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INNOVATION PLATFORMS FOR ESTABLISHMENT AND MANAGEMENT OF COMMUNITY NURSERIES IN THE CENTRAL HIGHLANDS OF ETHIOPIA

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ABSTRACT

Developing community nurseries is one of the very important steps to expand tree covers in degraded as well as other areas. The establishment of such nurseries, however, requires a sustained commitment from the community and proper coordination of a sequence of activities as any failure to pay attention to the details of important processes may result in the production of poor-quality and quantity of seedlings. This study was, therefore, designed to document important processes, lessons and challenges encountered from the participatory nursery establishment and management in Borodo and Mekentuta watersheds of central Ethiopia. The processes of establishing nurseries were started by forming Innovation Platforms (IPs). The IPs in each watershed consisted of local community, a local administrator, village and watershed representatives, religious leaders, elders, researchers and development agents. Each IP elected its own leader, who was responsible for (i) registration of interested members, (ii) organising meeting and field visits in the absence of researchers or development workers, and (iii) monitoring the implementation of agreed nursery schedules. The proper execution of planned nursery activities, however, did not materialise as all members did not share responsibilities equally. Hence, local bylaws were formulated to ensure equal and sustained participation, although, their effectiveness was constrained by the existence of blood relationships among IP members and weak enforcement mechanisms. Overall, this paper discusses the most important processes, lessons and challenges encountered during participatory nursery establishment and management so as to use such experiences as inputs for similar development works in the future.

Key Words: Community nursery, innovation platform, tree and shrub species, watershed

RÉSUMÉ

Le développement des pépinières communautaires est l'une des étapes les plus importantes pour l'expansion des couvertures d'arbres dans des milieux degradés et autres. L'établissement de telles pépinières, par ailleurs, nécessite un engagement durable de la communauté et une bonne coordination des activités étnt donné que toute erreur d'inattention sur les détails de processus importants pourrait conduire à une production de pauvre qualité et quantité des plants. Cette était conçue pour documenter des processus importants, des leçons et contraintes rencontrées dans l'établissement et la gestion participative des pépinières dans les basins versants de Borodo et Mekuntuta en Centre de l'Ethiopie. Les processus d'établissement des pépinières étaient initiées en formant des plate forme d'innovation (IPs). Les IPs dans chaque basin versant composes de la communauté locale, un administrateur local, des représentants des villages et basins versants, des leaders religieux, les personnes agées, les chercheurs et les agents de développement.Chaque IP avait élu son propre dirigeant,ayant pour responsabilité de (i) enregister les nouveaux members, (ii) organiser des reunions et descente sur terrain en l'absence des chercheurs ou agents de développement, et (iii) suivi de l'exécution des programmes agréés de pépinières. L'exécution correcte des ectivités planifiées de pépinières, par ailleurs, n'a pas été matérialisée étant donné que tous les members n'ont pas partagé équitablement les responsabilités. Ainsi, des législations locales étaient formulées afin d'assurer une participation et durable, si bien que leur efficacité était handicapée par le fait que tant

de membres de l'IP avient des relations familiales très proches et de faibles mécanismes de renforcement. En somme, ce article présente les processus les plus importants, les lessons et contraintes rencontrées dans l'établissement participative et la gestion des pépinières, afin de se servir de ces expériences pour initier des travaux de développement similaires dans le future.

Mots Clés: Pépinières communautaires, Plate forme d'innovation, Espèces d'arbres et arbustes, Bassin versant

