On-farm testing and dissemination of agroforestry among slash-and-burn farmers in Nagaland, India

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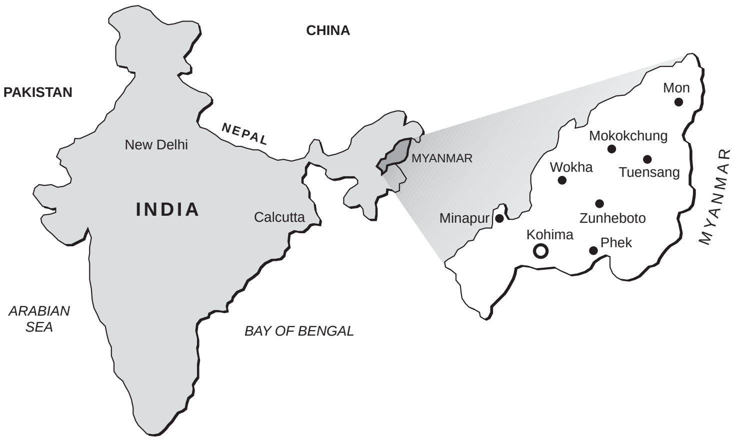
The State of Nagaland is located in north-eastern India along the border with Myanmar (Burma). It is almost entirely populated by indigenous people belonging to at least 17 different tribes (see Figure 1). Agriculture in Nagaland is primarily oriented towards subsistence, and the swidden systems that predominate in most areas of the state are the main cause of the rapid deforestation that has occurred in the last 30 years. Rapid population growth, limited opportunity for sedentary agriculture, mountainous topography, and the wealth of native tree biodiversity in Nagaland have led some development specialists familiar with the region to propose agroforestry as a means of modifying the traditional agricultural production systems and reducing deforestation. When fast-growing high-quality timber trees are integrated into the traditional practice of crop production (usually a two-year cycle, based on upland rice), the subsequent fallow forest cover is enriched and can generate increased revenue when the trees are cut before the next cropping period, 10–15 years later. Thus, income from tree production can eventually become a significant cash source, which would encourage farmers to practise intensified agroforestry instead of extensive swidden. However, experience with agroforestry in other tropical regions indicates only limited success in getting traditional farmers to adopt agroforestry in place of their traditional subsistence systems, and only minimal success in slowing down deforestation.

This paper describes the structure and impact of a development project in Nagaland, which was designed to encourage traditional swidden farmers to adopt agroforestry. We describe and assess how the project was implemented and we estimate its reach and impact. Initial evaluation suggests that agroforestry has spread rapidly and been primarily adopted on land that otherwise would have been used only

Figure 1: Map of Nagaland within India



for swidden agriculture. Thus, Nagaland appears to be on a path to intensified land use based on agroforestry, which is likely to reduce the rate of deforestation. Following this, the factors that have affected the extent to which agroforestry has been scaled up are summarised, and lessons are drawn from the experience in Nagaland.

Land-use systems

Farmers in Nagaland practise a form of swidden agriculture called *jhum* in local dialects. As in other swidden systems (Faminow 1998; Sánchez 1976), Nagaland's farmers slash and burn a small plot of forest (often 1 ha or less), plant a wide mix of crops for one or two years of production, and let the land go to fallow, which then usually permits the forest to return eventually. The environmental impact made by each farm family is small, but the cumulative effect on local and regional ecosystems can be substantial. In Nagaland only about 1700 km^2 of the land is suitable for terracing and irrigation. An area of 7000 km^2 is subjected to shifting cultivation, 500 km^2 of which is slashed and burned each year.

With long periods of fallow (*jhum* cycles of 15–20 years), shifting cultivation in Nagaland can be sustainable (Ramakrishnan 1993). However, a high birth rate combined with economic stagnation and limited off-farm opportunities has caused the rural population to grow at an annual rate of nearly 4 per cent. About 70 per cent of the roughly

1.5 million population lives in rural villages and is dependent upon agriculture for a livelihood. In some villages in Nagaland, land is now in such short supply that *jhum* cycles have shortened dramatically, and farmers must return to the same plot of land after only three to five years. Yields are plummeting and rapid deforestation of mountaintops has seriously affected water supplies.

Nagaland is a complex mixture of similarities and contrasts. Virtually the entire state is mountainous, and swidden agriculture can be found at altitudes between 300 m to over 1800 m above sea level. In some highland areas of the state (for example, in Kohima and Phek Districts) population pressure is still moderate and ample water supplies allow for terraced irrigation for producing rice, the staple food. There, shifting cultivation is quite limited and is often used for growing animal feeds like millet and maize. In other areas (for example, Mokokchung and Wokha Districts) altitudes are generally lower, population pressure is substantial, and water limitations effectively preclude terraced rice production. Upland rice is generally planted in extensive swidden plantations and the fallow period is often short. Broadly, the swidden systems used in Nagaland appear similar, but substantial variation can often be seen upon closer inspection.

