5 On farm

Some of the major concerns related to livelihood improvement are maintaining soil fertility, degradation of community lands, increasing farm income, building capacity of the community, and decreasing women's workloads. Several questions arose concerning these issues and PARDYP tested and synthesised a number of options to address them.

How Can Farmers Maintain or Improve Soil Fertility?

Soil fertility is a key concern of every farmer. Soil fertility can be supported through appropriate agronomic practices as well as appropriate use of fertilisers. PARDYP tested various agronomic practices in the different project watersheds. The main agronomic practices considered were inter-cropping, crop rotation, mulching, and liming. The main soil fertility management options were pit composting, black plastic composting, vermicomposting, and use of effective micro-organisms (EM) (rhizobium, azatobacter, and boakshi). The tests in PARDYP-Nepal focused on on-farm composting using black plastic and EM, and lime application in acidic soils. PARDYP-Nepal also monitored leachate in the soil erosion monitoring plots in agricultural and degraded land to help understanding of the nutrient dynamics in the soil profile.

On-farm composting

Compost or farmyard manure has played a crucial role in maintaining and building up soil fertility in Nepal. Many different composting methods were tested and demonstrated in the Jhikhu Khola watershed. Among the different methods, farmers considered **black plastic covered composting** as recommended by the Sustainable Soil Management Project to be the best.

Black plastic composting was first tested with 16 farmers in 2004. By 2005, about 50 farmers had started using this method in the Jhikhu Khola watershed. In this method, a traditional compost heap is covered with a piece of black plastic, which protects nutrients from leaching during rainy days and provides a favourable environment (increased temperature and decreased evaporation loss) for the growth of microbes (Figure 33). The method is based on a passive aeration approach, the black plastic is removed from the compost heap for a short period each day. Using this method, compost decomposed within 45-50 days compared to about 4-6 months without the plastic sheet. Black plastic (thickness ~ 800 μm) is light, easy to use, and durable. Compost is produced with less time and labour than by the standard method.

Use of **effective micro-organisms (EM)** is another method being adopted by the watershed residents. In this method, composting is based on aerobic decomposition and

Figure 33: On-farm composting with black plastic cover

Figure 34: Composting with effective micro-organisms (EM)

again it takes about 45 days to decompose fresh materials rather than 4-6 months. Effective micro-organisms (EM) refer to a mixed microbial culture of selected species such as lactic acid bacteria, yeasts, photosynthetic bacteria, and actinomycetes. All of these are natural, compatible with one another, and coexist in liquid culture. In this method, locally available raw organic materials such as crop residues, plant leaves, and grasses are used as fertilising resources. The ingredients are mixed together and piled in multiple layers; the EM solution is sprinkled between layers together with old compost as microbial inoculums. Water is also sprinkled on each layer to ensure the moisture content. The pile is covered with a plastic sheet; 3-4 wooden poles are inserted vertically to provide sufficient ventilation, and the pile is turned every 10 days (Figure 34). Moisture status is monitored and water is sprinkled on the heap if deficiency is observed. The general practice in the Jhikhu Khola watershed is to use about 1,000 kg of the fresh ingredients, about 500 litres of water, 250 kg old compost, and about 1 litre of EM solution. EM is easily available in the local markets and is cheap.

Soil acidification and lime experiment

The soil survey showed that soil acidification problems were similar in both watersheds (Table 14). In both watersheds about 80% of soils tested had a low pH (~5.0). Extensive use of chemical fertilisers (particularly urea and ammonium based fertilisers), presence of partially decomposed pine litter in farmyard manure, and acidic bedrock (sandstone, siltstone, and quartzite) are among the factors contributing to acid soil (Schreier and Shah 1999).

Table 14: **Soil pH in the watersheds**

	Soil pH	
	Jhikhu Khola watershed	Yarsha Khola watershed
Mean	4.65	4.75
Maximum	6.70	7.42
Minimum	3.97	3.59
Sample Number	200	340

Source: Schreier and Shah 1999

Soil acidification, associated with high inputs of acid-causing fertilisers (urea and ammonium based fertilisers) and acid bedrock geology, is becoming a major problem in the double and triple crop rotation systems in the Jhikhu Khola area. Chitrakar (1990), Sherchan and Baniya (1991), and Suwal et al. (1991) noted that the commonly used fertilisers, ammonium sulphate and urea, tend to acidify soils. This acidification has serious implications as low soil pH (< 5.0) slows the rate of organic matter decomposition, and leads to the leaching of base cations (calcium and magnesium) and the fixing of available phosphorous in the soil – making it unavailable to plants – and to aluminium toxicity and micronutrient deficiencies (Shah 2003).