INTRODUCTION

Trees in the farming system can play multiple roles especially, in sustaining crop production, improving soil fertility, protecting soil erosion, and in providing timber and non-timber forest products. However, massive deforestation in Ethiopia reduced the contribution of forests to environmental protection, food security, and income generation (Badeg, 2001). According to Reusing (1998), the rate of deforestation in Ethiopia is one of the highest in tropical Africa ranging from 163, 000 to 200,000 ha yr^{-1}. Similarly, the problem of deforestation is so serious in the central highlands of Ethiopia, where this study was conducted. The Participatory Rural Appraisal (PRA) survey conducted in 2010 indicates that the principal reasons behind the on-going forests decimation in and around the study areas are expansion of agricultural land, unsustainable exploitation of existing forests for various uses (e.g., fuel wood, fodder and construction materials), low agricultural productivity, unplanned settlement in the forest areas, and overgrazing. To end this, such deforested areas could, however, be recovered through well organised and coordinated reforestation programmes. Various developmental organisations in Ethiopia are involved in the establishment of nurseries to produce quality planting stocks for different planting schemes (e.g., establishment of woodlots, roadside plantations, live fences, wind breaks, riverbank stabilisation, and others). However, the successes of such forestry activities have been unsatisfactory because of poor seedling quality and poor participation of local people, development agents and local government administrations in the planning and execution of afforestation/reforestation programmes (Mekonnen *et al*., 2008).

A successful reforestation scheme begins with the production of quality seedling at the nursery (Bayley and Kietzka, 1996) and good participation of all actors in the reforestated area. A tree nursery is literally defined as a protected site designed to produce tree seedlings under favourable conditions until they are ready for out-planting (Mansur and Sukendro, 2003). Such nurseries could vary greatly in size, facilities and capacity (i.e., quantity of planting stocks produced) despite of all being important part of any tree planting ventures. The African Highland Initiative (AHI) project, as one of the regional projects in Ethiopia, sought to address land degradation in the selected watersheds of Ethiopia by improving the conditions of small-scale farmers through participatory natural resources management (e.g., tree planting on different niches, soil fertility management, constructions of contour bunds and terraces) and modification of agricultural technologies (e.g., provision of improved livestock and crop varieties) (Tukahirwa *et al*., 2013). Tree planting in both watersheds is vital, not only to increase local tree covers, but also to protect natural resources from further depletion and help to improve the livelihoods of farmers dwelling within the selected watersheds and the surrounding areas. Hence, four community nurseries were established in Borodo and Mekentuta watersheds to avail multi- purpose tree/shrub seedlings to the communities. The objective of the study was, therefore, to document important processes, lessons and challenges encountered from participatory nursery establishment and management schemes. The obtained experiences will inform similar development oriented initiatives in the future.

MATERIALS AND METHODS

Site characterisation

a) Geographic location and climatic conditions. This research work was conducted in two

watersheds (Borodo and Mekentuta) of the central highlands of Ethiopia. Borodo and Mekentuta watersheds are located in the districts of Dendi (West Shewa zone) and Were-Jarso (North Shewa zone), respectively. The total area of Borodo watershed is 374 ha whereas the corresponding area at Mekentuta is 1307 ha. Borodo has mild sub-tropical climate with a mean daily temperature of 15 to 23 °C. The respective mean minimum and maximum temperatures in Mekentuta are 14 °C and 24 °C. Both watersheds experience bimodal rainfall patterns with the short rainy season falling during March to April and the long rainy season lasting between June and September.

b) Topography and soil types. The topography and soils of the selected watersheds varied greatly. The Mekentuta watershed is characterised by relatively flat land (< 8%), with an altitude ranging from 2500 to 2570 m.a.s.l.. In contrast, the mean altitudinal range for Borodo watershed is 2210 to 2720 m.a.s.l; and has undulating topography and extended valley bottoms. Farmers in both watersheds classified soils on the basis of colour, relative fertility and regular workability, although, the former criterion is the most widely used. Accordingly, *Koticha*, *Dimile* and *Borebor* soils are the major soil types in Mekentuta watershed whereas *Koticha*, *Dimile* and *Abolsi* soil are found in Borodo watershed (Table 1). However, *Koticha* is the dominant soil type in both watersheds.

