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Abstract

The Eastern Highlands of Papua New Guinea (PNG) are experiencing a severe shortage of firewood. Residual native forest and some plantation forestry are insufficient to supply the community’s firewood needs. In response, in October 2014, the PNG Forest Authority (PNG-FA) undertook a three-day training program in the township of Goroka. Farmers received training in nursery techniques including seed collection, preparing nursery beds, germinating seedlings and out-planting seedlings. Farmers were supplied with seed, shade-cloth and polybags to start their own home nurseries. Follow-up interviews found that nine of thirteen participants had raised seedlings. However, for those farmers living outside of the Goroka environs, problems have emerged. A severe shortage of seed has resulted in farmers using inappropriate Pinus species. In PNG, land is often community-owned but managed by individual farmers. Long-term tenure is therefore subject to negotiation between clan members. Technology sharing is also not common between clans. In the grasslands, fire is always a problem. These findings indicate a need for an approach to forest extension which accommodates a low rate of technology diffusion between clans and in which farmers in remote locations receive one-to-one follow-up extension assistance, access to seed, and guidance for inter-crop planting patterns that will provide tree-plantings with protection from fire.

Introduction

There is a critical shortage of firewood in the Eastern Highlands of Papua New Guinea (PNG). Small bundles of firewood (approximately 5 pieces by 60 cm long and 5 cm wide) sell for five kina (K5) at the local markets. The Eastern Highlands landscape is dominated by imperata grassland due to deforestation which is causing local rainforest to retreat to mountain slopes. Winters in the highlands are cold and many families are in need of firewood for heating. The problem is exacerbated by a demographic shift in the highlands in which people who live in remote locations are moving to town centres in search of work (Paul, 2012). Typically these people live with their extended families, resulting in increased local requirements for firewood. Many local people have no option but to use firewood as their basic source of heating and cooking. Purchasing firewood is a major expense for many people. Several aid programs have tried to address people’s fuel-wood needs through the establishment of community-based nurseries (Gio, 2011). However, the short duration of most aid programs has resulted in many project nurseries closing once funding ceases. The infrastructure costs required to set up these nurseries can be several thousands of kina. This amount is far beyond the financial capability of many rural farmers.

In response to this problem the Papua New Guinea Forest Authority (PNG-FA) currently distributes seedlings to farmers (and churches, schools, individuals and Non-Government Organisations) whenever seedlings are available. However, seedling distributions do not
result in nursery technology transfer to farmers in a manner which will make them self-reliable (Harnath, 1989). To remedy the situation, the PNG-FA (Goroka) decided to undertake research to investigate whether small home-based nurseries may be viable for individuals and communities. The underlying premise of extension activities was to train farmers in nursery techniques so that they could establish their own home-based nurseries themselves or pass the training on to others. The second requirement was that no finance and very little material would be supplied, thus avoiding the possibility that participants may join the training program purely in the hope of material gain.

In this paper we present the results of research that was undertaken to investigate the usefulness of small home-based family nurseries as a means of assisting farmers to grow timber trees for domestic use. In the next section we present the methods we used to train farmers in basic nursery techniques. We then present the results of the training program and an analysis of our results in terms of the socio-economic context of small-scale farmers of the Eastern Highlands of PNG. Finally, we discuss implications of our work for nursery extension in PNG.

**Research Methods**

In November 2014, PNG-FA staff provided a three-day live-in nursery extension training program in Goroka Township. Participants were recruited from PNG-FA records of people who had approached the FA for timber tree seedlings. Fifteen participants were invited to attend the program at the house of a local tree farmer. These fifteen farmers were representative of the types of farmers found in all the six districts of the Eastern Highlands Province. During the course, participants received formal training delivered by foresters. A key aspect of the training was hands-on practical exercises which resulted in demonstrated competence of the skills being imparted. The training covered the following topics:

- Seed collection, extraction and storage - the three common tree species planted in the PNG highlands (i.e. *Eucalyptus grandis*, *Pinus strobus* and *Casuarina papuana*) were used. Seed collection and extraction methods for each of the species is demonstrated and seed is stored in small containers;
- Preparing seedling trays;
- Germinating and transplanting seedlings;
- Watering and fertilising;
- Weeding and hardening;
- Out-planting and management; and
- Constructing a nursery from materials that can be commonly found in rural communities.
At the conclusion of the course, the participants were given seed of the three tree species, polybags and a 50cm sieving wire. Follow-up site visits, interviews and phone calls were undertaken to record participants’ progress, problems and their plans for further reforestation.

