Planned Comparison Protocol: Tree Planting

Tree planting Planned Comparison Protocol

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Rationale

Establishment of trees in farms for provision of various products and services has gained traction among farming communities in the tropics. Successful tree planting activities support people's livelihoods with fruits, timber, energy (firewood) and fodder products, thus diversifying the enterprise base for smallholder farmers. Trees on farm have become of particular importance in the wake of changing climatic regimes. Trees help regulate the farm micro-climate, control erosion, regulate floods and build organic carbon in the soil. While further study is needed, it is hypothesized that farmers with more trees and a higher diversity of species in their farms are more resilient against climatic and other shocks, due to the specific ecosystem services and livelihood diversification opportunities they provide.

Trees can be established through natural regeneration (where stumps and/or seeds of desirable species remain in farms) or through direct planting. Direct planting, often by use of nursery-raised seedlings is widely promoted as it allows farmers to make species choices and/or benefit from genetic improvement in the procured seedlings. Unfortunately, tree planting in most dry areas of East Africa has not been successful due to various factors related to tree planting practices. Examples of such constraints include: mismatch of species to sites, use of poor planting techniques such as poor holing, spacing, timing of rain-fed planting, quality of seedlings used, poor watering regimes, termite attack and free livestock grazing. Machakos, Makueni and Kitui counties of Kenya typify examples of areas where tree planting efforts often fail due to poor field survival. However sustained interventions by both farmers and external agencies have at times had high levels of success as observed in Machakos county.

Though farmers and extension staff have tried various innovations to improve tree survival, including injecting water bottles into the sapling root zone, mulching, different hole sizes, tree fencing, and various spacing regimes, results has been varied albeit informative. As species of different use groups such those for timber and fruits require greater care from the nursery to early field establishment stages, it's not clear how certain quality standards (seedling vigor, hardening, age/seedling size, use of potting medium etc) affect tree survival in the field. For dry areas, we suspect field level practices involving poor techniques on soil moisture preservation worsen tree survival and therefore seek to explore cultural and new practices to change this situation.

Planned comparison on tree planting approaches

The planned comparison is designed to help farmers identify the tree planting approaches that confer the best chances of survival of the planted seedlings with minimum investments for them, given their values, interests and resources. The design factors informing this study are outlined in Table 1. The study will take place in selected sub-catchments, with the comparison of options and data collection done at the individual farm level. Farmer selection will be based on demand expressed during the DryDev CAP process conducted in August 2015 where farmers from 14 watershed areas in three counties (Machakos, Makueni and Kitui) expressed interest to learn more on tree-survival-enhancing practices. However to avoid possible tension among farmers brought about by those not participating in this planned comparison sensing a disadvantage, IPs will promote tree planting activities among all project farmers.

Initial selection of tree species to promote was done through community and local stakeholder consultation processes which prioritized the following species: *Melia volkensii, Gliricidia sepium, Syzingium cuminii, Mangiferal indica, Casimiroa edulis, Leuceana spp, Tephrosia vogelii* and *Senna siamea.* The planned comparison will however test only 3 species per farm to minimize complexity in farmer data collection and the difficulty of availing all the species in the amounts demanded by farmers owing to limited nursery infrastructure. Local tree nurseries will be identified and supported to supply the required seedlings through training on good nursery practices and materials supply (e.g. seeds, seedling bags, scions) by IPs. Since nurseries' capacities to propagate certain species may be a limiting factor and may influence species choices at the hindsight - this process is continuously being refined prior to the PCs implementation to avail the most desirable species to farmers. Tree species selection will however be concluded early, taking into consideration recommendations by KEFRI, KFS, and local knowledge acquisition studies on tree utility in the region for appropriate dry land species, to enable timely seed procurement and establishment of seedlings in selected nurseries.

Design and treatments

The planned comparison will test options that farmers can practice to promote tree survival and early growth as shown in Table 1. The objective is to compare tree survival on farm when seedlings are planted in different hole sizes with manure only; manure+mulch or mulch only compared to common farmer tree planting method without manure or mulch (using either

90*60 sq.cm[1] hole sizes for fruit trees such as mango or 30*60 sq.cm hole sizes for other tree species). The comparisons will involve each farmer testing these treatments in two combinations of planting holes [(i) Twice (2x) size of seedling potting bag and (ii) thrice (3x) size of the potting bag as shown in Figure 1.