Some of the variation is related to ethnic differences. Although there is still academic debate about the actual number of tribes and languages present in the state, the Naga people can be divided into at least 17 major tribes, each with a different language. Within a given tribal language may exist local dialects that differ substantially from each other. Land-tenure arrangements can vary considerably by tribe and even among villages within a tribe. Private ownership is the norm across Nagaland, but there are variations in traditional property law ranging from individual ownership through to family or clan land custody (which can be passed down to heirs, but not sold). Among two tribes, the Konyak and the Sema, occupying Mon and Zunheboto Districts, village chieftain systems entail that the village chief is the ultimate owner of all village land. Regardless of the land-tenure system in use, however, land is almost always controlled locally, with state ownership limited to about 9 per cent. This contrasts with the communal ownership of natural resources common in other tribal areas of India and Nepal, which are often complicated by unsatisfactory legal frameworks, making the legal basis for common property ambiguous (Arnold 1998). Beckly (n.d.) has pointed to the importance of tenure issues in improving forest management and believes they have not been given adequate attention in studies related to agroforestry.

In traditional Naga cultures, governance in local villages was (and still is) the foundation of society. Historically, although there is some variation between tribes and between villages, villages operated independently and were governed in a way akin to ancient Greek city-states, with a governing council comprising elders with administrative authority (Keitzar 1998). Much of this tradition continues today because, when Nagaland became a state of India, special consideration was taken to ensure that traditional tribal law and practices of land use and ownership continued to take precedence. Villagers meet with their village council before the start of each planting season to plan and coordinate their strategy. In most cases, swidden plots for all families in a village are located together and major activities, such as burning, are co-ordinated. As a result, development projects implemented in the village, with significant decision-making functions residing with local authorities, may offer greater potential for adoption and sustainable change in some circumstances than do top-down strategies.

Identification of solutions

New and improved technologies are sometimes touted as primary weapons in the battle against deforestation, particularly in tropical moist forest areas like Nagaland. Technology can encourage intensification, increase yields, and set the stage for permanent cultivation. Many governments have embraced this idea and actively tried to wean swidden agriculturalists from their traditional practices. However, when top-down solutions are imposed without due consideration of local needs and conditions, they can be ineffective or even damaging. For example, in remote hill areas like Nagaland, efforts to introduce high-yielding rice varieties and production methods must take into account the limited potential for terracing and irrigation, and recognise that many high-yielding varieties of rice that were developed for plains areas do not perform well at altitude. Combined with few marketing opportunities, a lack of commercial tradition in rice, and poorly developed infrastructure, this type of intervention may even create greater food insecurity.

Even when 'hi-tech' solutions appear to be in farmers' interests, indigenous peoples are often vulnerable when interaction with the outside world is increased (Egneus 1990; Higgins 1998; Jodha 2000). They may lack information and experience in cash market participation. 'Participatory' strategies that are culturally sensitive and conform to ecosystem properties so that they modify, rather than replacing, existing systems might do better (Baker 1998).

Immediately after Nagaland became a state in 1963, the Indian government and the government of Nagaland waged a long and ultimately futile battle to put a halt to jhum cultivation and initiate sedentary agriculture based on intensified annual cropping (NEPED and IIRR 1999). Nagaland has potential for more irrigation but, because of topographical, market, and traditional cultural constraints, it has proved impractical for most villagers. Ultimately, the government of Nagaland concluded that the *jhum* cultivation system could not be eliminated, at least in the short to medium term.

However, some community groups and Nagaland government officials began to develop locally based solutions to counteract expanding *jhum* and deforestation. During the 1980s, one village in Mokokchung District held a seminar to discuss the problem that they and most other villages were facing: population was increasing, there was little or no opportunity to irrigate, and the *jhum* cycle was decreasing (that is, they had to shorten their fallow periods to grow enough food for subsistence). In areas of extensive swidden, entire mountainsides were being slashed and burned each year. They wanted a solution.

Land-shaping using contour bunds was initially encouraged as the primary corrective measure for soil erosion and declining soil fertility. This concept of land-shaping is a direct derivative of the practice of intensified swidden that one specific group in Nagaland, the Angami, uses, particularly in Khonoma Village in Kohima District. In this intensified swidden system, stone-reinforced terraces are built, and nitrogen-fixing alder (*Alnus nepalensis*) trees planted along the contour to provide firewood and enrich the soil. The yields are high for crops planted in this intensified system and the fallow period is minimal. Typically, two years of crops are planted, followed by only two years of fallow. The resulting highly productive four-year swidden cycle has been maintained in Khonoma for hundreds of years with stable productivity and without any apparent degradation (NEPED and IIRR 1999).

As a result of the seminar held in Mokokchung, two small-scale land-shaping and tree-planting projects were developed to deal with the problems of soil erosion and decreasing fertility. Government officials wanted to undertake projects on a larger scale but felt the projects would not work unless the villagers themselves had designed them (NEPED and IIRR 1999). They explicitly recognised the importance of including grassroots participation – especially the rural poor – in the earliest consultations before drawing up priorities for a larger scale project. The problem is complicated further in Nagaland because jurisdiction over agroforestry extends across several government departments.

