# Why Don't Farmers Adopt Recommended Technologies? The Example of Contour Hedgerow Intercropping Technology

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## Introduction

Though mountains play an important role in providing ecological and environmental services to, and in safeguarding livelihoods for, more than half the world's population, these areas have been faced with numerous development constraints. In order to improve livelihoods and conserve the environment, a large number of improved technologies have been developed for and promoted in the mountains. However, the farmers' adoption/adaptation rate of these improved technologies has often been unsatisfactory. Since farmers are the key players both in agriculture and environmental conservation in mountains, it will be useful to analyse the factors influencing farmers' adoption of improved technologies. This paper will provide a case of testing, demonstration, research, and extension of contour hedgerow intercropping technology (also known as sloping agricultural land technology or SALT) in the Hindu Kush-Himalayan (HKH) region. It is hoped that the findings from this study will be useful for promoting the technology's extension in the HKH region and other regions.

## A Brief Assessment of Contour Hedgerow Intercropping Technology

Contour hedgerow intercropping is a simple technology that involves growing hedgerows of densely planted nitrogen-fixing plants across slopes at a distance of 4-6m depending on the slope gradient. The alley areas between the hedgerows are used for cultivation of food and or cash crops. The very thickly planted hedgerows are the key element of this system. They act as barriers to soil erosion and are periodically pruned to provide materials to improve soil fertility, to avoid shading on companion crops, and to reduce competition with companion crops. Many studies have demonstrated the effectiveness of contour hedgerow intercropping technology in reducing soil erosion to a very low level, effectively improving soil fertility, and enhancing land productivity. In addition, properly managed hedgerows can also provide fodder and firewood.

## Soil Conservation

Research carried out in the tropics (e.g., Kiepe 1995; Palmer 1995) and ICIMOD-coordinated research in the HKH region has indicated that thickly planted hedgerows can help reduce surface runoff by up to 30% and soil loss by up to 99% of traditional up and down farming (Sun Hui et al. 2001). Among the benefits of this technology, effective control of soil erosion has been confirmed by all the studies carried out so far.

## Soil Fertility

Research in the HKH region shows that appropriately established and managed hedgerows help improve soil fertility through reducing nutrient loss and application of hedgerow prunings as green manure or mulch. Research on a very poor soil indicated that the content

of total nitrogen and organic matter increased by 85-292% and 87-132%, respectively (Sun Hui et al., this volume). However, the magnitude of the effect depends on the amount of biomass produced by the hedgerows and the initial soil fertility. ICIMOD's project on Appropriate Technologies for Soil Conserving Farming Systems (ATSCFS) in the HKH region has indicated a positive effect in most cases (refer to Khisa; Sun Hui et al.; Sundriyal, this volume) but less effect on soil fertility in Godawari where a very fertile forest soil was used for the study (Tang Ya, in press).

## Crop Yield

The effect of hedgerow technology on crop yield has been the most controversial. Roughly half of the papers reported positive effects, and half negative effects. The ATSCFS project revealed that application of this technology could enhance crop yield by 10-70% or at least maintain similar crop yield to that of controls (Sun Hui et al.; Sundriyal; Maskey this volume).

## Farm Income

Due to diversified cropping systems, improved soil fertility, reduced soil erosion, and decreased inputs, farm income under contour hedgerow technology is increased (Sundriyal, this volume; Yuan Yongliang et al. 2001).

## Factors Influencing Adoption of Improved Technologies

It is clear that contour hedgerow intercropping is a good technology. But in many places the adoption by local farmers has been unsatisfactory. Based on the author's own observations and experiences in the HKH region, many factors influence farmers' adoption, but the following may be among the main ones.

## Technology Demonstration

For a technology to be adopted or accepted by farmers, adequate demonstration of its advantages and disadvantages are equally important. Farmers must learn the risks they are likely to face in applying a technology. However, project staff often try to communicate only the advantages of the technology and neglect to share any negative aspects or disadvantages. Generally speaking, a technology will have both positive and negative effects. Certainly positive effects should be promoted and maximised, and negative effects minimised, but the latter should not be neglected or hidden.