PARDYP investigated whether pine litter in compost was contributing to soil acidification on red soils originating from phyllitic parent materials and brown (non-red) soils from quartzitic materials. Twelve 50 x 50 cm plots were established; six plots each were assigned for red and non-red soils. Plots of one red and one non-red soil were combined to make six sets of treatments. In the first set of plots, 1 kg per m^2 of dry pine litter was incorporated, and the same amount of pine litter was added 2 times in the 2nd, 3 times in the 3rd, 4 times in the 4th, 5 times in the 5th, and 6 times in the 6th set at intervals of six months. The soil was analysed for pH, exchangeable cations, carbon, and available phosphorous (Bray-1) using standard procedures (after Schreier and Shah 2000). No acidification was detected after the first year, but after the second year there was clear evidence that soil acidification was taking place. Initially the rate of acidification was higher in the non-red soils on quartzite bedrock, while the red soils resisted acidification. During the second year, the trend towards greater acidification was significant in both soils. While the carbon and calcium content improved with pine litter addition, the pH decreased. In the non-red soils, the available phosphorous content increased, but not in the red soils where the low levels remained the same throughout the experiment. This suggests that pine litter is acidifying the soils and that in the process the phosphorous availability in the red soils is impaired. While there are benefits from improving carbon and calcium values by pine litter addition, the negative effect on acidity outweighs them. These results suggest that the addition of other types of litter is needed to have a positive impact on nutrient management (Schreier and Shah 2000). Earlier PARDYP experiments showed that acidification is a slow process and that different soils respond differently. In general this is a long-term problem seen by researchers, but farmers tend not to see it as a serious problem because it is not yet affecting their yields.

Intensification and in particular cash crop production has influenced the nutrient budget and soil nutrient pool of irrigated and rainfed lands. No changes were observed in soil pH between intensively and less intensively farmed sites, but a slight decline was noted in irrigated fields and a slight increase in rainfed fields. Intensification has not led to more acidic soils as the soils are already acidic and would probably need higher levels of acidic inputs to cause further acidification. Also the calcium-enriched irrigation water tends to buffer the effects of soil acidity in irrigated sites (Shah 2003).

PARDYP tested the effects of applying lime to the acidic soils of the Jhikhu Khola watershed. Eight sites with low soil pH were selected. A recommended dose of lime was applied to five ropanis of land (1 ropani = 508 m^2) by each of three farmers (three sites) in Lamdihi to test its effects on maize – for example: 120, 230, and 294 kg of lime per ropani on clay loam soil with pH 6.0, 5.5, and 5.2 respectively, as per Agriculture Development Diary 2005 (AICC 2005). Likewise, lime was applied to five vegetable farming sites (cauliflower, potato, tomato, and brinjal). At each site control plots were established, and soil pH and production before and after lime application studied. The results showed a slight increase in soil pH (by 0.1-0.3) after one crop season following lime application. Interestingly, the production of potato increased by about 50% in plots where lime was applied. A few research farmers pointed out that it was easier to till the land after lime application. The effect of lime on soil pH and production demands much more intensive scientific study, including cost:benefit analysis, proper design, and accuracy of measurement.

Leachate Study in the Jhikhu Khola Watershed

Nutrient loss through leaching reduces soil fertility and thus production. PARDYP monitored leaching in its soil erosion monitoring plots on agricultural and degraded land to understand the nutrient dynamics in the soil profile, which might be very important for sustainable soil fertility management.

The leachate volume (6 to 58% of rainfall) in rainfed agricultural land was significantly higher than runoff (2 to 7% of rainfall), whereas in degraded land the leachate volume (12 to 16% of rainfall) was slightly lower than runoff (18 to 29% of rainfall). The total leachate volume was higher in agricultural land than in degraded land, ranging from 541 to 4,712 m^3/ha in rainfed agricultural land and from 389 to 865 m^3/ha in degraded land. The reason might have been the effect of the red soil in the degraded plot, which was very compact due to inadequate vegetation resulting in low infiltration. The agriculture plots were somewhat levelled, and due to soil working for cultivation, infiltration in agricultural land is significantly higher than in degraded land. Also, farmers apply chemical fertilisers to rainfed agricultural land while no chemical fertilisers are applied to degraded land (see Annex 15).

In rainfed agricultural land, nitrate leaching ranged from 306 to 2,518 kg/ha, which is equivalent to 147 to 1,230 kg/ha of urea fertiliser. Leaching of nitrate from degraded land ranged from 59 to 237 kg/ha, equivalent to 29 and 115 kg/ha of urea fertiliser. Phosphate leaching ranged from 5 to of 94 kg/ha in rainfed agricultural land, equivalent to 3 to 66 kg/ha of diammonium phosphate (DAP) fertiliser, while from degraded land it ranged from 1 to 5 kg/ha, equivalent to 1 to 3 kg/ha of DAP fertiliser. Potassium leaching ranged from 41 to 801 kg/ha in rainfed agricultural land, which is equivalent to 68 and 1,334 kg/ha of murate of potash fertiliser, and from 52 to 160 kg/ha in degraded land, equivalent to 86 and 267 kg/ha of murate of potash fertiliser (see Annex 15). Among the three nutrient parameters, nitrate was most leached from the soil, followed by potassium and then phosphate. Phosphate leaching was comparatively small.