It was eventually decided that the development of permanent agroforestry could be a long-term corrective measure for soil degradation, biodiversity management, and income growth, providing a pathway to an improved *jhum* system (Ramakrishnan 1993). Importantly, however, as Mallik and Rahman (1994) have noted, community forestry often meets the basic needs of the community, in addition to market-oriented objectives. Ultimately, it was decided to implement a participatory forest management approach following eight of the practical steps to system improvement that Ramakrishnan (1993, 1996) had proposed:

1 Encourage technology exchange between various ethnic groups.
2 Where possible, maintain a swidden cycle of at least 10 years.
3 Incorporate ecological insights into tree architecture.
4 Introduce nitrogen-fixing trees into the system, such as alder.
5 Maintain important bamboo species to conserve soil and serve as windbreaks.
6 Introduce fast-growing native shrubs and trees.
7 Condense the timespan of forest succession and accelerate recovery by adjusting species mixes in time and space.
8 Strengthen conservation measures based upon the traditional knowledge and value system.

The Nagaland Environmental Protection and Economic Development (NEPED) Project was initiated in 1994 with funding from the India-Canada Environment Facility (a funding mechanism of the Canadian International Development Agency, CIDA) and Canada's International Development Research Centre (IDRC). The project is a large-scale experiment in participatory development emphasising local technology. The strategy for technological development is farmer-led testing, where farmers themselves select agroforestry technologies, implement the field tests, and assume responsibility for disseminating the results locally.

Design of the Nagaland Environmental Protection and Economic Development Project

The goal of NEPED was sustainable management of the natural resource base in land used for shifting cultivation. Objectives were (1) to stimulate interest in agroforestry so that farmers plant trees along with food crops in *jhum* fields; (2) to improve upon soil and water conservation methods; and (3) to encourage and develop local capacity for starting and carrying out development initiatives.

A key factor for successful forestry projects is to adopt the best possible forest technologies, including suitability of species chosen for projected end-uses; this adoption should be accompanied by good nursery practices and post-planting tree management (Tamale *et al.* 1995). A top-down approach, which requires significant technical direction and control, was rejected early in the planning stages for NEPED. Instead, NEPED opted for a 'search and find' philosophy that would encourage farmers to experiment themselves, where the project implementation team would provide basic technical advice but adopt more of a facilitation role, especially in disseminating indigenous solutions and strategies.

The principal activity of the project was to establish test plots for farmer-led experimentation and dissemination of agroforestry in each participating village, with the target to establish test plots in every registered village in the entire state. The primary budget outlay was to promote planting trees for enriched fallow in *jhum* fields, along with shaping the land to improve soil management. Each village has a village development board, which is an autonomous, locally directed body that can disburse state development funds. These boards were each asked to select two farmers or groups of farmers to be allocated test plots, one at an upper altitude and another at a lower altitude. In most cases, test plots were allocated to individuals or small informal collectives of three to five farming families. The selection criteria were that the trees must be planted in *jhum* fields scheduled for planting in the year selected and that the farmers chosen should be progressive. Aside from this, discretion of selection was given to the village development boards. Organised larger groups, such as women's societies, church groups, and youth groups, were also allocated test plots if the local authorities selected them. Usually these groups used village-owned land or developed sharing arrangements with individual landowners. Farmers selected for participation received cash payments to offset field-testing costs. Success in farm forestry is generally contingent on enough free seedlings being available (Chatterjee 1995), so the cost of planting material was included. Farmers were then responsible for carrying out the field testing and reporting the results.

Test plots were normally 3 ha but occasionally were larger when villages contributed additional funds or in-kind inputs. Because family-sized plots are typically smaller than 3 ha, most test plots involved small, informal collectives of farm families. The project paid farmers for planting trees and for digging contour trenches (that is, land shaping using bunds). Initially, total payments to farmers amounted to US$245 per hectare, with land-shaping as a significant component (about 75 per cent) of the amount. However, farmers did not readily accept the technique of land shaping with contour bunds; therefore, beginning in 1998 test plot owners were encouraged to use a modified land-shaping technology (traditional erosion control with very small trenches). Total payments were lowered to US$230 per hectare and the land-shaping share to 50 per cent of the total. Payments occurred in three steps and were subject to project officers verifying the work. The initial target was to establish 2000 test plots (two in each of the 1000 villages in Nagaland). This ambitious target to extend the project across all villages was nearly fully achieved.

The agroforestry part of the project was to ensure that farmers planted trees during the first year of a two-year swidden crop sequence, so that food crops were integrated with timber trees. After the second year, fields are normally left fallow, and tree planting would result in an improved fallow as vegetation spontaneously grew again around the planted trees. However, in practice, test plots were generally maintained and managed as tree woodlots after crop harvest. In addition, roughly 10–15 per cent of the test plots were implemented as farm forestry in the low altitudes (under 500 m) where irrigated crop production is ample and swidden agriculture limited. Across the entire state, over 1800 test plots were handled in more than 850 villages.