Often the benefits of a specific technology are not fully or adequately demonstrated due to lack of committed project staff. In the case of contour hedgerow technology, it has been shown to be very effective in reducing soil erosion, improving land productivity, and increasing cropping options. It has been developed to solve problems associated with small farmers depending on sloping croplands. In order to correctly use this technology, the following basic principles must be followed.

- It should be applied in sloping croplands.
- Hedgerows must be planted very thickly.
- Alleyways between hedgerows should be of appropriate width to provide sufficient land space for planting crops and for hedgerows to produce sufficient biomass to improve soil fertility.

- Alleyways should be fully and appropriately used.
- Hedgerows should consist of perennial woody nitrogen-fixing plants, and they must be pruned in a timely fashion. The later is very important because pruning can prevent shading of hedgerows on companion crops and also provide materials for improving soil fertility. In addition, timely pruning of hedgerows also reduces their root competition with associated food crops.

These principles look simple. Experiences in the HKH region have revealed that where these principles are followed the adoption by local people has been successful, and that where these principles are not followed the farmers' adoption has been extremely poor. At some project sites few of the benefits have been adequately demonstrated, and in some cases no correct principles of the technology have been demonstrated, possibly because the project staff was either uninterested or not committed. As a result, the following problems have been observed in the demonstration of this technology.

- Sites were selected on flat land or land with very gentle slopes where water-induced soil erosion was not a serious problem and there were better options for improving soil fertility.
- Hedgerows could not act as erosion barriers because the distance between plants in hedgerows was near to or more than 20-30 cm. Little soil conservation can be expected under such conditions. If the project staff do not seem to understand the principles of the technology despite their training, farmers may wonder what we 'scientists' are doing!
- Hedgerows were not pruned in time or even at all. Therefore they grew very tall, which had a severe adverse shading effect on companion crops, and could not demonstrate the use of prunings to improve soil fertility. Unpruned hedgerows might also increase the competition between hedgerows and crops for light, soil moisture, and nutrients, pruned hedgerows can recycle nutrients, and reduce evapo-transpiration and shading.
- Hedgerows were established with very narrow alleyways that could not be used to cultivate crops.
- Only hedgerows were established and no crops were planted in the alleys. If alleys are not used, there is no need of hedgerows because fallow and regenerated vegetation may do better than hedgerows for soil conservation in such conditions. Farmers may think that these 'scientists' are merely playing games.
- Hedgerows consisted of plants of 2-3 years' lifespan. As a result, they had to be replanted every 2-3 years, which greatly increases the cost.

## Project Staff

Committed staff is the key factor for the success of a project. However, because most of the project staff in the partner institutions are salary earners and do not depend on land, it seems they are not much concerned about the success or failure of a project. Project team members often do not care what impact the implementation of a project will have on local people and are more interested in the outside world other than in their targeted local farmers. This partly explains why the above-mentioned problems have emerged.

Staff's feelings of equality with farmers also influences farmers' perception of technologies. Unfortunately most project staff often cannot treat our farmer partners as real partners

and treat them equally. Farmers are the sole judges of a farm-based technology. Though participatory approaches have been advocated and promoted quite extensively by different organisations in the HKH region, there are still only a few project staff who treat local farmers (local cooperators) equally. Mentally the project staff regard themselves as 'higher' or 'more advantaged' than the local co-operators they are educating, teaching, or guiding in what to do and how to do it. Farmers in such cases will be very reluctant to tell a project staff member their real ideas. As a result, project staff usually cannot understand what the local people really think of the technology that the project is promoting. There is a long way to go before we really treat our farmer partners equally and treat them as real cooperators rather than only labour.

## Technology

For a technology to be adopted by farmers it must have certain characteristics, and improvement in cash income is foremost among them. For many farmers, whether or not there is an increase in income, especially cash income, is a key factor in deciding whether to adopt a technology. The extension of the plastic film technology in China, Nepal, and other countries in the HKH region strongly supports this point. It is accepted quickly by many mountain farmers because of the obvious differences with and without the use of plastic films as mulch.