Table 1: Detailed design summary

Question or objectives	To determine how seedling planting and management practices influence tree survival and growth vis-à-vis the costs associated with the practices (such as labor) across different farm contexts
Hypothesis	Tree planting in bigger holes with manure or mulching or both increases tree establishment in dryland areas with low out-planting survival rates. 1. The higher survival rate is considered by farmers worthwhile for high-value trees planted in the homestead. 2. Mulch only makes a noticeable difference on lighter textured soils 3. Wealthier households will consider investing in more input-intensive tree establishment techniques but poorer ones will not.
Options to compare	Manure/compost: Holes with or without applied once at seedling out-planting stage
	Mulching: Holes with or without
	Hole size (depth and width): (i) small – twice (2x) size of seedling pot; (ii) large – thrice (3x) size of seedling pot (two pot sizes are commonly used in the area: 9*12cm and 4*6cm); and (iii) farmers' methods (common hole sizes in area are e.g 90*60 sq.cm for Mango and 30*60 sq.cm for other tree species). Other farmer suggestions to be tested in subsequent seasons
Contexts to compare	Within or outside (within and outside the cropping fields) and the homestead Soil characteristics: Type (Black cotton clay, sandy loam, other farmer categorization); Soil depth; level of degradation, state of the surface (crusted/not) Household wealth category Slope Erosion status
Study units	Individual trees

[1] Farmer's tree planting practices are very varied and the specific comparison to be done in each farm will be with what that individual farmer gives. The two hole types given here are becoming common as they combine Zai pit technology with tree planting where a big hole is dug to capture moisture for tree survival but crops are planted in the hole in the first few seasons of tree establishment

Planned Comparison Protocol: Tree Planting

Responses to measure	• Farm niche • Soil type (Black cotton clay, sandy loam, other farmer categorization); state of the surface (crusted/not) • Soil depth • Slope • Erosion status/level of degradation • Household wealth category • Survival (yes/no), • Cause of mortality, if known (drought, fire, grazing, insects,…) • Tree height to the longest tip, • Labor cost (hired), man-days (family), Cost/amount of inputs (manure/compost/mulch) Farmer's assessment of each treatment in terms of cost, labour, effectiveness. Farmer's perception of growth under each treatment
Roles of farmers	Each farmer to compare all options at least with two species (farmer selection to ensure sufficient replication for all options to be tested in many contexts)
Roles of others	Partner extension staff for data capture (mobile phone with GPS); analysis by ICRAF scientists
Study/ experimental design	A completely randomised design at the level of each farm to ensure that every option has equal chance of being assigned to any targeted hole micro-site. Each farmer can have between two and three replicates of the treatments but the replicates to have different species
Suggested timing (start and end)	March 2016-Nursery establishment; October 2016-field/farm planting November 2016 – first assessment to get a definitive record of what was actually done and planted, and measure farmers reactions to the task of planting, collected when memory is fresh) March 2017 – second assessment, to see whether trees survived the first dry season (the most critical time) Sept 2017 – third assessment to check survival and growth at one year October 2017 – implementation of round 2

Planned Comparison Protocol: Tree Planting

At least two replicates involving different species is required but three in every farm is preferable. The approach is to have farmer managed PC where the farmer decides on the species to plant and the planting method (control). The researcher input is the introduction of two 'new planting hole sizes with or without manure and/or mulching, which the farmer compares with at least two species. For ease of trial monitoring and measurement, especially where farm sizes are big, a linear arrangement of the seven holes constituting a replicate is recommended but farmers are free to choose own planting designs as long as treatments are randomly assigned (Fig. 1).

The comparisons will be as follows: Farmer tests at least 3 species (to be selected per use group e.g. one for timber, fodder and fruit) to plant in the farm as part of the PC as long as s/he is willing to plant two species in at least 7 holes that reflect 6 treatment combinations and 1 hole as control or usual planting method (Table 2). The farmer has freedom on the planting method for the other species but will be encouraged to establish at least one more in the same arrangement of 7 holes to constitute 2 other replicates.

Table 2: Simple trial plan

Replicate	Tree	Treatments	Factors
Species 1	1	Farmer method	Farmer usual hole size
1	2	manure only	Planting hole size1
1	3	manure and mulch	hole1
1	4	Mulch	hole1
1	5	manure only	Planting hole size2
1	6	Mulch	hole2
1	7	manure and mulch	hole2
Species 2			
2			

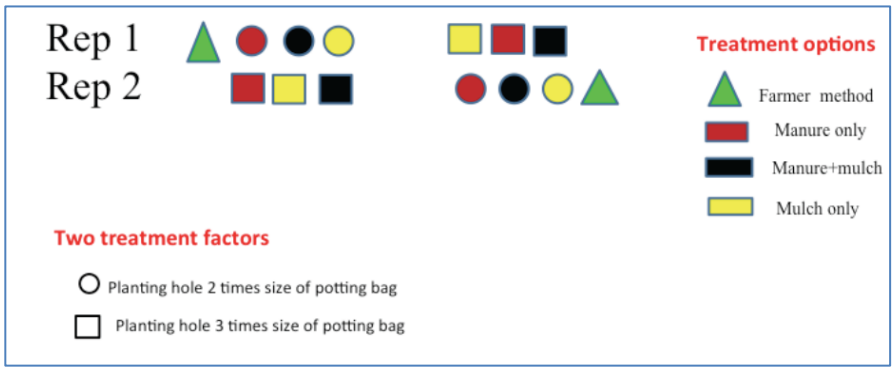

Figure 1. Treatment combinations of planting holes and OM application

(Farmers encouraged to draw such a plan of what they actually plant, so they can remember what is what at assessment at least 1 year later. Rep 1 and Rep 2 could be in different niches)