Beginning in 1996, a gender component was added to the initial management plan, requiring that some test plots be allocated to women's groups. Women were coming forward and asking to be included, even though traditional law in almost all villages does not permit women to own farmland. In total, 93 test plots were allocated to women's groups. Sharing arrangements with landowners were chiefly verbal, and in some cases women only had limited ownership benefits of the trees that were the product of their work.

On the test plots, farmers could experiment with different techniques and systems that they chose. Training and advice to farmers focused on technical aspects related to constructing bunds and on recommendations about tree planting (spacing, species selection, planting method). Farmers, however, were free to select species composition, planting density, and location as long as the area they worked totalled three contiguous hectares. They undertook soil conservation measures, and otherwise maintained the area well. A broad range of tree-planting approaches was allowed and the farmers actually used this range. For example, although project officers suggested relatively sparse tree planting (600 seedlings per hectare), based upon silviculture recommendations to optimise timber yield, most farmers chose much denser planting (often up to 2000 seedlings per hectare). A forestry expert criticised this practice during the NEPED mid-term review. However, interviews with farmers revealed underlying benefits that suited farm livelihood needs that would have been missed if the farmers had been forced to adopt the silviculture-based recommendation:

- Dense planting encouraged straighter trunk development and increased final timber value.
- The upper canopy closed sooner and lowered weeding costs in the early years of tree growth (labour is generally the constraining resource for farmers in Nagaland).
- Available planting material was often of variable quality, and farmers were unable to be selective when establishing plantations.
- Trees exhibiting substandard growth could be harvested after five to seven years of growth and sold in the market for construction poles, thereby providing cash in the intermediate term and allowing remaining trees to achieve better girth.

Over the course of the project, other local practices, ecological insights, and grassroots innovations were observed and disseminated:

- To improve biodiversity of *jhum* lands, planting a range of local species was encouraged. Initially about 100 species of fast-growing local trees with good timber quality were identified. Farmers were trained to use locally available planting material (wild seeds and seedlings) and encouraged to select trees to plant from these local species. Ultimately, roughly 40 species were adopted on a fairly broad scale across Nagaland.

- In some regions of Nagaland, farmers use indigenous methods of erosion control, forming runoff blockades with available materials (split bamboo, logs, rocks). These blockades are effective because they do not disturb the soil integrity. Farmers who used this method did not want to shape their land with contour trenches because the labour cost was three times higher, and erosion control only marginally improved. Cultural resistance prevented introducing other techniques such as contour hedges.
- Some of the local tree species were unknown by forest experts or by the market, but formed part of Naga local botanical knowledge. Persons with expert local knowledge contracted in the course of the project were instrumental in identifying indigenous species with desired characteristics, such as being fast growing, providing good timber quality for various uses, usefulness for firewood, and helped identify the most effective propagation techniques.
- Early on, project officers encouraged planting a diversity of trees in fields. But as a consequence of participatory learning by both farmers and field officers, farmers planted a narrower spectrum of varieties in later years of the project.
- The species planted in test plots included a diverse mixture of mostly local species (see Tables 1 and 2). *Gmelina arborea* was by far the most common species, followed by *Alnus nepalensis* (the nitrogen-fixing alder), *Tectona grandis*, and *Melia composita*. Of the top ten species, only *T. grandis*, teak, can truly be termed an exotic. Some unidentified local species were also planted.
- Forest enrichment through selective weeding became a more prominent management technique, where valuable species were allowed to rejuvenate naturally by being spared while weeding. This helped ensure that test plots retained natural biodiversity and did not rely entirely upon tree seedlings from nurseries.

Scaling up the project

A key indicator of success of this participatory project was the rate at which other farmers in the villages actually replicated the agroforestry strategy by planting trees in their swidden fields and using improved soil conservation techniques, without receiving direct project support. Test plots served as local entry points for testing and disseminating improved technologies for use in *jhum land*. At the outset of NEPED, it

Table 1: Most commonly planted species under NEPED, 1995–7

Rank	Species	No. planted (thousands)
1	*Gmelina arborea*	2544.0
2	*Alnus nepalensis*	947.3
3	*Tectona grandis*	642.4
4	*Melia composita*	571.0
5	*Terminalia myriocarpa*	362.0
6	*Cedrella* spp.	290.0
7	*Spondias axilaris*	274.5
8	*Aquilaria agallocha*	204.4
9	*Duabanga grandiflora*	114.1
10	Unidentified local species	107.8

Table 2: Diversity in trees planted in 1997 test plots, by district

District	No. of species observed	Most common tree species observed
Kohima	17	*Gmelina arborea, Tectona grandis*
Mokokchung	18	*Gmelina arborea, Aquilaria agallocha, Duabanga grandiflora, Tectona grandis*
Phek	10	*Gmelina arborea*
Wokha	10	*Gmelina arborea, Tectona grandis*
Zunheboto	8	*Gmelina arborea, Alnus nepalensis*
Tuensang	15	*Gmelina arborea, Alnus nepalensis, Melia composita*
Mon	11	*Gmelina arborea,* unidentified local species

was expected that tree planting would scale up rapidly because the plan was that all 1000 villages in Nagaland would participate in the experiment. Land-use decisions in Nagaland are generally taken jointly within a village, so it was anticipated that experiments that proved successful would be quickly adopted by other villagers, who would initially adopt a 'watch and see' strategy. Wide dissemination was also encouraged because farmers were trained on site and non-participating farmers invited to attend training sessions. Follow-up visits by the implementation team to verify progress and provide supplementary training ensured that the project had high visibility in the communities. An important component of this capacity for follow-up visits was that all project officers were assigned a vehicle.