Contour hedgerow intercropping technology, on the other hand, lacks direct and visible cash benefits even though reduced soil erosion and improved soil fertility have economic value. In such case, efforts are needed to work with farmers to foresee the problems of continued soil erosion and the benefits of soil conservation, and to understand that changes in soil conservation and land productivity take a long time. Lack of direct and visible cash benefits is the major weakness. But this is also where research institutions can play a role in modifying the technology to suit local physical and socioeconomic conditions. Where modifications have been made to produce direct and visible cash benefits, the technology has been extended to farmers' fields on a large scale. Planting mulberry trees as economic trees within hedgerows, a joint innovation of the Chengdu Institute of Biology and local government, has become the key contributing factor for the wide extension of this technology in Ningnan County of China (Zhang Yanzhou et al. 2001).

Analysis of farmers' adoption of improved technology revealed an interesting phenomenon: that the technologies which have environmental significance (such as contour hedgerow intercropping technology) usually do not help improve income generation and those which can promote income generation (such as plastic film technology, chemical fertilisers, and pesticides) usually have negative impacts on the environment. Government has a crucial role to play In the extension of environment-friendly technology .

## Government Support

Governmental support is very important to encourage farmers to adopt improved technologies, especially those that are more environmentally sound but lack direct and visible benefits. For instance, in the past two decades, almost all the terraces in China have been constructed with financial support from government. Though the contour hedgerow intercropping

technology has shown better benefits than terracing in numerous aspects, no government support has been provided to encourage farmers to adopt this in China except for Ningnan County, where local government has a policy to promote extension of this technology. Without government support to adopt this technology, local farmers will prefer constructing bench terraces instead of establishing hedgerows, because they can get money for doing so.

## Farmers' Perceptions of Environmental Degradation, Especially Soil Erosion

Success in soil conservation depends substantially on farmers. Only if farmers take environmental degradation seriously, especially the soil erosion that is diminishing their livelihood base, will they consider applying measures to mitigate the problem. However, because environmental degradation and soil erosion are slow processes and their effect on land and people is also slow, most farmers do not see soil erosion as a serious problem. This in many cases also affects farmers' attitudes to adopting new technology. Evidence indicates that if farmers wish to maximise their incomes they will not care for soil conservation practices, and this explains why up and down farming practices are still common in the region: they are more labour saving and easier to operate.

## Future Implications

Farmers' unwillingness to adopt improved practices has been due mainly to poor economic returns, inadequate on-farm demonstration of both benefits and possible risks, and technical ineffectiveness under real conditions. Resource constraints of farmers, their small scale of production, and their exposure to high livelihood risks mean that the technologies they use must have certain key characteristics. These include improved food or cash security, rapid return on investments, minimal use of purchased inputs, and effective use of micro-niches to diversify production. Poor farmers require technologies that maximise returns, especially cash income. Unless likely economic returns are fairly attractive, farmers are unlikely to adopt any improved technologies.

Scientists and government agencies know that environmental degradation, including soil erosion, must be controlled. Farmers depend on land for their livelihood and therefore they should be more interested in the land's stability than anyone else. But it seems that those who are not directly dependent on land are more concerned about land problems. Is there something wrong? We may need to reconsider our approaches and rethink our strategies in this.

Why are farmers unwilling to implement recommended activities? Farmers do not adopt practices if they do not benefit from them. Analysis of technologies adopted easily or not by farmers indicates that in general the former will cause environmental problems sooner or later, and the latter usually promote environmental conservation. This strongly suggests that we need to invest in environmental conservation. In some cases, we may need to pay farmers not to use some technologies that have negative environmental effects. It will be important for people to understand that the returns on environmental conservation investments are not short term. This may explain why chemical fertilisers, plastic film technology, high yielding varieties, and so on have spread more widely and more quickly than any other technological innovations in the history of agriculture (Jha 2001).

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