Approach for implementation of the planned comparison

A. Species selection and seedling production

The following preparatory stages are proposed for procurement of sufficient seedlings in order to roll out the tree survival planned comparison in the field:

1. Conduct site consultation meetings with implementation partners (WVK, CARITAS and ADRA) on contextual implications of rolling out the tree planting planned comparison across 3 Counties (Machakos, Makueni and Kitui)
2. Identification of specific areas for implementing the tree planting PC drawing from the results of the CAP process (more of this in B below)
3. Discuss criteria and process for selecting lead farmers and listing participating farmers for the planned comparisons with implementation partners
4. Site scoping visits to determine the actual tree species choices to test in the PC (drawn down from the list generated at the CAP process) as informed by nursery outlay and seed and availability (Jan to February 2016)
5. Decide on the final list early and discuss with the enlisted farmers to select preferred species before commencing nursery seedling production in order to determine the number to be raised per category of species (If 1000 farmers participate in the trial a minimum of 7000 seedlings need to be produced per use category and this number would have to be higher if selection is not done apriori)
6. Decide on the method to procure seedlings (purchase or raise in nurseries) of all selected species as all seedlings trialed in a watershed need to be of similar standards in terms of size, age, seed source, size of potting bag, potting medium per species to minimize variation from genotype and nursery practice
7. If the source of all the seedlings is community nurseries, the nurseries to be identified early and supported by ICRAF and IP staff to ensure uniformity of planting dates, size of potting bags, records of seed sources, records of seedlings and that appropriate nursery procedures (watering/shading/hardening) are followed[2].
8. Raising of tree seedlings in selected farmer nurseries during the March-May 2016 rain season – production of species with long nursery rotations (such as grafted fruits and some timber species) to be well timed in order to be ready for out

[2] Support in form of capacity assessment on good nursery practices and filling capacity gaps through training, provision of seedling production guidelines particular to the selected species and, where necessary, material inputs

planting at the onset of rains in October and in strategic sites to ensure reliable water supply throughout the nursery period.

9. Explore early whether seedlings of long nursery rotation species such as grafted fruits e.g. mango and timber, e.g. melia, need to be purchased from existing nurseries should be made if production time is insufficient. If this is necessary then carefully select nurseries to contract to conform to the uniformity standard already highlighted above.
10. Ensure minimal distances between seedlings source and planting areas to minimize transport costs and transportation shock on seedlings. Where transport of seedlings from distant nurseries is inevitable allow 4-5 days to recover 'transportation shock' before field planting so as not to compromise survival.
11. Care should be taken when transporting seedlings e.g. by covering with thick polythene sheets when open trucks are used
12. Field planting of seedlings in farms to be executed at the onset of October/November 2016 rains
13. Avail 7 seedlings per species for up to 3 species each according to use group e.g timber, fruit, fodder, fuel species to participating farmers who receive a total of 21 seedlings in 3 sets of same species. Farmers could plant more (than 3) species but these will be made available through purchase from the nurseries and planted in farmers own designs (possible choices to include: *Melia volkensii, Gliricidia sepium, Syzingium cuminii, Mangiferal indica, Casimiroa edulis, Leuceana spp, Tephrosia vogelii,* and *Senna siamea*)

B. Farmer selection and field planting

1. At least 1000targeted farmers from about 14[3] watersheds to participate in the PC (Table 3). Assuming 10 farmers participate in a village, 3- 5 villages will be selected per villages depending on the demographic data available for each catchment
2. Consider setting control PC trials (possibly one per county) in watersheds that did not request for any tree planting activity during CAPs to check if farmers familiar with appropriate techniques to ensure high tree survival rates
3. Farmer selection/recruitment for the trials to be conducted before the beginning of the March-May 2016 rain season after the completion on the CAP process in all catchments.

[3] This number is still an estimate as we await completion of the CAP process in the remaining 16 watersheds in April 2016. Of the 12 watersheds where CAP has been done 8 watersheds have made the request for a learning priority on successful tree planting practices and a number close to this is expected from the remaining ones.