c) Forest resources and forestry activity in the watersheds. The PRA survey was conducted in and around the two watersheds in 2010 by a multi-disciplinary team of researchers and agricultural development agents from livestock, crop, natural resource and agricultural economics sectors. Various participatory tools including individual and group interviews with farmers, key informants with focused group discussions (FGD) were used to generate data. The multi-disciplinary team developed checklists used for FGD. The results showed that *Eucalyptus camaldulensis* and *E. globulus* were the two dominant tree species in Mekentuta watershed, and were mostly planted around homesteads as live fence, wind break and woodlots. Farmers in the study area also had a culture of protecting and managing naturally grown indigenous tree species (e.g., *Acacia abyssinica, Cordia africana and Faidherbia albida*) around their farmlands, grazing lands and along river banks. They believed that such scattered trees/shrubs have positive roles on soil fertility maintenance, soil erosion control, and provision of shade to their domestic animals. Besides, farmers acknowledged the additional benefits they got from naturally grown trees/shrubs in terms of fuel wood, charcoal, farm implements and construction materials through various tree management options (e.g., pollarding, lopping or pruning their branches). Farmers in this watershed, however, did not plant the aforementioned species on their land holdings because of land shortage, lack of seedlings and fear of uncontrolled browsing by livestock.

Unlike the Mekentuta watershed, the immediate surroundings of Borodo watershed had a large tract of natural forest (the Chilimo Forest Reserve). The size of this forest has, however, dwindled sharply from 26,000 ha to 6,000 ha over the past 30 years (personal communication with natural resource protection unit, 2012, Dendi district). The PRA survey also found that indigenous trees such as *Acacia abyssinica, Apodytes dimidiata, Juniperus procera, Olea africana, Podocarpus falcatus*

TABLE 1. Soil characteristics at Mekentuta and Borodo watersheds

Local name	Soil classification	Soil colour	Fertility status	Workability
[a]*Koticha*	Vertisols	black	relatively fertile	Difficult
[a]*Dimile*	Nitosols	red to brown	relatively fertile	Easy
[b]*Borebor*	Leptosols	light colored	less fertile	Easy
[c]*Abolsi*	Cambisols	dark red to gray	less fertile	Medium

[a]found in both watersheds, [b]found only in Borodo, [c]found only in Mekentuta

and *Prunus africana* were among discriminately severed species from the tree population. Consequently, households within the Chilimo forest boundary had organised themselves into forest management and utilisation cooperatives in order to protect the forest from further destruction. They developed a byelaw that governs the utilisation and development of Chilimo forest. The byelaw was formulated (i) to ensure sustainable utilisations of Chilimo forest by its dwellers and, (ii) to deny people who lived outside an access to this forest. Both dwellers and local institutions (such as local administrator and police) were responsible to enforce this byelaw. As a result, *Eucalyptus* plantations have expanded in the vicinity of Chilimo forest and Borodo watershed.

Processes during community nursery establishment

a) Problem identification. The processes of establishing community-based nurseries were initiated by forming Innovation Platform (IP) in the respective watersheds. The IP refers to a forum established to facilitate interactions and learning among stakeholders with a common challenge to address (Tukahirwa *et al.*, 2013). The joint efforts of the stakeholders lead to participatory diagnosis of problems - joint exploration of opportunities and investigation of solutions leading to promotion and harnessing innovation. The IP was consisted of local community, a local Administrator, village and watershed representatives, researchers, religious leaders, council of the elders and development agents. The role of each IP member was not clearly specified. However, each IP elected its leader who was responsible for registration of interested members and monitoring the proper implementation of agreed schedules. This approach was found to be effective at Galessa (Kidane *et al.*, 2008) and Dendi watersheds (Mekonnen *et al.*, 2008). The total numbers of registered IPs members in Borodo and Mekentuta watersheds were 100 and 147, respectively (Table 2). Results from the FGD revealed that natural resources degradation was one of the major problems and contributed to the declining of soil fertility and agricultural productivity in both studied watersheds. Such findings were later presented to the whole IPs members through a feedback meeting. Participants had thorough discussion about the severity of land degradation in their respective watersheds and proposed possible solutions to counteract.