How to Rehabilitate Degraded Land

Degraded land is a major problem in the Jhikhu Khola watershed, and rehabilitation of degraded land is one of the major concerns of local people. Degradation is common on communal lands as well as on rainfed sloping agricultural (bari) land. PARDYP tested two major options to improve these lands: rainfed hill terrace improvement and rehabilitation of degraded communal lands.

Rainfed hill terrace improvement

In Nepali, improvement of rainfed hill terraces is known as 'gara sudhar'. Rainfed sloping agriculture is very common in the mid-hills of Nepal. Soil fertility is maintained by adding compost and/or fertiliser, but most of the added nutrients are usually washed out in the first rains of the monsoon season. Soil erosion, nutrient leaching, high runoff, and low soil moisture status are major concerns on this type of land. At the same time, the productivity of the crops grown and the scope for crop diversification is limited by the slope. PARDYP joined with the Nepal Government's Department of Soil Conservation and Watershed Management to test and demonstrate rainfed hill terrace improvement with farmers in the Jhikhu Khola watershed. The improvements involved slope correction of the terrace (thus increasing terrace stability), conserving soil nutrients and moisture, and planting nitrogen-fixing hedgerow species along the terrace margins in single or multiple rows (thus increasing fodder availability, reducing erosion and runoff, and stabilising the riser). All technical activities were performed manually using locally available tools and materials. The species preferred by farmers in the Jhikhu Khola watershed for terrace stabilising were:

1) **grasses:** napier (*Pennisetum purpureum*), molasses (*Melinis minutiflora*), and stylo (*Stylosanthes guianensis*);
2) **shrubs:** sunhemp (*Crotalaria juncea*), tephrosia (*Tephrosia candida*), and flemingia (*Flemingia macrophylla*).

Typical plantations are shown in Figure 35.

As a result of levelling and planting of vegetative hedgerows, the slope of agricultural land was reduced from about 30% to around 5%. The technology took about a year to be fully established and cost approximately USD 1,300 per ha during the establishment phase including labour and USD 340 per ha for maintenance. The activity was carried out by the farmers themselves; PARDYP supported 25% of the total cost of the activity in the establishment phase and of the planting materials in the following years.

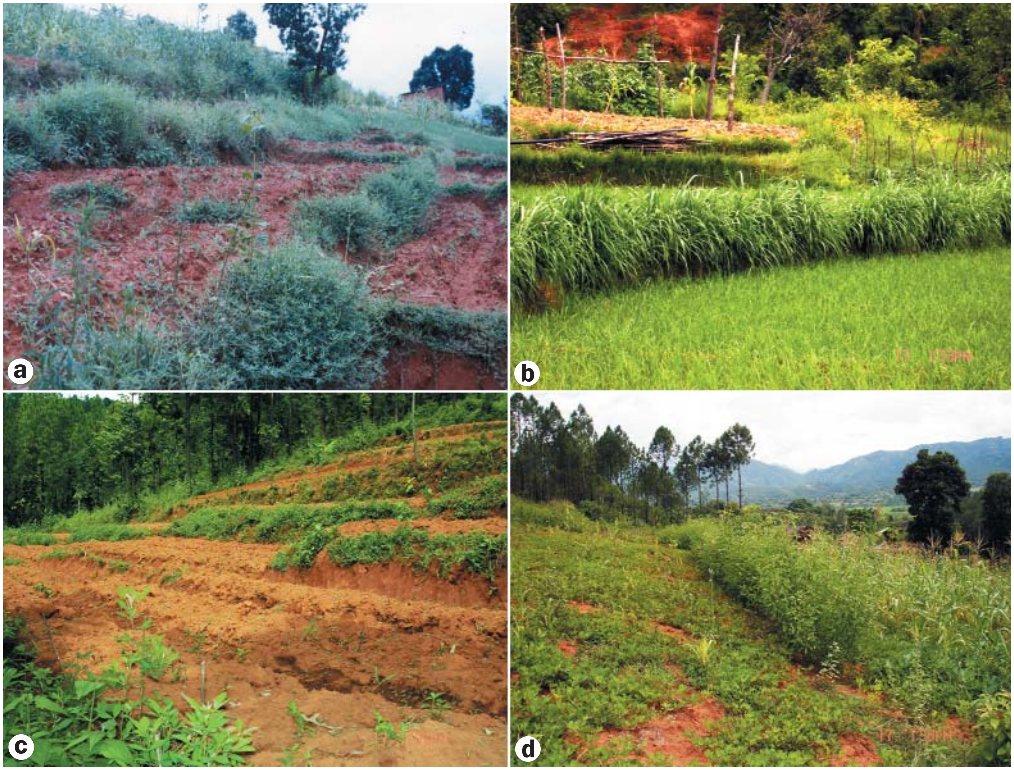

Figure 35: Grasses planted during improvement of rainfed hill terraces
a) Molasses (*Melinis minutiflora*) and stylo (*Stylosanthes guianensis*) along a terrace;
b) Napier (*Pennisetum purpureum*) along a terrace riser; c) Stylo (*Stylosanthes guianensis*) on a terrace riser; d) Sunhemp (*Crotalaria juncea*) hedgerow planted along a contour