**Results**

It was found that four participants had established large nurseries capable of growing several thousands of seedlings per year. These participants have become actively involved in distributing seedlings to their wantok\(^1\) and have told FA staff that spreading tree growing technology becomes a social obligation. Apart from the free will of the distribution of seedlings to wantoks, three thousand seedlings were sold to local schools and the public during the World Environment Day.

**Subsistence Famers**

Phone interviews also indicated two subsistence farmers had grown seedlings and distributed them freely to community members. These 51 community members are affiliated to their village cooperative group and were given twenty seedlings each.

Of the 15 participants, 14 had initiated nurseries in their home gardens (see Table 1). The common feature of the participants is that they had all successfully raised tree seedlings and had transferred the skills and knowledge acquired during the nursery training. Generally, the farmers with large nurseries wanted to plant everything but constraints such as transportation of seedlings and limited finance for labour employment are setbacks in establishment. For example, one participant wanted to transport nine thousand seedlings for a 200-hectare landmass establishment but transportation has been a constraint. Furthermore, to sustain their nursery production, some of their seedlings were sold to partner organisations and the public. On the contrary, subsistence farmers had planted almost every seedling and also have distributed seedlings to their siblings and extended families.

The only secondary school involved had commenced teaching forestry as an instructional course with the help of FA staff giving supplementary notes on all aspects of forest silviculture. A permanent nursery is now planned because a forestry course is now a full time course unit, but this nursery is yet to be established.

**Table 1. Characteristics of Fourteen of the Nursery Training Participants**

<table>
<thead>
<tr>
<th>Participant</th>
<th>District</th>
<th>Driving time from Goroka township</th>
<th>Occupation</th>
<th>Number of seedlings raised / planted</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1/ A2</td>
<td>Daulo</td>
<td>70 minutes</td>
<td>Teacher/house wife</td>
<td>2000 / 2000</td>
</tr>
<tr>
<td>B</td>
<td>Asaroka</td>
<td>15 minutes</td>
<td>Businessman</td>
<td>600 / 400</td>
</tr>
<tr>
<td>C</td>
<td>Asaroka</td>
<td>15 minutes</td>
<td>Secondary school</td>
<td>NA</td>
</tr>
<tr>
<td>D</td>
<td>Goroka</td>
<td>10 minutes</td>
<td>Retired Teacher</td>
<td>3000 / 1000</td>
</tr>
<tr>
<td>E</td>
<td>Goroka</td>
<td>10 minutes</td>
<td>Church-employee</td>
<td>9000 / 200</td>
</tr>
</tbody>
</table>

\(^1\) wantok in Pidgin refers to close relatives but also extended family and friends.
<table>
<thead>
<tr>
<th></th>
<th>Location</th>
<th>Duration</th>
<th>Occupation</th>
<th>Income  /  Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Goroka</td>
<td>25 minutes</td>
<td>Pastor</td>
<td>3500 / NA</td>
</tr>
<tr>
<td>G</td>
<td>Goroka</td>
<td>25 minutes</td>
<td>Activist</td>
<td>3000 / 1000</td>
</tr>
<tr>
<td>H</td>
<td>Ungai</td>
<td>45 minutes</td>
<td>Politician</td>
<td>6000 / 2000</td>
</tr>
<tr>
<td>I</td>
<td>Ungai</td>
<td>20 minutes</td>
<td>Student</td>
<td>300 / 200</td>
</tr>
<tr>
<td>J</td>
<td>Ungai</td>
<td>20 minutes</td>
<td>Subsistence farmer</td>
<td>1000 / 700</td>
</tr>
<tr>
<td>K</td>
<td>Ungai</td>
<td>20 minutes</td>
<td>Subsistence farmer</td>
<td>500 / 200</td>
</tr>
<tr>
<td>L</td>
<td>Okapa</td>
<td>120 minutes</td>
<td>Subsistence farmer</td>
<td>800 / 800</td>
</tr>
<tr>
<td>M</td>
<td>Okapa</td>
<td>120 minutes</td>
<td>Subsistence farmer</td>
<td>700 / 700</td>
</tr>
<tr>
<td>N</td>
<td>Benna</td>
<td>35 minutes</td>
<td>Retired Soldier</td>
<td>NA deceased</td>
</tr>
</tbody>
</table>

