Sustainable Upland Agriculture Development in Yunnan

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Introduction

Sustainable development of upland rice-based systems in tropical and subtropical Asia mountain area poses important challenges. Low productivity, low access to markets due to remoteness and mountainous terrain, high incidence of poverty, and environmental degradation are the typical characteristics of these systems. The traditional shifting cultivation-based land use system is no longer sustainable under the strain of rising population pressure. An important agenda of governments and development agencies of the region is to design effective strategies for protecting the rich environmental resources of uplands while adequately addressing the food insecurity and poverty of the farmers who are dependent on these uplands for their survival. Despite several initiatives to encourage the adoption of sustainable land use practices and commercialization of upland systems for raising farm incomes, the progress in most cases has been too slow to make any significant impact.

In China, the central and the provincial governments of Yunnan launched a series of reforms to address the problems of upland development during the 1990s. These reforms were based on the premise that the best strategy for addressing the problems of upland development is to promote intensification of land use so that farmers' food needs are met from a smaller area. The land and labor resources formerly tied to meet the food needs can then be released for the production of income-generating cash crops and also for environmental purposes. Guided by this strategy, the government promoted improved upland rice technologies and initiated other reforms to encourage land use intensification. Anecdotal evidence indicates that this strategy is making a positive impact on farmers' livelihoods and the environment by inducing desirable changes in land use patterns.

Banning of food production in steeply sloping land

Food production in slopes steeper than 25 degrees was banned to prevent further degradation of land. Instead these steep were meant to be "returned to forests". This initiative was often called the "farmland back to forest". Forest plantation schemes to return such farmland back to forest was subsidized through various financial incentives to farmers.

Construction of terraces

While terracing is a traditional practice of irrigated rice farmers, investment in terracing for growing upland rice received a major boost during late 80s and 90s through publicly-sponsored program. Terracing is believed to alleviate shortage of land, improve the land quality, reduce soil erosion and loss of water, and generate employment for rural labor force. It was also seen as an important means to sedentarize shifting cultivators. Having made investment in terrace construction, it is unlikely that farmers will practice the land extensive shifting cultivation. The government programs provided the required technical and financial support while farmers used their labor to construct the terraces. The financial support provided to farmers was approximately $300/ha, and this was often paid in kind in the form of food or inputs.

Improved upland technology for food production

Simultaneously with the two previous initiatives, the government promoted the application of modern

technology for upland rice production. A campaign "Two hybrids and two chemicals for upland" was launched. This involved the use of hybrid rice and hybrid corn along with the application of pesticides and fertilizers. Hybrid rice was introduced in 1982 and with 2-years of testing was widely promoted since 1986. The technical knowledge, improved seeds, chemical fertilizers and pesticides were provided to farmers at subsidized rates as a part of various poverty reduction programs. In the late 1990s, improved rice varieties developed by the Yunnan Academy of Agricultural Sciences were promoted due to high cost of hybrid rice seeds and the unsuitability of hybrid rice in higher altitudes. This work started in 1980s, and since 1995, upland rice varieties IRAT104, Yunlu 29, B6144F-MR-6, and Yunlu 52 have been released by the provincial government.

Commercialization and diversity of upland agriculture

The government also encouraged the development of commercial agriculture through programs that supported cash cropping. This initiative was implemented though both state-owned enterprises and private sector. Planting materials, inputs and technical advice to farmers were provided to farmers at subsidized rates to encourage them to grow various cash crops. The processing and marketing channels for outputs were established through the involvement of local authorities. These various initiatives encouraged cash cropping in the area.

The production system in the study area changed over time from a shifting cultivation-based subsistence system to a commercially-oriented predominantly fixed cultivation system. Although food production based on shifting cultivation is still practiced in some areas, farmers now grow food and cash crops mainly in fixed fields. Productivity of the staple crop rice (and especially of upland rice) has increased over time as farmers have adopted more intensive methods of rice production. Some of the steeply sloping land previously under the upland rice-fallow rotation is now being "returned" to forest. Food production has increased over time making the households more food secure. Also, cash cropping is extensively practiced and this has resulted in substantial increases in cash income of farmers. Some positive environmental effects have been generated through increased forestry plantation in areas previously used for food production. Thus the changes that have occurred so far seem to be positive on food security, income generation and environmental grounds. This 'win-win' transformation of agricultural production system is obviously the result of the confluence of several factors, each of which contributed to the effects of others in a synergistic manner.