Some of the benefits farmers observed from the technology are:

- less soil erosion, rill erosion, and nutrient leaching compared to the traditional sloping agricultural land;
- increase in soil moisture due to reduced slope and improved efficiency of fertiliser input, leading to better yields;
- reduced movement of sediments downstream;
- increase in the selling price of land due to improved conditions of the land and better production capacity;
- increased fodder and grass production from the land, thereby reducing the workload of women, who are traditionally entrusted with collecting fodder;
- hedgerow species such as tephrosia and sunhemp have benefited other crops; first they serve as stakes for cash crops, and secondly the crop yield has improved due to their nitrogen-fixing properties.

Farmers in the watershed are now gradually adopting this technology.

Rehabilitation of degraded lands

Figure 36: Dhotra rehabilitation site, Jhikhu Khola Watershed

PARDYP was involved in rehabilitating various sites in the watersheds. Dhotra Rehabilitation Site near Dhotra Village, a thirty minute walk from the roadhead at Tinpiple in Kabhre District, is a good example of rehabilitation of highly degraded dry land (Figure 36). The site comprised about 2.5 ha of very badly degraded south-facing red-soil land at an elevation of 850-875 masl, with hardly any ground vegetation. The site became degraded due to excessive overgrazing. Two major gullies with small slides threatened a trail and farmland.

PARDYP collaborated with the community and the local Ekanta Basti Yuba Club from Dhotra village to carry out re-vegetation of the barren slopes, and gully control activities.

Moisture stress was the major constraint to growth of vegetation on the site. Due to moisture constraint, planting activities carried out eight years previously had not been successful. The technique of eyebrow pitting was adopted to retain rainwater. In this technique small curved trenches in the shape of an eyebrow facing inward to the slope are dug at intervals to catch water and slowly return it to the soil. Altogether 130 eyebrow pits were dug together with catch drainage trenches. The row-to-row distance between the eyebrows was 6m; the average length, depth, and width were 2m, 40cm, and 50 cm, respectively. The average length of the drainage trenches was 4m and the depth was 20 cm. The eyebrow pitting design is shown in Figure 37.

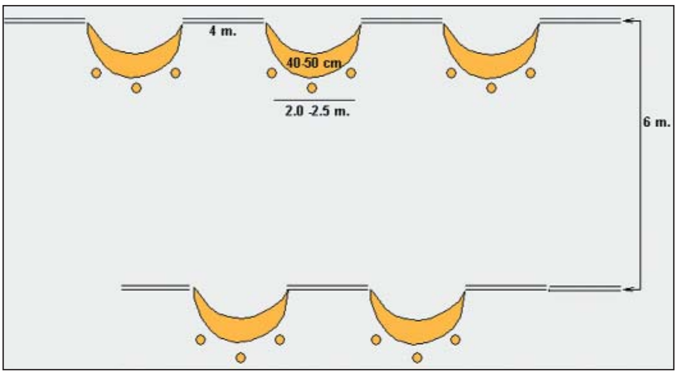

Figure 37: Eyebrow pitting design

Several species of grass and fodder were planted along the ridges of the eyebrows and drainage trenches. Contour hedgerows were planted in between the eyebrows and drainage trenches, and tree species just below the eyebrows (Figure 38). The species used were: sunhemp (*Crotalaria juncea*), tephrosia (*Tephrosia candida*), flemingia (*Flemingia microphylla*), tithonia (*Tithonia diversifolia*), stylo (*Stylosanthesguianensis*),