**Participant acceptance of nursery technology**

A follow-up visit in April 2015, 6-months after the training, found that the average number of seedlings raised was 2040. The smallest number was 300 and the largest was 9000. The species planted were Pine, Casuarina and Eucalyptus. Typical reasons for planting were for firewood, for future timber generation, reforestation, timber and poles, boundary demarcation and combatting global warming. Some farmers passed on skills to others and gave some seedlings to their community members. Of the 15 participants, 14 proceeded to germinating seedlings and accepted the training and established their small home-based nurseries.

**Problems in raising and transplanting seedlings**

The subsistence farmers, especially those who live in remote locations, were faced with a number of challenges:

- Seeds - farmers cannot access Pine seed. This has been especially problematic for farmers from grassland areas where they know the pine trees will perform very well.
- Material - the cost of purchasing basic materials like polybags and shade-cloth.
- Limited finance - PNG today is a cash society where money will drive community forestry activities.
- Fire - a major setback for grassland communities for the establishment of woodlots.

**Participant demographic characteristics**

We found that participants could be described as either wealthy farmers or subsistence farmers who live in remote areas and close to Goroka Township. The first group began tree growing out of a passion or a business interest and had possessed available finance, manpower and materials to continue extension. The training had encouraged all participants to construct the same scale of nursery, however, we found two cohorts of people. The first cohort consisted of farmers who had constructed nurseries which were typically capable of growing several thousand seedlings, for planting as a hobby or for sale. They are innovative and creative, persistent in order to continue their nursery production regardless of any setbacks. The second cohort were those farmers that did not have enough money to continue
their nursery, in terms of material purchases and access to seeds. Accessibility to services is difficult due to remoteness of their locality, poor road condition, and an inability to access seed trees. Because the second group are highly vulnerable in PNG society, they have been identified as targets for future extension work.

**Discussion and Conclusion**

Our findings indicate that formal instruction delivered in a three-day live-in course, including competency training, is an appropriate instructional method for PNG farmers. The high percentage of farmers who accepted the training (now growing their own seedlings) also indicates the farmers are ready and willing to accept new techniques and interventions. In particular, our findings indicate the farmers have the motivation to construct small home-based nurseries themselves. In contrast to the failure of some larger community-based nurseries when funding eased, our research indicates that farmers have the motivation to grow their own seedlings. However, a lack of materials, particularly seeds, would appear to be a major constraint. For subsistence farmers living in remote areas, the cost of accessing government services (i.e. seeds or tree seedlings) from the PNG-FA may require a trip to a local town at a cost of an average weekly income. If these people are to be engaged with new technology, our research indicates that it must be taken to them. The implication of this research for the current situation in PNG is that frequent visits and mentoring will substantially help farmers. Small inputs of targeted assistance to help the farmers overcome problems and constraints are essential to maintain their motivation and enthusiasm.

In conclusion, we found that farmers were willing to solve most of their problems. One of the interesting findings is that extended family members or in a wider context the clan system, imposes mutual obligation on its members. In PNG culture, sharing is restricted to extended family members and people in close social proximity. Generally speaking, clans are competitive in natural resource management. However, in this instance, clan-based obligations have resulted in diffusion of the seedling nursery technology to other locations. Technology diffusion occurred both in their communities as well as other neighbouring villages where a relationship has been established through inter-marriages, family ties, and a mutual brother-sister relationship. An unexpected finding was that our research found two examples of cross-clan cooperation – one of an activist local leader cooperating with all her neighbouring clans, and another of a keen tree farmer diffusing the nursery and woodlot establishment technology to another province. These communities have large areas of unused grassland and afforestation is a real need for them. The challenge is to facilitate this process.

**References**