Within two years after the project was implemented, evidence of extensive tree planting became apparent and could be observed casually across the state. Initially, most scaling up was spontaneous, but targeted government programmes later reinforced it. Some of the Nagaland government departments began distributing tree seedlings on a limited scale in 1997–1998. Three districts were not included in the government programme, and seedlings were disbursed to only 150 villages. Then Nagaland declared 1999 as the 'Year of Tree Plantation' and, in a highly visible and publicised initiative, distributed close to ten million seedlings to individuals and organisations across the entire state. The untargeted approach of the government programme in 1999 appeared effective in getting seedlings out into the countryside, but it had significant regional gaps, and often seedlings did not reach lower income farmers.

Survey to measure extent of scaling up

With a modest budget and limited time, an attempt was made to estimate the impact that the NEPED Project made on reforestation and on improving agroforestry techniques among villagers across the state. As data were collected before the Nagaland Year of Tree Plantation programme, they should be considered conservative estimates of the extent to which agroforestry was scaled up. A random sample of villages was selected from among all those that had been awarded test plots in the project. Questionnaires were developed and administered to villagers in the selected communities to gauge the level of participation in improved agroforestry techniques.

Because travel to the remote villages in the study population was difficult, it was necessary to establish upper limits on questionnaire size and sample size. Each of the seven hill districts in Nagaland has subdistricts. In a random draw, two subdistricts were selected from each district. All test plots in the selected subdistricts were eligible for selection, except for a small number that were not easily accessible. Two test plots were then randomly drawn from each of the chosen subdistricts, providing a random sample of 28 test plots. Three separate questionnaires were developed: one for the village council, one for the owner(s) or operator(s) of the selected test plot, and one for the owner(s) or operator(s) of a replicate plot, drawn randomly from lists of replicators provided by village councils. It was sometimes difficult to differentiate clearly between actual project replicators and farmers who would have planted trees anyway, either being influenced by other programmes or for private reasons. However, the other programmes that distributed planting material were initially stimulated and highly influenced by NEPED, so including replicators that these programmes supported does not seriously undermine our evaluation of the project's impact. Before NEPED began, tree planting had been sporadic and limited, so the widespread and extensive spread of the new approach (as documented below) could only be directly due to NEPED or to other government programmes (the primary one, the Year of Tree Plantation, had not yet taken effect when the survey was completed) strongly influenced by NEPED, both in initiation and in implementation.

Questionnaires were developed by the project team and then pre-tested under actual field conditions. The pre-testing revealed several problems in questionnaire design, which led to revised question formats. Questionnaires were in English, with the field officers (and, when possible, accompanying local experts) translating them in the field. Most commonly, questions and answers were done in Nagamese, the non-written 'lingua franca' used in Nagaland among people from different ethnic backgrounds who do not speak English. Field officers were trained in questionnaire methods and translations agreed upon before going into the field. Surveys were successfully conducted and the three questionnaires collected in all 28 villages. Interpretation of the survey results below is conditioned by five years of interactive work with villagers in Nagaland, using a variety of participatory and informal approaches.

Impact on the community

Elders in the selected villages were informed about the upcoming visit and asked to assemble information about tree planting in their villages, including a list of households that had begun planting trees in their swidden plots after establishing their two test plots. Table 3 presents summary statistical data for several key variables in the questionnaire: village size (number of households), estimated number of households that have begun planting trees in swidden fields (that is, replications), estimated area planted in the replicate plots, and number of trees planted in the replications.

Village size averaged 266 households with the size in the sample varying between 33 and 1200 households. On average, 98 of the households (37 per cent) have planted trees in *jhum* fields since the project was implemented in 1995. A total of 1917 ha of trees were planted in replications in the 28 villages; the average area per village was 69 ha.

Table 3: Summary statistical data for sample (number of observations: 28)

	Households in villages sampled (no.)	Replications in villages sampled (no.)	Area planted in replications (ha)	Trees planted in replications (thousands)
Total	7441	2731	1917	4180
Mean	266	98	69	149
Standard deviation	258	87	118	160
Maximum	1200	350	565	800
Minimum	33	5	6	10