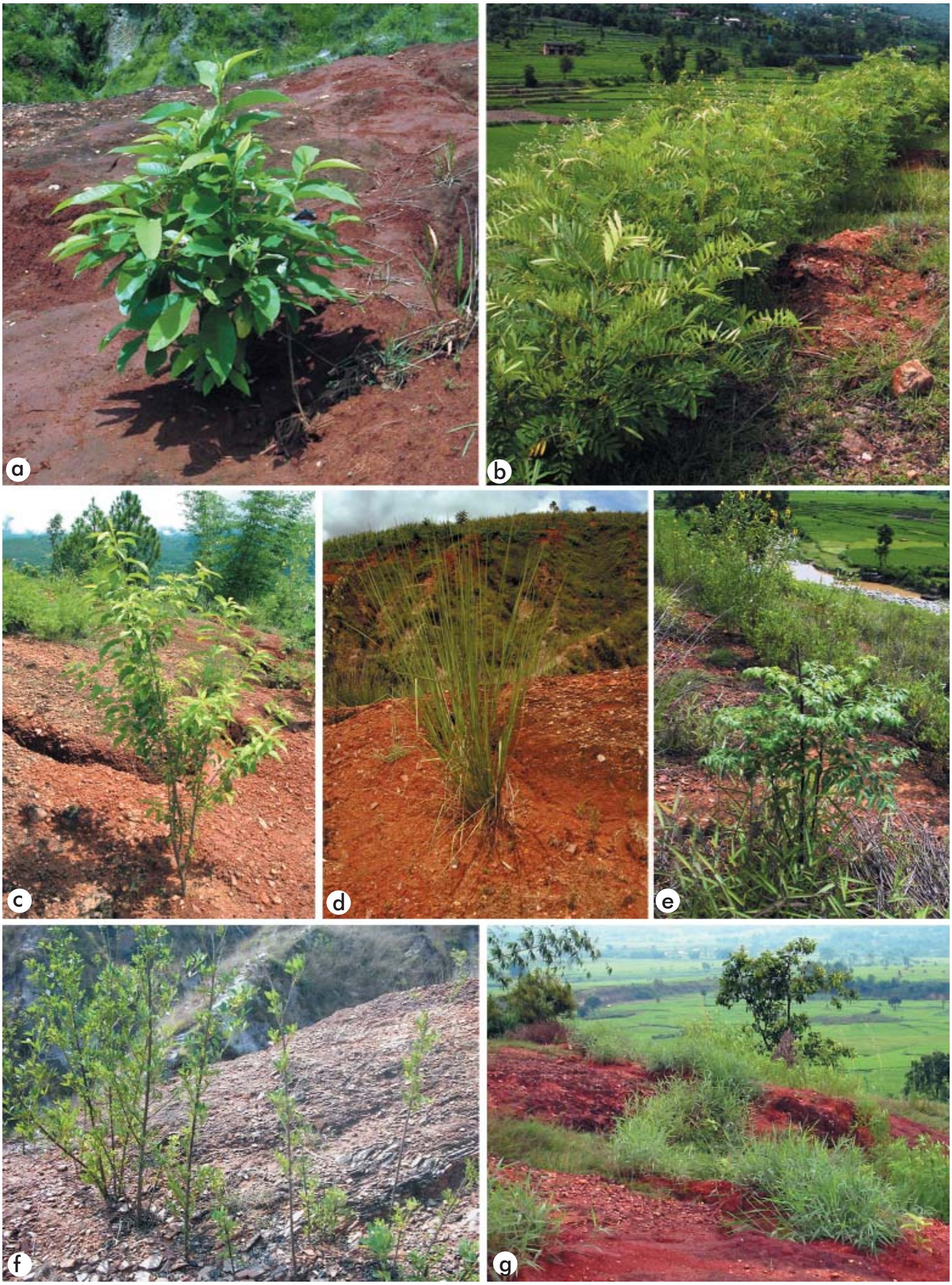

Figure 38: Vegetation planting for rehabilitation of degraded dry land in Dhotra
a) Champ (*Michelia champaca*); b) *Tephrosia candida*; c) Paiyun (*Prunus cerasoides*); d) Vetiver; e) Bakaino (*Azadirachta indica*); f) Sunhemp (*Crotalaria juncea*); g) Molasses (*Melinis minutiflora*)

napier grass (*Pennisetum purpureum*), gini grass (*Panicum maximum*), mollasses (*Melinis minutiflora*), dinnath (*Pennisetum pedecellatum*), wyancassia (*Chanaecrista rotundifolia*), signal (*Brachiaria decumbens*), dhaincha (*Sesbania grandiflora*), and epil-epil (*Leucena leucocephala*). Apart from grass and fodder, tree species such as champ (*Michelia champaca*), bakaino (*Melia azedarach*), chilaune (*Schima wallichii*), lapsi (*Choerospondias axillaries*), paiyun (*Prunus cerasoides*), bamboo, chiuri (*Bassia butyracea*), kalki (*Callistemon viminalis*), kapor (*Cinnamomum camphora*), amba (*Psidium guajava*), nim (*Azadirachta indica*), and amala (*Emblica officinalis*) were planted. The species were chosen using preference ranking derived from a needs assessment survey. About 1,700 hedgerow plants and 1,050 tree seedlings were planted, and 7 kg of grass seeds propagated.

In the gullies, 25 check dams were constructed using soil-filled cement bags. Bamboo was planted on the upper and lower side of each check dam (Figure 39).