During their discussion, they stressed the role of tree planting in protecting the environment apart from providing woody (e.g., fuel wood, construction poles, posts and timber) and feed materials. The establishment of community nurseries in the selected watershed areas was

TABLE 2. Total number of participants in each nursery activity by watershed and sex group

Activity	Borodo[b]		Mekenetuta[b]	
	Male	Female	Male	Female
Fencing	110*	24*	152**	70**
Bed preparation	104*	23*	197**	60**
Preparation of compost	103*	19*	13*	31*
Pot filling	210**	45**	22*	6*
Seed sowing	197**	30**	37*	-
Weeding	197**	30**	36**	51**
Seedling transplanting	188**	30**	18*	-
Seedling dispatching[a]	225	46	394	87

[a]farmers who did not participate in any of the nursery activity appeared to take seedlings

[b]The total number of registered IP members in Borodo and Mekentuta watersheds were 100 and 147, respectively. The female-to-male ratios of the IP members in the respective watersheds were 0.23 and 0.14

*these activities were performed 1-3 times

**these activities were performed several times (>3 times)

the first step to increase tree planting activity around homestead, degraded lands, along contour bunds and/or newly constructed terraces. Targeted information with regard to tree nursery managements (i.e., opportunities, challenges and their experience) could, however, not be obtained during PRA survey as farmers in both watersheds did not have experience on community based nurseries.

b) Nursery establishment. Two community nurseries were established in each watershed (i.e., two nurseries were established in 2010 and the other two in 2011). The size of these nurseries ranged from 100 to 200 m^2. During nursery establishment, members were divided into subgroups to facilitate the timely organisation and execution of nursery activities (site clearing, fencing, seedbed preparation, soil mix preparation, seed sowing, mulching, weeding, watering, root pruning, etc). This experience was adopted from previous works at Galessa watershed (Kidane *et al*., 2008) and Dendi district (Mekonnen *et al.*, 2008). Members at Borodo contributed poles and posts to fence newly established nurseries which were not the case for the previous project site at Galessa watershed (Kidane *et al*., 2008). Nurseries at Mekentuta were also fenced off by wooden post (brought by farmers) and barbed wire supplied by the AHI project. Tree seeds and other inputs (polyethylene tube, and nursery tools and equipments) needed for quality seedlings production were provided by the project.

c) Seedlings production at nursery. A total of ten species namely A*cacia abyssinica, A. saligna, A. decurrens, Chameacytisus palmensis, Cordia africana, Croton macrostachys, Eucalyptus camaldulensis, E. globulus, Hagenia abyssinica,* and *Sesbania sesban* were selected by the IPs members to be planted on different planting niches (home garden, degraded lands, farm boundary, contour bund and terraces). Species selection was performed following farmers own criteria that included (i) high production of biomass for fuel wood and fodder, (ii) effect on soil fertility and adjacent crops , (iii) soil erosion control, (iv) ease to propagate, (v) provision of shade, (vi) rate of leaf decomposition, and (vii) economic value (Table 4). Seeds of the selected species were purchased from the Forestry Research Center. The seeds of all species were directly sown onto polythene bags (12 cm long and 10 cm in diameter, each) with the exception of *C. africana, E. camaldulensis* and *H. abyssinica* whose viability was less than 50%. Thus, they were sown onto the germination bed until the seedlings reached >3 cm. Seedlings were kept in nursery until they attained planting size of 25 to 30 cm. The total numbers of participants in each nursery activities and the total number of seedlings produced are given in Tables 2 and 4, respectively.

d) Training organisation. The forestry research team from Holetta Agricultural Research Center (HARC) organised a two days training programme. This training covered a wide range of issues including how to construct a community nursery, how to produce quality seedlings in the nursery, how to select suitable sites for tree/shrub planting and how to manage them after planting out. A cross-site visit was also organised to build the capacity of IP members in the areas of tree seed collection, potting, transplanting, watering and shading management, hardening-off, and site preparation for tree planting. Since it was not possible to accommodate all IPs members in the cross-site visit, the training was conducted in two steps. Small groups that consisted of development agents and educated farmers visited the forestry research sites at HARC. The acquired knowledge/ experience from this cross-site visit was then transferred to non-participated IPs members by organising on-site training in the watersheds (lasted for 3-5 days). Meetings were held regularly to identify problems and to take corrective measures on time. More importantly, issues raised in each meeting were documented to monitor the success and failure of participatory tree nursery establishment and management in the selected watersheds.

