UPS 4: Improved wood supply on-farm, education and tree planting: Wood supply and environmental sustainability in rural communities

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KEY OBJECTIVE **This UPS was designed to address the cooking energy and land degradation problems by integrating fast growing tree species to supply wood and improve soil fertility.**

KEY CONSTRAINT ADDRESSED

Over 90% of rural households in Tanzania rely on biomass energy for heating and cooking. Native forests are limited and facing increased pressure as wood is extracted for fuelwood, construction materials, and other wood products. Consequently, there is an acute shortage of cooking energy in semiarid sites like Dodoma. To cope with this problem, farmers often uses crop residues and livestock manure as a source of cooking energy. However, this approach accelerates land degradation and nutrients depletion because it disrupts the nutrient cycling processes.

DESCRIPTION

This UPS focus on building the capacity of farmers to produce tree seedlings and plant trees that provide alternative sources of wood biomass for the supply of cooking energy (especially firewood), fodder, other wood products (e.g. poles), and for the provision of other environmental services (e.g. improving soil fertility, carbon sequestration, and soil erosion). One of the main challenges to tree planting is the availability of a sufficient number of high quality tree seedlings. In order to address this challenge during and after the Trans-SEC project phase out, community-based tree nurseries were established. This activity started by mobilizing farmers into groups (*Mazengo* and *Jamhuri*) to facilitate training. These groups have a total of 31 members, with women forming 74% of the group. Training was conducted for three days per group and covered the following topics: site selection, seed source, selection and collection, potting mixture and pot filling, nursery management, as well as silvicultural treatments of seeds and seedlings at the nursery. Group members were also trained on tree planting techniques. After training, farmers participated in nursery establishment activities, including pot filling and seeding. Tree seedlings were planted in various niches in the fields, including farm boundaries, within the farm where suitable species like *Gliricidia sepium* are intercropped with crops, and in highly degraded sites not suitable for crop production, such as woodlots or pure stands. ARI Hombolo and ICRAF staff conducted regular monitoring of trees in the nursery and farmers fields to get feedback from farmers on progress and challenges encountered as well as to assess the survival and growth of the seedlings. Data collected was used to calculate preliminary estimates of biomass yields to demonstrate the extent to which agroforestry technologies may meet household cooking energy demand, improve crop production, and reduce land degradation.

Proven success in TZ and beyond

Boundary tree planting, intercropping, and woodlot technologies have shown great success in Dodoma, Mkundi in Morogoro (Kimaro et al., 2007) and in the Shinyanga and Tabora regions (Nyadzi et al. 2003) under the ICRAF and SUA research programs. Selected tree species easily regenerate, especially in agricultural fields. They proved high success in firewood production and other wood related produce in a rotation of 10-20 years with annual volume increments of 5-15 cubic m/ha (Orwa et al.2009).

Trans-SEC findings

The potential for on-farm wood supply to meet household energy demand

The tree nursery groups produced about 12,000 seedlings of different species during the 2015 and 2016 growing seasons (Table 1). Over 94% of these seedlings were planted in farm boundaries, woodlots, as shelterbelts, and intercropped with cereals. The types of tree species chosen were based on farmers' preferences for fodder and soil fertility improvement (*Gliricidia sepium* and *Melea azedirachta*), fuelwood (*Cardia sinensis* and *Senna siamea*), and timber (*Afzelia quannzesis*) supply. These species also recorded the highest survival rates (67-100%), based on the May 2016 assessment. The high survival rates reflect the excellent adaptation to harsh and dry conditions in the village and, hence, the potential for fuelwood supply and addressing land degradation challenges. After 2 years, the tree species planted produced 1 – 16 t/ha of wood, depending on growth rates (Table 2). This amount of wood is sufficient to satisfy a 5-member household for up to 29 or 88 months, when using three stone fires or the improved firewood cooking stove, respectively (Table 2), based on the per capita daily consuption rates of 9.7 kg and 4.7 kg (Sererya, 2016). Tran-SEC studies reveal that Ilolo farmers spend over 6 hrs to collect a headload of firewood (approx 25 kg), which is typically spent in 3 days when cooking with a 3 stone firewood stove (Kahimba et al., 2015; Sererya, 2016). Based on this estimate, the amount of firewood collection time saved as a result of on-farm wood supply is 1.4 or 2.8 months, when cooking with the three stone fires or the improved firewood cooking stove, respectively. Thus, a substantial amount of the time spent collecting fuelwood could be diverted to other income generating activities, such as farming, livestock keeping, and agrobussiness to address food insecurity and poverty.

