Species Screening Trial

Protocol

Western Kenya Integrated Ecosystem Management Project

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TRANSFORMING LIVES AND LANDSCAPES

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1. Introduction

The WKIEM project seeks to build the capacity of local communities and other institutions in identifying and managing ecosystem issues as well as in the implementation of conservation and/or mitigation measures. The project also addresses the linkages between upstream and downstream land use practices through the development of community managed integrated ecosystem management plans. The sustainability of agricultural land use will be enhanced by the project through the financial support of IEM planning, capacity building, creating awareness of the need for improved farm management practices, and the protection of habitat areas of critical importance. It is expected that integrated ecosystem management interventions will increase above and below ground carbon sequestration, while simultaneously reducing erosion and harmful agricultural run-off into waterways.

From our work in the region over the past 20 years, we know that there is a serious problem of land degradation across the target river basins. The abundance and distribution of degraded and abandoned lands will be documented in the baseline surveys. The project will specifically target working with communities and individuals to rehabilitate these lands and put them back into productive use. These lands have become severely degraded because they are not appropriate for low-input subsistence agriculture. Therefore we will work with partners in the communities to find alternative land uses that restore soil fertility and improve vegetative cover. To a large extent, these alternative management practices will involve community forestry and agroforestry practices.

In implementing this project and others in the region, extension agents are often confronted with lack of sources of knowledge regarding indigenous tree species. Target populations often express preferences for exotic species like *Eucalyptus spp*., *Casuarina equisetifolia* and *Grevillea robusta*. While these species are highly productive, it is not clear that these species are the best choices for degraded sites. Secondly, there is a lack of knowledge by farmers about the potential productivity of indigenous species. Farmers often remark that indigenous tree species are not as productive as fast-growing exotics. Yet they also readily admit that they do not have experience with these species in a plantation setting and that their observations are based on volunteer trees in the landscape that are not properly protected and cultivated.

Many technical manuals suggest that indigenous species are better adapted to the local environment and should have better survival and growth rates in a region, particularly on marginal lands. Additionally, we recognize the risks associated with introduction of exotic species into new landscapes, although the preferred exotic species have shown no

tendencies to be invasive. Finally, while farmers tend to believe that exotic species grow better, we have observed that there is a lot of variation in indigenous species. We believe that with proper selection the potential exists that these species could perform as well or better than exotic species on degraded sites. All of these 'beliefs' need to be substantiated through demonstration. Thus, ICRAF is organizing a series of species screening trials within the framework of the WKIEM Project.

2. Objective and hypotheses

The objective of the species screening trials is to assess the performance of appropriate indigenous tree species relative to farmer-preferred exotic species on degraded lands. The hypotheses are:

H_1: Indigenous trees will have higher survival rates during the first year of planting than exotic species on degraded soils.

H_2: Indigenous trees will grow faster on degraded soils than exotic species.

Additionally, we seek to develop a predictive model for tree performance on degraded lands through a widespread network of trials that cover a large geographic area and that span a wide variation in climate, soils and other biophysical conditions.

3. Choice of sites

Because this project seeks to use agroforestry and other reforestation practices to rehabilitate degraded and abandoned sites in W. Kenya, the trials are all installed on areas that are eroded or areas with obvious low fertility (esp. abandoned areas) to assess tree potential in these conditions. To be eligible for participation, farmers must meet a minimum set of criteria. These requirements are put in place to ensure that the experiments are maintained long enough to give the expected results.

- Farmer needs to prove that land is owned by the farmer, not rented.
- The available area for planting must be at least 30m x 30m.
- Farmer should be willing to plant and manage 144 trees.

- Farmer must understand that the plot is for research purposes and he must agree not interfere with the management of the plots without knowledge and approval of project staff. The farmer is informed that the trees belong to him at the end of the experiment. Everything is done through verbal agreements.