Data collection and analyses. The total number of farmers involved in each nursery activity, total number of seedlings raised, and survival

TABLE 3. Types of species chosen by the IP members and their respective reasons

Species	Origin	Local name	Family	Altitudinal range in Ethiopia (m.a.s.l)[d]	Reasons for selection[e]
A. abyssinica[b]	Indigenous	Bazra girar	Fabaceae	1500 - 2800	1, 3, 4, 6
A.deccurens[a]	Exotic	Akacha	Fabaceae	1600 – 2500	1, 4, 5, 8
A. saligna[a]	Exotic	Akacha saligna	Fabaceae		1, 4, 5
Ch. Palmensis[b]	Exotic	Tagasaste	Fabaceae	1700 – 3300	2, 3, 4, 5, 7
C. africana[c]	Indigenous	Wanza	Boragenaceae	900 – 2500	2, 3, 4, 6, 7, 8
Cr. macrostachys[b]	Indigenous	Bisana	Euphorbiaceae	1100 – 2500	1, 2, 3, 4, 5, 7
E. camaldulnsis[c]	Exotic	Key Bahir zaf	Myrtaceae	1200 – 2800	1, 5, 8
E. globolus[a]	Exotic	Nech Bahir zaf	Myrtaceae	1700 – 2800	1, 5, 8
H. abyssinica[b]	Indigenous	Kosso	Rosaceae	2300 – 3300	3, 4, 7, 8
S. sesban[c]	Exotic	Ginangire	Fabaceae	300 - 2000	2, 3, 4, 5, 7

[a]species chosen for Borodo watershed; [b]species chosen for Mekentita watershed; [c]species chosen for both watersheds; [d]according to Bekele-Tesemma (2007); [e]1-high production of feul and charcoal, 2-high production of feed and bee forage, 3-improving soil fertility and less effect on adjacent crops, 4-soil protection from erosion, 5-ease to propagate, 6-provision of shade, 7-fast rate of leaf decomposition, 8-high economic return (in form of timber, poles and posts)

TABLE 4. Total numbers of seedlings raised at Borodo and Mekentuta watersheds in two growing seasons

Tree/shrub species	Seed treatments	Nursery life span (weeks)[c]	2010 - 2011		2011 - 2012	
			Borodo	Mekentuta	Borodo	Mekentuta
A. abyssinica	Nicking	28	-[d]	4264	-	1609
A. decurrens	*[a]	24	5820	-	5700	-
A. saligna	*	20	5951	-	6800	-
Ch. palmensis	**[b]	16	-	351	-	9056
C. africana	Nil	14	3600	1680	2553	568
Cr. macrostachys	Nil	22	-	3588	-	1396
E. camaldulensis	Nil	16	5733	17400	4500	12000
E. globules	Nil	16	4988	-	11600	-
H. abyssinica	Nil	22	-	250	-	1500
S. sesban	Nil	12	5060	8208	1000	2600
Total			31152	35741	32153	28729

[a]soaked in hot water and cooled for 24 h; [b]immersed in hot water for 2-5 minutes; [c]the lifespan is referring to the time between seed sowing and seedlings' attaining a height of 25 to 30 cm. Most species had attained the highest height earlier in Borodo than Mekentuta watersheds; [d]not planted

percentage of planted seedlings under each planting niche were gathered and descriptive statistics employed. Important processes, lessons and challenges encountered during participatory nursery establishment and management were also documented so as to use such experiences as inputs for similar development works in the future.

RESULTS AND DISCUSSION

Lessons learned

The following important lessons were learned from the participatory nursery establishment and management work at Borodo and Mekentuta watersheds.