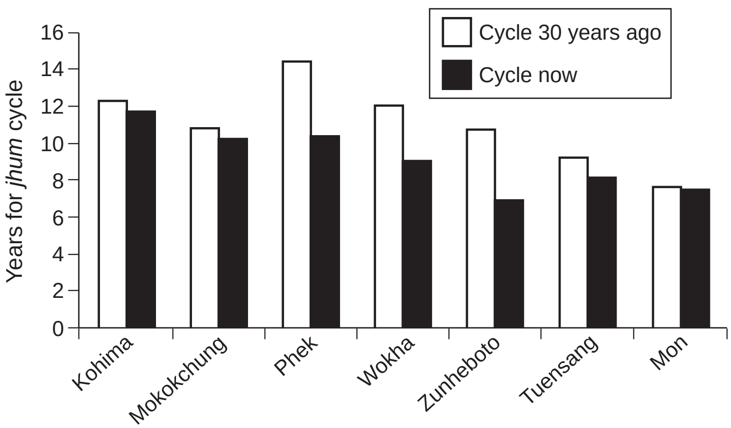
Extrapolating from the sample to the entire population of villages with test plots at the time of the survey suggests that roughly 59,000 ha of tree plantation (69 ha per village, 854 villages) has occurred subsequent to the project, confirming the casual field observation of widespread tree planting in recent years. However, the standard deviation of mean area replicated per village was very high (118 ha) because of two large outliers – one village reporting 372 ha and another 565 ha. Both outliers were located at very low altitudes with exceptionally good access to forest processing facilities and rail transport. Excluding those two outliers provides a mean of 38 ha per village (standard deviation = 31 ha). Thus, a more conservative estimate of the total area of replication is 32,000 ha (38 ha per village, 854 villages).

Village elders were also asked to estimate the number of trees planted in replicate plots. The project management normally helped to arrange for seedlings for test plots, but villagers usually arranged for their own planting material in replicate plots. By early 1999, when the survey was conducted, seedlings from the limited government programmes available at that time had been made available to a limited number of villages in some, but not all, regions of Nagaland. Many villagers, especially more prosperous ones, reported purchasing seedlings from commercial nurseries. In other cases, local nurseries using village resources were established to provide seedlings, or farmers used planting material (saplings and seeds) collected in the wild. In total, the estimated number of trees planted in replication plots in the sampled villages was nearly 4.2 million trees, averaging 149,000 trees per village. If these self-reported estimates are accurate, extrapolation to the 854 villages included in NEPED indicates that about 130 million trees could have been planted in scaling-up activities since the NEPED

Project began. Excluding the two large replicate plots, the other 26 villages in the sample planted an average of 119,000 trees in replicate plots; extrapolated to the 854 villages, this would indicate that 100 million trees were planted in scaling-up activities.

One concern is that enthusiasm for tree planting might actually increase deforestation because land committed to trees will not be available for food crops after the normal fallow period unless farmers are willing to harvest trees when they are well below optimal market size. Although the market for timber in India appears buoyant and capable of absorbing the trees from Nagaland, serious market assessments were not done, a fault being corrected in the second phase of the project. In each village, villagers set land aside as a forest reserve. This reserve land is not cultivated but is instead used for collecting firewood, hunting, and foraging for other non-timber forest products. These reserves are usually located on steep mountainsides that are inferior for cultivation and are close to the villages. Mature trees may be selectively harvested for timber, but villagers traditionally manage the forest reserve carefully. The remainder of forest land owned by the villagers is normally exploited for crop cultivation, with long swidden cycles when land is abundant and short cycles when it is relatively scarce. Excepted is steeply sloped land at high altitudes (generally above 2000–2500 m). Therefore, to meet village food needs farmers must

Figure 2: Length of swidden cycle, by district



either intensify the use of available land by shortening swidden cycles or exploit their forest reserves. Figure 2 shows the length of swidden cycles in each district, now and 30 years ago, as reported by village elders. In all cases, cycles have shortened, but particularly so in Phek, Wokha, and Zunheboto Districts. In four cases (Wokha, Zunheboto, Tuensang, and Mon) swidden cycles are now below the benchmark of 10 years needed for the system to be sustainable. In those districts, entire mountainsides are often cleared for swidden cultivation. In Phek and Kohima Districts villagers depend upon irrigated rice production in terraces for most of their food supply and have extensive forest reserves.

When questioned, only three villages reported encroaching on their forest reserves. One village in Kohima District (a village reporting substantial scaling up, 370 ha) reported using over 150 ha, while two other villages in other districts reported 6 and 2 ha of new deforestation, respectively. Thus, the immediate impact on deforestation appears to be nil in most cases and significant in only one village. Extensive field observation by the project field team over five years suggests that the survey results are broadly accurate – there is occasional and generally limited deforestation with a few cases of fairly extensive forest loss. However, the longer-term impacts might be more substantial. In 23 cases, village elders reported that they did not anticipate that tree planting would adversely affect village food supply, and in all 28 cases they reported that their intention was to expand the extent of tree planting in their *jhum* fields.

Most individual farmers who were questioned were also unconcerned about an adverse effect of agroforestry on food security. One reason for this lack of concern might be because of the way in which planting timber trees was generally adopted in Nagaland – as an additional crop in a highly diversified subsistence food mix. Village elders in about 40 per cent of villages indicated that they plan to use village development board funds for planting trees in the future. Their assumption that planting more trees will little affect subsistence food production in the village may be correct, given that only one *jhum* cycle will need to be shortened to compensate for the increased land devoted to planting trees before they realise the anticipated cash income from timber sales. However, if village elders have underestimated the impact on food production that shortened cycles may have, ultimately the village may be forced to increase the use of forest reserves simply to produce enough food.

