information systems so that the effort of extension can be appreciated and approved by the local communities. Farmers should appreciate that trees have the same values or even more than what has been attached to crops and livestock and that investing in tree planting is a worthwhile venture. On-farm tree planting should shift from the traditional fruit, shade and ornamental trees to other species through provision of markets and marketing information and formation of farmer based co-operatives for promotion of farm forestry.

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