4. Species choice – farmer selects 3 new tree species from those listed as appropriate for their sub-sub catchment; one must be indigenous, one fruit and another category (each species category must have at least 7 potted seedlings)
5. Participating farmers to be requested to identify areas in the farm where tree planting is intended aiming to prepare up to 21 holes if 3 replications are implemented. An example of the treatments layout and holing plan per replicate is shown in Fig.1
6. Seedlings can be planted across all niches that farmers prefer to plant, i.e. homestead, crop field, fences/hedge, etc as long as fine-scale variation within farm is considered to ensure that each replicate is as homogeneous as possible across the 7 holes. Each farmer will be trained and assisted on treatment randomization across niches.
7. Farmers to label the hole sites between 1 and 21 in order for the field monitoring team to randomly assign the treatments and guide the farmer on hole preparation
8. ICRAF and IP staff conduct training to the field monitoring team (which includes lead farmers) on data collection methods and submission arrangements will be discussed with champion farmers and trial farmers to determine successful approaches.
9. ICRAF and IP staff to discuss trial monitoring arrangements with the field monitoring team and clearly demarcate practical areas of operations, frequency/schedule of mentoring events, etc.
10. Appropriate, simple labelling of trial material to be improvised and discussed with participating farmers and lead farmers in order to promote data accuracy

Data collection

From the outset farmers will be required to indicate willingness to participate in the PC and their choice of species. Information on chosen tree planting method/site/design, planting dates, main field crop, and dominant soil types will be assembled in order to define a given context. Implementing agents will facilitate lead farmers and participating farmers to record data at three months intervals using simple data collection sheets covering: farmer preferred tree species, planting methods/site/design, tree survival counts, pest incidence, GPS points and other field observations, as well as the contextual factors listed in table one. Farmers will be encouraged to keep records on tree planting practices following a simple log. Data collection tools are included in the Annex section.

Data management and analysis

Data collected by farmers on tree survival and growth will be keyed into electronic devices in the field by the field monitoring team using ODK excel entries and submitted for cleaning by ICRAF staff. Initial analysis will be done using simple descriptive statistics such as means and percentages using R statistical software. Qualitative data such as farm/context characterization, reasons for planting method & species choices, will be coded for additional descriptive analysis.

Annex 1: Farmer record sheet on tree survival, growth measurement

Sheet 1: Farmer recording sheet 01

Farmer ID

County:

Sub location:

Site:

Village: Farmer name:

Farm GPS Coordinates:
Slope:
Erosion status:
Farm size:
Number of trees already on the farm and the species:

Distance to water source:
Grazing animals on farm?

Niche[4] (where planted in the farm) for replicate 1 (tree hole number 1 – 7)

Niche (where planted in the farm) for replicate 2 (tree hole number 8 – 14)

Niche (where planted in the farm) for replicate 3 (tree hole number 15 – 21

1. [4] EB – External boundary; IB – Internal boundaries; CL – scattered in cropland; WL – woodlot; HC – Home compound; O – Other (specified)

Planned Comparison Protocol: Tree Planting

Planting Date:

Farm ID/Farmer name:

Farm site	Tree/hole number	Treatment combination	Amount of manure used	Manure source	Amount of mulch used	Species name/local name	Assessment after 1 month Date: …….		Assessment after 6 months Date: …….		Assessment after 12 months Date: …….	
							Survival (tick)	Height (cm)	Survival (tick)	Height (cm)	Survival (tick)	Height (cm)
1	1											
1	2											
1	3											
1	4											
1	5											
1	6											
1	7											
2	1											
2	2											
2	3											
2	4											
2	5											
2	6											
2	7											
3	1											
3	2											
3	3											
3	4											
3	5											
3	6											
3	7											

Other Observation (s)

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Annex 2: IP staff record sheet on the farm profile

(if farmer is also participating in Zai Pit PC, only collect any details not already collected through Zai Pits sheets)

Farmer ID

Date:

County:

Sub-county:

Site:

Sub location:

Village:

GPS Coordinates:

Farmer's name:

Gender of HHH

Description of the land use/ cultivation history:

Soil texture (also indicate if varying within the farm):

Land Use history of the plot

Area cultivated (acres)

Planned Comparison Protocol: Tree Planting

Time since the land was opened to cultivation,

Time since the land was fallowed

Crops commonly planted

Management practices (burning, inorganic fertilizer)

Does the farmer burn trash/ crop residue?

Does farmer apply fertilizers/ herbicides /Pesticides?

Slope (degrees):

Erosion (gully, sheet, rill, none):

Has the farmer ever employed a Soil Water Conservation practice before?
Which one?

Crops and cropping history:

Land size (acres)

Land tenure type

Distance from farm to main road (km)
Distance from farm to nearest main market (km)

Any other observations
Farmer's tree planting practice – type of holes