In our frequent field visits during the course of the project, we observed that local village governments increasingly used village resolutions to plant trees as a way to stimulate villagers to move from swidden food production to combined forestry-and-food systems. Village resolutions are collective decisions taken by village councils. They are usually a powerful force in shaping land use. In the Naga village governance system, village resolutions are commonly a means of initiating new practices or principles of livelihood. The village councils use them as moral persuasion to encourage village members to follow new practices that deviate from well-established traditions. New concepts and practices are difficult to implement in the Naga form of social cohesion without the blessing of village elders, and the village resolution provides legitimacy to newly evolving ideas. We observed that the passing of a village resolution was frequently the formal signal from elders to villagers and the needed stimulus to move from experimentation to widespread adoption.

Twelve of the villages in the sample have passed resolutions to plant trees. Six of these pre-date the implementation of NEPED, with one passed as early as 1985. This is not surprising because the initial impetus for NEPED arose locally from several villages and was broadly promoted by several community leaders. Dividing the sample data into two groups, one comprising villages that have passed a resolution and one group that has not, suggests that village resolutions seem to be effective agents for motivating the integration of trees in swidden fields. In villages with resolutions, 47 per cent of households have adopted the agroforestry system compared with 31 per cent in villages that have not. The average area devoted to agroforestry was 93 ha in the former, compared with 50 ha in the latter. Interestingly, it was the smaller villages that were most successful in passing village resolutions and in stimulating agroforestry. This suggests that size and homogeneity might be factors in determining a group's ability to take action (Mueller 1989). The average size of villages passing a resolution was 215 households (standard deviation of 99), as compared with 304 households (standard deviation of 324) in villages that have not passed a resolution.

Farmer practices

When conducting the survey, a 30 x 30 m square was staked out in the centre of each plot, in which trees were counted and recorded by species. There was little difference between test and replicate plots.

Although there is considerable overall diversity in species planted across Nagaland, farmers placed heavy reliance on teak and gomari (*Gmelina arborea*), which are in strong demand in regional timber markets. More than half of the plots contained gomari, about one-third contained alder, and about one-quarter contained teak.

The average count was 269 trees in the 30 x 30 m squares of the test plots and 213 trees in the 30 x 30 m squares of the replicate plots. Since plot size averaged about 3 ha, about 9000 trees would have survived in each test plot and 7100 in each replicate plot (assuming the same density of trees throughout the plots). This is substantially more than the average 5900 seedlings reported to have been planted in test plots and slightly higher than the 6400 reported planted in replicate plots. Farmers who had test plots were encouraged and trained to weed selectively and allow natural re-growth of valuable species. The data suggest that farmers with test plots appear to have done this, but the technique was not widely disseminated to other farmers.

There was a major difference, however, in the percentage of total trees represented by each species in the 30 x 30 m squares. Replicate plots contained a higher percentage of gomari (*G. arborea*), teak (*Tectona grandis*), hollock (*Terminalia myriocarpa*), and hill toona (*Cedrela serrata*) trees than did test plots; these species generally have a good cash market. These four species accounted for 58 per cent of all trees in replicate plots and only 35 per cent of those in test plots. Test plots contained a greater diversity of species than did replicate plots. About 35 per cent of trees in test plots were not in the top nine listed species, while only 20 per cent of trees on replicate plots were not in the top nine.

Farmers in the survey were asked a series of questions related to their agroforestry practices and the reasons for those practices. Although farmers adopting agroforestry in replications did not have the same level of advisory services as were available to those who had test plots, for the most part they followed similar practices. Farmers were asked about the number of species of trees and seedlings that were planted in their plots, and reported that test plots contained an average of five species while other farmers reported an average of four species.

Only half of the villagers who were awarded a test plot had ever planted trees in a *jhum field* before; 68 per cent subsequently did so in another *jhum* field. Among those who did not receive a test plot, twice as many (86 per cent compared with 43 per cent) planted trees in a *jhum* field after the NEPED test plot was established in their village as had planted trees before. Virtually all villagers indicated that they were likely to plant trees in *jhum* fields in the future.

However, scaling up of the recommended trench land shaping in *jhum* fields was not extensive. Only a limited number of farmers (18 per cent of test plot owners and seven per cent of replicate plot owners) reported that they had made contour trenches in fields after the NEPED test plots were established in their villages. About one-third of the farmers indicated they would possibly use this style of trench land shaping in the future. Most farmers (about 90 per cent) had used traditional erosion control methods before NEPED being established in their villages and reported an intention to continue using these methods. Given that a substantial share of the programme benefits that farmers received was for the land-shaping component, the very limited extent of scaling up suggests that efforts should be concentrated on the more accepted tree-planting component.

Farmers were asked what factors they considered important when making decisions about planting trees in their *jhum* fields. There were no significant differences in the answers given by farmers of test and replicate plots. Expected benefits from tree planting emphasised economic benefits from:

- timber for home use;
- timber for cash sales;
- improved firewood supplies;
- money for children's education;
- security for old age.