Figure 39: Bio-engineering activities for gully treatment

The community participated in all steps of planning and implementation. Women participated much more in all plantation and gully protection activities than men, who only dug the pits for plantation. Men and women participated equally in filling bags. Women comprised 56% of all participants, men 44%.

The implementation of activities started in June 2004. Several meetings were organised and the capacity of a local institution (Ekanta Basti Yuba Club) was strengthened. A user group, all women, was formed for future management, planting, and protection work. Within a year, the community was able to collect a small amount of money by selling grass seed and the results of the rehabilitation were encouraging.

How Can We Increase Farm Income?

Proper and diversified management of farm resources for better production and efficient utilisation of farm inputs are major components for increasing farm income. A number of innovations and new technologies from across the region can help raise farm income significantly. PARDYP tested several options, some of which worked while others did not. The System of Rice Intensification (SRI) was one of the most successful options tested in the Jhikhu Khola watershed. The System of Rice Intensification has been discussed in the context of efficient use of water. Here it is considered in terms of increased production.

System of Rice Intensification

In the Jhikhu Khola Watershed, farmers consider the SRI a potential agronomic option to grow rice especially under controlled irrigation management. In this system, fewer younger seedlings are planted at greater intervals than is the usual practice and grown without flooding except at the flowering stage. The result is markedly improved productivity. PARDYP tested this option on station as well as on farm (Figure 40); the results of the trials are described in detail in Annex 12.

On-station research: at Tamaghat's Spice Crop Development Centre research station, SRI increased Makawnpur-1 rice yields by 10-25% on irrigated land and 10% on rainfed plots.

On-farm research: In 2003, yields in the SRI plots with different rice varieties were 10 to 57% higher than those recorded in traditional plots. The highest yield increase of 57% was recorded for the Naya Parwanipur rice variety, followed by 54 % for Panta 10. In 2004, the yield increase in SRI plots varied from 2 to 67%: 6% for Makwanpur-1; 2 to 45% for Parwanipur; and 67% for Japanese Mansuli. In 2005, the yield increase in SRI plots varied from 8 to 93% with the highest yield recorded for Markwanpur-1 followed by Japanese Mansuli variety and Parwanipur.

Farmers understood that SRI requires only 25% of seeds, 50% of labour for transplanting, 50-60% of labour for irrigation, and less use of pesticide than traditional methods. At the same time there was a 40-50% increase in grain and 20-25% increase in biomass production. This was considered advantageous for smallholder farmers. However, certain problems were encountered with SRI. Extensive weed growth added 50-

Figure 40: On farm action research on SRI

60% to the cost of the first weeding. It was difficult to regulate the irrigation and drainage to keep the land moist or dry where there were no proper irrigation and drainage facilities. Preparation of the 8-12 day seedlings to match with transplanting time, especially under rainfed conditions, was also difficult.

What Approaches Can be Used to Build the Capacity of Communities?

PARDYP followed a participatory action research approach to prepare communities to steer development according to their needs. This is illustrated in the following examples.

Entry point activities: using farmers' priorities to develop collegial participation

Case Study: Mule trail at Kabre village, Yarsha Khola watershed

In December 1999, PARDYP in collaboration with the Department of Forest and Department of Soil Conservation and Watershed Management organised a meeting at the District Development Committee in Dolakha to discuss activities to be undertaken by PARDYP during its second phase. This meeting refined the activities proposed in the previous meetings held at the District Development Committee (DDC) Charikot and Village Development Committee (VDC) Yarsha Khola watershed.

DDC and VDC representatives, schoolteachers, community-based organisation representatives, and farmers prepared a list of research and development activities required for their VDCs. PARDYP's main task was to carry out natural resource management related research activities. During the discussion, the VDC Chairperson of Kabre, another village in Dolakha district, proposed improving the mule trail as their priority activity. PARDYP supported this as an entry point activity to build a good rapport with the VDC and the villagers, and to engage them in the natural resource management research. After a detailed proposal from the VDC in March 2000, and a request from PARDYP/ICIMOD, SDC agreed to partially support completion of the proposed trail to improve the safety of passage for local people and project staff, especially during the monsoon period (Figure 41).

Although this intervention was not a planned activity of PARDYP, it turned out to be one of the most popular and highly appreciated activities with the villagers. As a result a good rapport was built with the VDC and local residents, which ultimately helped PARDYP to conduct research with different stakeholders in a collegial way.

Figure 41: Improved mule trail

Improvement of the trail connecting Bagar with Jyamire

The population of the three VDCs (Kabre, Mirge, and Gairimudi) used this trail extensively to reach the roadhead at Minapokhari and to visit the weekly market at Bagar. The biggest part of the trail improvement included mending damaged steep slippery slopes and watercourses (the most difficult part), which were a major problem, especially for schoolchildren, during flooding. The trail was 406m long with an average width of 1.2m. Concrete, cement, and stones were used to make steps on the steepest slopes and stone soling was done on level sections. The trail included three small culverts (underground channels to carry water) to cross the small streams and an irrigation canal. Two big reinforced culverts were constructed over the Khahare Khola using cement, stone, sand, and iron rods.