The IP members had their own solutions for different problems and even willing to provide what they had as long as they were convinced by the importance of establishing nurseries in their respective watersheds. Based on the trainings offered, the IP members had considered a number of factors during nursery site selection that included (i) the availability of water and good soil medium in the selected site, (ii) exposure of the land to sunlight, (iii) flat or slightly sloping topography with good drainage, (iv) protection from animals and natural calamities such as flooding, landslides and strong winds, and (v) proximity to planting area. Securing communal lands with the above attributes, however, was not an easy task for the IPs members. Since the IP members were convinced by the objective of the project, the prevailing challenge did not deter them from securing suitable lands for the planned nurseries. The IP members explored different options and showed higher willingness to provide what they had. Accordingly, suitable land at Borodo was obtained after a series of bargains and negotiations with two farmers that had lands with the required attributes. All participants agreed to contribute two Ethiopian Birr per month (1 Birr ~ 0.055 USD) so that each land owner would share that money equally. The land owners, in return, took all responsibilities to protect seedlings from cattle and thefts. However, a different approach was employed at Mukentuta watershed. Farmers were willing to offer the required land as the IP members promised them to put equal size of communal land under these farmers' concessions. Such processes made the formation of IPs a cost effective strategy as partners synergize in bringing more resources and new ideas to the platform (Tukahirwa *et al.*, 2013).

The level of involvement by IP members depended on the time chosen for scheduled activities. The communities in both watersheds did not conduct farm activities (tillage, weeding, harvesting and threshing) on certain dates every month because of religious beliefs. They did not also involve in on-farm and off-farm activities during social events (e.g., marriage and funeral). IP members were usually engaged in church activity on Sundays; and organising visits, trainings and meetings on such days was found to enhance the involvement of IP members. However, getting agreeable days to perform nursery activities (fencing, bed preparation, sowing, watering, transplanting, weeding, shading, and others) was difficult for the IP leaders as members were heterogeneous and had different interests. Consequently, the IPs leaders were often forced to always revise the agreed schedules as all members did not share responsibilities equally (in terms of labour force, materials and financial contributions). Watering was the most difficult activity to organise as it demanded members to show-up frequently. The problem was relatively serious at Mekentuta compared to Borodo watershed although the level of involvement in both watersheds depended on the time chosen for scheduled activities (Table 2). The IP leaders proposed the hiring of a community facilitator (local manager) so as to ensure the timely implementation of the proposed nursery activities thereby, reducing burdens on themselves. After an intense and hot discussion, their idea was accepted by the IP members but most members in both watersheds were unwilling to cover the monthly payments of these facilitators. The project later intervened to hire one person for each watershed (at a basic salary of 801 Birr per month) to save the IP members from bitter disagreement to cover the cost.

Grouping of the IP members into similar sub-groups helped to get agreeable timeline to pursue most nursery activities. The innovative idea brought to the IP members by the hired community facilitators was grouping the IP members into smaller sub-groups based on members' wealth status (poor, medium and rich people). This brought a better agreeable time table for the execution of different activities as members in each wealth category differed less in their expectations and preferences for the established nurseries. The approach of grouping the IP members into similar sub-groups helped the IP leaders to pick the most agreeable time to conduct the proposed activities. However, the approach did not totally exclude the problem of unequal participations among the sub-group members. Overall, lack of agreeable timeline among the IP

members made the establishment and management of community nurseries in both watersheds a labor intensive and an inefficient venture despite large number of participants who were involved in each activity. In contrast to nursery activities, almost all IP members in each sub-group showed greater interest to participate in the cross-site visit arranged for HARC. Such high level of interest waned away when on-site training was organised by trained IPs members. This showed that the higher interest for cross-site visit was emanated mainly from per diem and other incentives expectation.