Table 1: Number of tree seedlings produced and planted and survived (%) at Ilolo Village during the 2015 and 2016 growing seasons

Tree species	2015			2016		
	Produced	Planted	Survival	Produced	Planted	Survival
Afzelia quanzesis	30	30	23.3	640	460	68.7
Gliricidia sepium	1539	1539	56.2	4500	4342	66.5
Senna siamea	167	167	38.9	1646	1775	75.1
Acacia nilotica	49	49	79.6	340	274	55.8
Albizia labbeck	-	-	-	132	132	54.5
Leucaena diversifolia	-	-	-	120	260	22.3
Cardia sinensis	-	-	-	36	36	100
Carica papaya	-	-	-	226	58	41.4
Melea azedirachta	-	-	-	2448	2040	75.6
Delonix regia	-	-	-	80	80	0
Eucalyptus camadulensis	-	-	-	3	-	-
Total	1,785	1,785	54.7	10,171	9,457	67.9

Table 2: Potential for meeting household energy demand in Dodoma using Agroforestry

Agroforestry Practice	On-farm Wood Production		Duration (months)*	
	Tree species	Biomass (t/ha)	With ICS	Without ICS
Boundary	Acacia polyacantha	0.98	4	1
	Eucalyptus camadulensis	2.03	9	3
Woodlots	Grevillea robusta	18.6	83	28
	Senna siamea	19.7	88	29
	Melia azadarachta	15.9	71	24
Shelterbelt	Grevillea robusta	5.6	25	8
Intercropping	Gliricidia sepium	3.3	15	5

*Duration of time it takes a household of 5 members to complete the amount of wood produced on-farm. The estimate is based on household consumption rates of 2.7t/yr when using ICS and of 8.1 t/yr for a three stone fire stove, as determined by the on-going M.Sc. research in the Trans-SEC project (Ogossy, 2016)

TYPE OF FOOD CROPS APPLICABLE:

Three agroforestry technologies (boundary tree planting, woodlot, and intercropping with cereals) were adopted at Ilolo. Boundary tree planting can go with any crop depending on the farmer's choice, as previous studies suggest that planting crops 3 m away from the tree rows will mitigate competition (Kimaro et al., 2014). Woodlots were established on uncultivated marginal lands. Farmers also can adopt sequential cropping arrangements whereby trees and crops are rotated on the same piece of land in the form of rotational woodlots or improved fallow systems (Nyadzi et al. 2003; Kimaro et al., 2007). *Gliricidia sepium* is the only tree species intercropped with cereals because it is compatible with crops in semi-arid areas when its leaves are regularly pruned in order to provide green manure during the cropping seasons (Mkumba et al, 2006). Ideally, with appropriate selection of tree species and management to minimize above- and below-ground competitions, agroforestry tree species can be successfully intercropped with agricultural crops including maize, millet, sorghums, and sunflower (Lott et al., 2000).

TECHNICAL SPECIFICS, DIMENSIONS:

Appropriate tree species for on-farm wood supply depends on agroecologies and farmer preferences. Planting spacing varies with species and site conditions, but spacing of 3 x 3m or 3 x 4m is fine for semiarid conditions (Orwa et al.2009). Planting crops 3 m away from the boundary trees will mitigate competition in semiarid regions like Dodoma (Kimaro et al., 2014).

IMPLEMENTATION CONSTRAINTS

Inadequate water supply for irrigation during the nursery stage can be a challenge in areas without reliable water supply. There is often low capacity and motivation to plant trees by farmers, due to low awareness, the length of time need to realize benefits, and constant maintenance efforts. Crop yields can fall due to failure to control competition or prolonged drought. There is also the risk of vandalism of planted trees by livestock owners. Insecure land tenure can affect tree planting as trees are associated with land ownership in most societies.

Linkage to other FVC components

Food Production, especially for intercropping systems where some tree species increase nitrogen content in the soil. Animal husbandry –forage from *G. sepium*, Natural Resources (concepts of agroforestry or agro-silvo-pastoralism); crop residues and/or manure used as a source of cooking energy are not available for replenishing soil fertility. Fuel source; most selected tree species such as *G. robusta, C. sinensis, G. sepium* and *M. azadirachta* are popular for firewood and charcoal at the household level and for small industries that rely on fuelwood as source of energy. Some of these species have calorific value of sapwood is about 4 800 kcal/kg, while that of heartwood is 4 950 kcal/kg (Orwa et al. 2009), reflecting the high potential for household cooking energy.

Considerations & criteria for UPS outscaling

The firewood scarcity in a given community and self-motivation on tree planting is a main criterion for outscaling. The supply of adequate firewood to meet household energy demands will provide extra time for the community to perform other economic activities, while also reducing expenditures on fuelwood. It is very important to make sure that the essential requirements of tree planting are available to minimize the costs of outscaling; including loamy-sandy soil for nursery preparation, polythene bags, and reliable water supply. The distance to the collection point contributes highly to time wastage that, if not addressed, will affect the community economically.

Key lessons learned

On-farm wood supply offers great potential to meet household fuelwood needs. This approach also reduces the substantial amount of productive time that is spent on firewood collection. This productive time can be diverted to other economic activities that improve rural livelihoods and environmental sustainability.

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