Construction work started in August 2000 under the supervision of the VDC chairperson of Kabre, and with the participation of the local people. The work was successfully completed in October 2000.

Participatory action research

Participatory action research methodology pursues action and research at the same time. It aims to change an organisation or community by increasing knowledge and understanding through learning by doing. There are several forms of action research. In participatory action research, the researchers (as facilitators) and villagers jointly diagnose problems, their causes, and possible solutions (Figure 42). An example of such research conducted by PARDYP was micro-irrigation combined with high-value cash crops (vegetables).

The PARDYP Water Demand and Supply Survey conducted in 1999 (ICIMOD 2002c) identified irrigation water shortage during the dry season as a major concern for farmers. Several village-level discussions were held in the Jhikhu Khola watershed to identify the possible causes of water shortage, which crops were adversely affected, and the practices and technologies adopted by farmers to cope with the situation. The advantages and disadvantages of the different technologies, and farmers' opinions

Figure 42: Participatory action research in the field

about micro-irrigation systems (drip and sprinkler) were discussed in detail. Drip irrigation was a new technology for the Jhikhu Khola watershed and it was decided to test its performance first in the government's Horticulture Centre at Tamaghat and with a few farmers in a Kubinde village. In the Horticulture Centre, the system was tested on bitter gourd and jointly monitored by the Horticulture Centre and PARDYP; in Kubinde village it was tested on cauliflower and monitored jointly by the participating farmers, the Institute of Engineering-Pulchowk, and PARDYP. Farmers' visits to the Horticulture Centre were organised during the technology testing phase. Formal and informal discussions were organised with the farmers who visited the centre, experiences shared, and interested farmers identified for further research (Figure 43).

Figure 43: Village-level interaction programme

Drip irrigation was tested in 2002 on vegetables (mostly bitter gourd) in 11 fields in different villages located at different altitudes. Training sessions were organised on establishing and maintaining the system; farmers actively participated in every activity (planting, watering, netting, and so on). The water requirement, cost, benefit, advantages, and disadvantages of both systems were analysed.

Village-level focus groups of old and new farmers were organised to evaluate the research results and share experiences on all the aspects of drip and traditional irrigation methods. Most farmers found the technology very effective, except for a few from higher elevations where water availability was higher.

The approach was repeated in 2003 to 2005 with more farmers. In the areas where drip irrigation was less effective, research was started on sprinkler irrigation. The results of sprinkler irrigation were also very encouraging. In 2006, more than 100 farmers were using drip irrigation in the Jhikhu Khola watershed and community-based NGOs, organisations, and district-level government offices (Divisional Irrigation Office and District Soil Conservation Office) had started promoting drip irrigation within and outside the watershed.

How to Reduce Workloads, Especially of Women

The workload for mountain women is higher than for men throughout the year, especially in fetching water, collecting fodder and fuelwood, and household work. In the PARDYP Nepal watersheds, a survey showed that women typically worked 3.8 hours longer per day than men. Various on-farm interventions implemented to generate more income have increased the workload on women. Given that women are also responsible for health and hygiene, childcare, and food security within a household, their greater workload hampers overall livelihood security. Therefore it is important to reduce women's workload for the overall welfare of the family. PARDYP tested roofwater harvesting jars, drip irrigation, and fodder planting activities as ways to reduce women's workload.

Water harvesting jars

Rainwater harvesting has been identified by PARDYP as a potential way of reducing women's workload in fetching water. The potential of roof-water harvesting using ferro-cement jars was demonstrated in both watersheds (See Chapter 3 and Figure 44). PARDYP's 1999 water survey in the Jhikhu Khola watershed indicated that in two-thirds of the households females, including young girls, are responsible for fetching water. People in the Jhikhu Khola spent an average of 33 minutes for each trip (5-120 min) to fetch 1 gagri (15 litre jar) of water (Prajapati et al. 2003). Construction of roof-water harvesting jars reduced this to an average of about 5 minutes (Sharma and Chiranjivi 2001).

Figure 44: Roof-water harvesting jar saves women's time in fetching drinking water

The total time saved in fetching water depends on the type of source, the distance from the source to house, family size, and the flow of water in the source. One analysis indicated that on average 20 sq.m of roof-water harvest saved about 358 hours yearly for a family of 2-4, 528 hours for a family of 5-6, and 591 hours for a family of 7 or more. Doubling the roof area to 40 sq.m saved 418, 674, and 795 hours for fetching water, respectively (see Annex 9). In addition, the use of rainwater during the monsoon season for drinking and other household uses is leading to better health and sanitation.