Most IP members were reluctant to enforce the formulated local bylaws whenever they were violated. The importance of local bylaws came into effect when the IP leaders realised unequal participation among members. The IP leaders together with researchers and village/watershed representatives had brought the idea of having bylaws, which was later taken by IP members. Such bylaws were formulated in local language to: (i) minimise the occurrence of conflict within the IP members, (ii) enhance the implementation capacity of local community, (iii) accomplish planned activities properly and timely, (iv) obtain legal recognition from local administration for their work, (v) encourage skeptical farmers to participate in nursery practices, and (vi) describe the rights and responsibilities of the IPs members and non-members. The types of corrective measures (i.e., levels of punishment) were also clearly stated in the formulated bylaws. However, the implementation of these bylaws was often hindered by the existing close blood relationships among some IP members and unwillingness of the IP leaders to enforce these bylaws. The IP leaders were sometimes reluctant to report "what went wrong?", "when it happened?" and "by who?" suggesting that the reporting mechanism within the IP members was poor. Whenever, wrong doings were reported, the level of involvement by the local administrators and other legal institutions (e.g., police) to enforce the formulated bylaws was very low. This undermined the importance of such bylaws in achieving what was anticipated initially.

Recognition of active IP member(s) through standing ovation and certification did not bring a long lasting outcome. Most IP members had initially showed a high level of interest to participate in the establishment and management of community-based nurseries. However, most farmers were unable to deliver what was specifically demanded from them (i.e., equal contributions both in labor and money). This was mainly due to the fact that the IP members had high level of diversity in terms of age, education and wealth status. Hence, the IP leader, local facilitator and researchers had reached consensuses on the following points; to further increase the level of participation by IP members: (i) identification of skeptical IP members and a close supervision of this group by the local facilitator and IP leader, (ii) creation of competitive environment among the IP members, and (iii) provision of recognition and/or incentive to the most committed IP members. The IP members were then informed about the idea and accepted it following a thorough discussion. A close supervision of skeptics and recognition of champion(s) by the IP members (through standing ovation and certification) was found to motivate other members to follow that example. Champions were those individuals with unique skills, expertise or talents, and were recognised and respected for their exemplary performance in specific fields including innovative farming, leadership or change agent (Tukahirwa *et al*., 2013). Such recognitions at the beginning of the processes had also created a competitive environment among the IP members. However, the competitive environment did not last long among the poor members as it was not complemented with some kind of material incentives (they were mostly focused on short-term benefits). Provision of material incentives (farm implements) was known to sustain similar participatory ventures in Dendi district (Mekonnen *et al*., 2008) although this project was not able to provide them with farm implements because of financial problem.

Production of seedlings at nursery. Producing quality seedlings in community-based nursery is

dependent upon proper coordination and execution of a sequence of steps by its members (Mansur and Sukendro, 2003). Failure to pay attention to necessary details of any of these steps may result in poor quality seedlings and limit reforestation success in all planting niches. Based on the preference of the IP members, a total of six and seven different species were raised and distributed at Borodo and Mekentuta watersheds, respectively (Table 3). The lifespan of seedlings in the nursery varied between 12 and 28 weeks depending on the species type (Table 4). *Acacia abyssinica* took longest time to reach plating size of 25 to 30 cm while *Sesbania sesban* took the shortest duration. The total number of seedlings raised at Borodo were 31,152 and 35,741 in 2010 and 2011 growing seasons, respectively; whereas, 32,153 and 28,729 at Mekentuta watershed. *E. camaldulensis* was the most preferred species in both watersheds regardless of its negative effect on water resources (i.e., during PRA survey, it was noted that most interviewed farmers believed that *Eucalyptus* species absorb too much water from the soil, streams and swampy areas). The shares of *Eucalyptus* to total seedling productions in 2010 and 2011 were 35 and 29%, respectively (Table 4). Farmers in both watersheds believed that all chosen species, with the exception of *Eucalyptus*, could protect the soil from erosion (Table 3). All produced seedlings were planted around homestead, degraded lands, farm boundary, and contour hedge and on newly constructed bunds (Table 5). At time of seedlings distribution, the root of some seedlings had grown beyond the pot size suggesting that root pruning was not done according to the cross-site visit and on-farm trainings. Overall, the total number of farmers who showed up during seedlings distribution was higher than the total number of registered IP members (Table 2) suggesting a higher tendency for free-riding among the community.