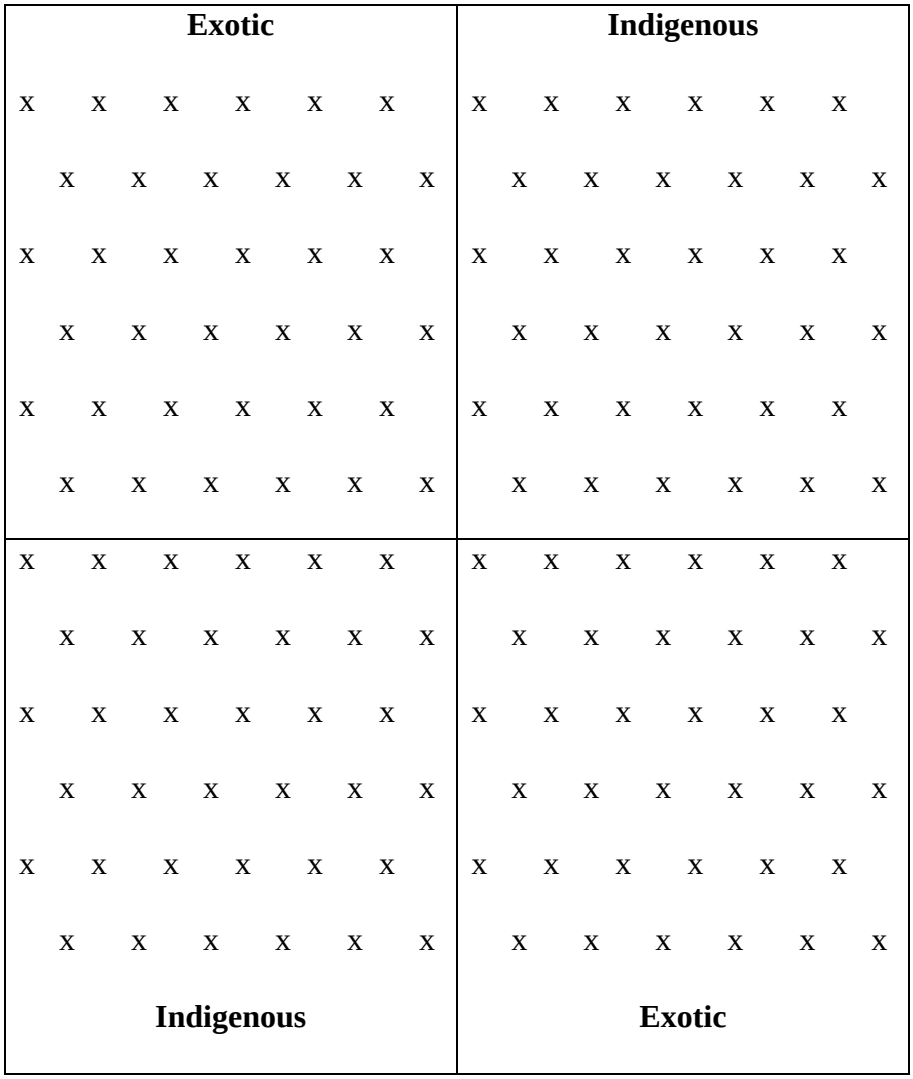
4. Choice and planting of tree species

These trials also serve as demonstration plots to sensitize farmers to the potential of indigenous trees. Thus, we ask the farmer to choose an exotic tree species for planting. As there is considerable concern about water availability in many of the target planting sites, we do not consider *Eucalyptus spp*. among the options. Farmers are allowed to choose between *Grevillea robusta* and *Casuarina equisetifolia*, two of the most popular exotic species planted widely in the region. Half of the plot is planted with the farmer's choice while the other half of the plot is planted with one of the species that project staff would recommend for the site. For degraded site rehabilitation, the project is recommending several species of *Acacia* including *A. polyacantha, A. tortillis, A. mellifera*, and *A. senegal*. The project is also recommending *Albizzia coriaria* for these sites. Thus, the other half of the plot is planted with our choice of tree species for the site.

This trial is a hybrid Type I – Type II trial. The farmer is given directions for management, but the project does not ensure rigid adherence to an experimental protocol. Thus, for example, the amount of manure added per plant will vary from farmer to farmer, as it would under project implementation conditions. This farmer-to-farmer variability will be handled statistically by using a random covariate in the statistical models to account for this variability.

Trees are planted at 2.5 x 2.5 m spacing on an overlapping hexagonal grid; thus, each tree occupies 6.25 m^2. The positions for the trees are pegged and the farmer digs the holes 2' x 2' x 2' separating the top soil and sub soil. Farmers are instructed to mix manure (~2kg wet weight per hole) with top soil and put it into the hole first to preserve moisture. The sub-soil is replaced on top of the topsoil. When the rains begin planting begins.

Each planting plot is divided into quadrats as shown below. The quadrats for the indigenous and exotic species are alternated to avoid any bias in the experiment due to slope direction, sun exposition and shading.



Farmers are trained on tree management: weeding, staking trees that bend, manure application (areas were degraded), mulching where termites are not a big problem. Management implementation is recorded as observations in comments sections on data collection sheets. Training insists on security, particularly w/ respect to grazing.

5. Measurements

Characterization: At the beginning of the experiment, each plot is characterized in detail using the WKIEMP baseline plot measurement system (see measurement and monitoring report for details. Briefly, this measurement involves measurements to allow for land

form and land cover classification following the FAO Land Cover Classification System (LCCS). Top soil (0-20 cm) and sub-soils (20-50 cm) are sampled at four positions and depth restrictions are noted. Infiltration measurements are made on 5 – 10 trials per block. The soil surface is characterized visually and the soil texture is determined by the ribbon method. Vegetation density and biomass is sampled using the t-square method. Land form is assessed according to the following categories:

Level land	**Sloping land**	**Steep land**	**Land with composite forms**
Plain	Medium gradient mountain	High gradient mountain	Valley
Plateau	Medium gradient hill	High gradient hill	Narrow plateau
Major depression	Medium gradient escarpment	High gradient escarpment	Major depression
Low gradient foot-slope	Ridges	High gradient valley	
Valley floor	Mountain highland		
	Dissected plain		

Periodic measurements: Periodic measurements are made on each trial to assess survival and growth. For survival assessment, all trees within the subplots are considered. For growth characteristics, only the four central trees are measured to reduce the possibility that the measurements are influenced by the edge effects of the plot. At three months following planting, a survival count is done. At six months following planting both survival and tree dimensions are measured. The tree dimensions include: root collar diameter, tree height, width of canopy and length of canopy. A similar measurement is made at 1 yr, 1.5 yr, 2.5 yr and 3.5 yr. As trees gain height and begin to exceed 1.5 m, diameter at breast height is also measured.

6. Data analysis

Species performance (survival and growth rates) will be evaluated and compared using simple mixed effects models for analysis if variance. Random effects will be included in the model to account for block-to-block variation and farmer-to-farmer variation within blocks.

More detailed and predictive models of species performance on degraded sites will be developed from the characterization data. It is impossible to propose the specific models that will be used, but we can describe the analytical strategy.

ICRAF has developed a spectral index of soil quality that will be reported as part of the soil analysis results. This index has not yet been peer reviewed, but we anticipate that this will be resolved in the near future. This index, along with the other characterization data will be used to develop statistically valid predictive models of species performance on sites with different levels of degradation. Again, a mixed effects model will be used to account for random effects associated with site quality, farmer management and geographic location of the trials.