However, more than half of the farmers reported that they expected the trees planted to improve soil fertility, provide erosion control, and secure village water supplies. These environmental benefits were given less importance than the direct cash and in-kind consumption benefits from trees.

Lessons

The NEPED project has attempted to stimulate villagers to adopt simple agroforestry systems that integrate timber trees into food crops grown in swidden agriculture. The project concept was originally developed in Nagaland by government officers who were distressed at the results of many unsuccessful attempts to wean villagers from swidden agriculture. People are more inclined to participate in social forestry projects when they perceive some immediate benefits for themselves (Muthayya and Loganathan 1992). When the basic swidden system is augmented instead of attempts being made to radically change it, villagers find it easier to perceive benefits and are more likely to respond, leading to a stronger scaling-up effect.

The approach to project implementation was also radically different from that of previous programmes in Nagaland and in many other regions, which are often centralised, bureaucratic, and top-down in nature. Instead, reliance was placed on local testing and dissemination. Rather than having extension agents arrive in remote villages with a solution in hand, responsibility for selecting, testing, and disseminating agro-forestry systems occurred within the villages. Project officers provided basic training, suggestions, encouragement, and (perhaps most importantly) cash resources to establish test plots, but they allowed villagers broad latitude in selecting the systems they thought most suited to local needs.

The project has been very successful in stimulating replication, as measured by the amount of tree planting that has been integrated into swidden fields in the sample villages. Clear evidence of extensive tree planting can be seen in field visits, the result showing up in the survey data. A conservative estimate is that the 5400 ha of test plots used for local-based testing across 854 villages have been replicated by at least 32,000 ha of tree plantation. This implies a scaling-up rate of at least 6:1. Although replication rates vary, the response has been positive in all districts of Nagaland. Survey respondents were asked to rank the income of project participants and replicators as low, average, or high, relative to typical income in the village. All test plot operators were ranked as middle-income families, while replicators were reported as 89 per cent middle income, 4 per cent high income, and 7 per cent low income.

The actual form of the test and replication plots that were established often differ from the basic concept recommended by project officers. For example, the land-shaping technology has rarely been adopted in replications, most villagers preferring to use indigenous methods of erosion control, such as the water-flow barriers made from available material, when required.

Within villages, replication plots often differ from test plots. In other words, local solutions and adaptations seem to be the norm. Over time, the selection of species planted in test plots narrowed as farmers and project officers gained experience with local species. Limited evidence of encroachment into forest reserves occurred, but generally it was minimal. However, given the plans of all villages in the sample to increase tree plantation and the general shortening of swidden cycles, adoption of agroforestry in Nagaland might still result in additional deforestation and loss of biodiversity down the road, albeit in the relatively benign form of social forestry.

The participatory and highly flexible approach to agroforestry technology created a wide diversity of experiences and outcomes, particularly because the farmer-led programme was implemented on such a broad scale. This diversity – which permitted farmers to first 'pick and choose' in the testing and then to 'watch, learn, and adapt' – was fundamental to scaling up. However, scientific verification is more complex and difficult when implemented on a very large scale, as in NEPED, in a region like Nagaland where transportation and communication are both exceedingly difficult.

This study confirms many of the findings found elsewhere in social forestry (see, for example, Dove 1992, 1995):

- Many foresters believe that small-scale farmers would oppose having trees on their farms because of the long growth period; in reality, some farmers had already experimented with agroforestry and quickly started planting more trees.
- There is an assumption that farmers would be interested only in planting large blocks of market-oriented exotic varieties; in reality, although a few highly valued species are prominent, many farmers also planted multipurpose native trees, such as alder, in substantial quantities. However, although this effect was more pronounced in project-supported plots, farmers who scaled up also tended to plant diversified plots.
- Although farmers are highly motivated by cash-market potential, many also recognise environmental benefits and plant trees to meet household needs for fuel and timber.
- The traditional system of private (individual, family, or clan) property rights in Nagaland was highly likely to be a critical factor in the NEPED success of encouraging scaling up. Farmers who plant trees in Nagaland are assured that they will reap the benefits when trees are ready for market.
- Widespread and regionally large investment in timber trees requires a large and growing market such as that in India. Nagaland is well situated to tap this market.

- The limited success in involving women in agroforestry indicates the impact of property rights. In the limited number of cases where women had clearly defined property rights to land and trees, test plots were properly established and maintained. However, most women's test plots involved temporary and unclear rights, with poor field results. Virtually none of the women's plots was scaled up.
- Initially, the subsidy was considered necessary by the project implementation team as a way to encourage tree planting because this has been the primary tool the Nagaland government had used, and farmers had become accustomed to being paid to try new systems. However, as the project progressed, the speed and magnitude of scaling up provided indications that the need for subsidies had possibly been overestimated.
- Continual monitoring and evaluation (including informal interview techniques with repeated visits) played a critical role in assessing the extent and nature of scaling up, identifying farmer-initiated adaptations, and initiating new project activities to overcome constraints experienced by farmers as the project progressed.

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