The major factors that contributed to this process of transformation are the land allocation policy, restrictions on the use of forest and forest lands, promotion of terrace construction in sloping areas, active promotion of improved technology for rice and cash crops through the distribution of information and inputs, establishment of marketing arrangements for cash crops, government support for cash cropping through the provision of credit, and an active supportive role played by local government authorities at various levels.

The process of transformation of upland agriculture in Yunnan thus clearly demonstrates the value of intensification strategy.

Challenge met

What are the likely negative environmental consequences of the intensification such as that occurred in Yunnan? Obviously, the strategy relies heavily on the use of external inputs such fertilizers. Farmers in Yunnan have increased the application of both fertilizers and pesticides to raise the land and labor productivity. Increased use of chemical fertilizers can lead to contamination of water resources of upland catchments. Similarly, the increased use of pesticides can harm the flora and fauna of ecologically fragile upland areas, contaminate the environment and lead to negative impact human health.

Another important issue met is the low efficiency of agriculture compared to other business, especially via intensive management and high out input.

Consideration.

The process of transformation of upland agriculture in Yunnan thus clearly demonstrates the value of intensification strategy as opposed to the conservation strategy. A low-input extensive form of agriculture is often suggested as an effective way of conserving natural resources of uplands in the conservation strategy. This strategy is driven by the philosophy that ecological sustainability is enhanced through maintaining a low-input low-output system that is based on exploiting the complementarity among various components of agricultural production systems. Although based on sound understanding of the ecology, a problem with the

conservation strategy is that conservation of natural resources, not agricultural production, is seen as the primary objective. Under the conditions of rising population pressure and increasing demand for food production, combinations of intensive technology generated in Yunnan and conservation technology generated in Brazil might be sustainable and high efficiency.

Preliminary activities

Table 1. Cover crops tested in 2005 in Yuanmou, Kunming, and Lancang

Number	Name	Purpose	
1	Brachiaria hybrid (ruziziensis x brizantha) var. Mulato	cover crops	Grass
2	Brachiaria ruziziensis	cover crops	Grass
3	Brachiaria brizantha var. Marandu	cover crops	Grass
4	Panicum maximum var. Tanzania	cover crops	Grass
5	Panicum maximum (orig. Cameroon)	cover crops	Grass
6	Cynodon dactylon	cover crops	Grass
7	Stylosanthes guianensis var. CIAT 184	cover crops	Legumes
8	Centrosema pubescens	cover crops	Legumes
9	Centrosema pascuorum var. Cavalcade	cover crops	Legumes
10	Pueraria phaseoloïdes	cover crops	Legumes
11	Crotalaria atrorubens	cover crops	Legumes
12	Canavalia ensiformis	cover crops	Legumes
13	Sorghum var. Pool Preto	Mix grain-biomass	Photoperiodism
14	Sorghum var. Irat 203	Mix grain-biomass	
15	Millet (Pennisetum typhoïdes)	Mix grain-biomass	
16	Coïx Lacryma Jobi (cv. with white seeds)	Mix grain-biomass	
17	Cajanus cajan var. Arata dwarf	Mix grain-biomass	
18	Cajanus cajan var. intermediate	Mix grain-biomass	

In order to combine intensive technology and conservation technology, cover crops are key to transfer DMC technology to Yunnan. 18 different cover crops were introduced and tested in three sites in Yunnan in 2005 (Table 1). And three of them, *Brachiaria* hybrid (*ruziziensis* x *brizantha*) var. Mulato, *Brachiaria brizantha* var. Marandu, and *Panicum maximum* var. Tanzania performed very well in Yunnan.

Priority of DMC in Yunnan

Use of DMC for green or organic tea and fruits production
Use of DMC for sugarcane production
Use of DMC for annual crops such as upland rice, maize, millet, soybean production
Use of DMC for animal farming
Use of DMC for control of water pollution, soil and water erosion

Request and offer

At the moment, Principle & technology of DMC, seeds of cover crops, training of key

scientist are urgent needs.

Of course, we could offer intensive technology, new cultivars of rice, upland rice, maize, wheat, barley…

Possible impact in Yunnan

DMC technology introduced and tested

Capacity built, key species propagation available

Technology package for tea available and used in big area

Use of DMC to restore degeneration field and produce forage for animal available