Grass and fodder species

Over the past few decades, the Jhikhu Khola watershed has witnessed an increase in forest cover due to community forestry programmes, but shortages of fodder and grass remain critical for local residents, especially during the dry season from March to May. PARDYP has been distributing various grass and fodder species to farmers since 2000 to

Figure 45: Fodder development helps women to reduce fodder collection time

help minimise fodder scarcity. About 500 households in the watershed took planting material from the project sources between 2000 and 2003. A survey of 51 randomly selected households was conducted to find out the impact of growing these grasses and to quantify how much workload (especially women's) had been reduced due to this intervention (Figure 45).

The survey found that after growing and harvesting grass from their private land, 35% of the farmers saved 30 to 60 minutes per day in collecting fodder, and 20% saved 60-90 minutes. Most of the women respondents said that they were spending less time collecting forage because the grass species were growing near their homes. They felt that they benefited the most during the busy seasons. Some mentioned that they could cook food and feed livestock at the same time after completing hard work in the field. A few farmers said that their children, also responsible for fodder collection, were getting more time for studies.

Drip irrigation

Due to easy access to the market at Kathmandu, farmers from the Jhikhu Khola watershed have shifted from subsistence to commercial farming and emphasised growing cash crops, mainly vegetables. However, the shortage of water increased the workload of women.

PARDYP, with the collaboration of the Institute of Engineering at Pulchowk, tested and demonstrated drip irrigation (see Chapter 3) in the Jhikhu Khola watershed from 1999 to 2001 with the aim of reducing women's workload by reducing the amount of time they spent collecting water and irrigating the crops. The results were very encouraging and a survey was conducted to assess the impact of drip irrigation on people's livelihoods and on women's workloads. Drip technology saved 50% of the labour required by conventional bucket irrigation.

After implementing drip irrigation, 43% of women found that their workload had decreased, 29% found no change, and 15% didn't know. Around 14% experienced an increase of workload because they had started growing vegetables during the fallow period when they had not done so previously. Men also saved time because of drip technology, and 26% of women mentioned their husbands now helped them to do some household work; 40% of women perceived their self-esteem was enhanced because of drip irrigation as they could grow cash crops on their own.

Lessons Learned and Recommendations

Maintaining and improving soil fertility

On-farm composting

- Covering traditional compost with black plastic and use of EM enhanced the compost formation process and produced well-cooked compost within 45-50 days rather than 4-6 months with the traditional method.
- The moisture requirement for EM is quite significant. This could be a constraint especially when there is water scarcity.

Soil acidification and lime

- In the Jhikhu Khola watershed, soil acidification is associated with acid causing fertilisers (urea and ammonium sulphate).
- Low soil pH (<5) slows the rate of organic decomposition, makes phosphorous unavailable, and leads to aluminium toxicity.
- The benefits of improved carbon and calcium values are outweighed by the decrease of pH when manure made from pine litter is added.

Leachate

- Leaching volume is significantly higher than runoff in rainfed agricultural land, whereas in degraded land it is slightly lower than runoff.
- Nitrate was most leached from the soil, followed by potassium and then phosphate.
- The average leachate of nitrate, phosphate, and potassium is equivalent to the loss of 683 kg/ha of urea, 17 kg/ha of DAP, and 846 kg/ha of murate of potash in rainfed agricultural land, and 70 kg/ha of urea, 2 kg/ha of DAP, and 174 kg/ha of murate of potash from degraded land.

Rehabilitation of degraded land

Rainfed hill terrace improvement

- Levelling terraces, water management, introducing grasses to the risers, and multiple cropping all raise production, making hill terrace improvement attractive to farmers.

Rehabilitation of degraded lands

- Eyebrow pitting is a technological option to improve soil moisture for vegetative growth in reclamation of dry degraded land.

- Planting various grasses and trees, especially leguminous species, is important for the successful reclamation of degraded land.
- Involvement of the beneficiaries, especially women, must be an integral part of managing the natural resource from the beginning.

Increasing farm income

System of Rice Intensification

- The system of Rice Intensification (SRI) increases yield with fewer farm inputs; therefore it is an option to increase farm income.
- Extensive weed growth is the foremost problem at the initial stage of the SRI, adding 50-60% more to the cost of the first weeding.
- Lack of controlled irrigation and drainage is the major constraint for successful SRI.

Approaches to building community capacity

Farmers' priorities for collegial participation

- Trust building is essential for work in rural communities.
- Entry point activities are important for building trust with a community.

Participatory action research

- People's involvement in research builds ownership, which helps in scaling up.
- Participatory action research not only eased scaling up of the technology but also helped orient people's behaviour to research in other areas, which is essential for the long-term improvement of livelihoods.

Reducing workloads

- Roof-water harvesting, fodder development, and drip irrigation are key activities for saving women's working time.