Major constraints encountered. Lack of equal participation by the IP members and inability to reinforce the formulated byelaws were the two major constraints noted during the establishment and management of participatory nurseries in both watersheds. Similar problems were also

TABLE 5. Total number of planted seedlings at different planting niches and their respective mean survival percentage

Species	Borodo				Mekentuta			
	Homestead	Degraded land	River banks	Contour/Terrace	Homestead	Degraded land	River banks	Contour/Terrace
A. abyssinica	-[a]	-	-	-	-	(2108, 34)	(2300, 23)	-
A.deccurens	(1476, 57)[b]	(3000, 35)	(2645, 44)	-	-	-	-	-
A. saligna	(1050, 53)	(2700, 42)	(2951, 51)	-	-	-	-	-
Cr. macrostachys	-	-	-	-	-	(1400, 41)	(2000, 32)	-
Ch. palmensis	-	-	-	-	(5400, 61)	-	-	-
C. africana	(1500, 50)	(1000, 35)	(1000, 10)	-	-	(2320, 20)	(2000, 18)	-
E. camaldulnsis	(4100, 64)	(2500, 51)	(1000, 43)	-	(14090, 69)	-	(1988, 58)	-
E. globolus	(4778, 67)	(4164, 58)	(3433, 51)	-	-	-	-	-
H. abyssinica	-	-	-	-	(250, 25)	-	(450, 41)	-
S. sesban	(1900, 49)	(2500, 42)	-	(1480, 38)	(2400, 44)	-	(60, 30)	(5730, 23)

[a]not planted; [b](total number of planted seedlings, mean survival percentage). The difference between raised (Table 4) and planted seedlings (Table 5) is accounted for those people whose planting stocks cannot be assessed during enumeration. These farmers took seedlings during dispatching but were not the members of the IPs

reported at Galessa watershed (Kidane *et al*., 2008), which is geographically not far from the Borodo watershed. Moreover, some farmers were not applying the techniques they learned during trainings especially in bed preparation, pricking out of seedlings, root pruning, determination of shading intensity and watering frequency. In 2010, getting sufficient amount of shading materials (e.g. *hyperenia* grass) was not an easy task at Mekentuta watershed. This was emanated from poor planning as the IPs members failed to harvest the grass on time. As a result, seedlings of *H. abyssinica* were damaged by an overhead sun. The lesson was taken and the demand for this species was met in the 2011-12 growing season.

During monitoring and evaluation stage, homestead planted seedlings were relatively better managed compared to those planted on degraded land, contour bund and newly constructed terraces (Table 5). This indicated that IP members did not fully take up what they were told during training time. Improper planting (e.g. shallow hole depth, and sparse or dense spacing) together with free browsing and extended dry season generally contributed to poor survival of seedlings in all planting niches. In general, free grazing, poor participation of IP members in most nursery activities, poor access to seeds of some species, poor availability of water sources during dry season, failure to implement what was taught during the training, poor inherent soil property of the dominant soil type (vertisol) and demand for incentives and lack of continual training were noted as the major constraints encountered in this development-oriented project work.

CONCLUSION AND RECOMMENDATIONS

Active participation by IPs members in a range of activities is crucial for the success of such community nurseries. Quality seedlings with required quantity can be produced if IPs members are involved in the range of processes including problem identification and selection of tree species. The sustainability of these nurseries is also heavily dependent on the commitment of IPs members to show-up in the routine nursery activities. Implementing resource-generating strategies such as marketing of excess seedlings and raising of high value fruit trees might help to sustain these nurseries in the future after the phasing out of the project. Given the higher number of participants involved in each nursery activity, the overall performance of these nurseries could be rated as a labor intensive and inefficient venture. However, if members pursue cost reduction measures (e.g., assigning someone to take the facilitator role) and ensure equal participation among members, the IPs are the viable approaches to bring visible impacts in these and other watershed areas.

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