Drivers effecting the development and sustainability of the Quesungual Slash and Mulch Agroforestry System (QSMAS) on hillsides of Honduras

Miguel Angel Ayarza[1] and Luis Alvarez Welchez[2]

[1]Regional Coordinator CIAT-Central America, Tegucigalpa, Honduras. Edificio DICTA/ Secretaria de Agricultura y Ganaderia. Segundo Piso, Modulo 224, Boulevard Miraflores. Apartado Postal No 151259. E-mal: ciathill@cablecolor.hn
[2]Project Officer, FAO, Project Lempira Sur, Honduras. Avenida Juan Lindo. Sendero Guyana. Casa 2450. Apartado Postal 1808, Tegucigalpa, HONDURAS. E-mail: fao-empira@cablecolor.hn

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Summary

The Quesungual Slash and Mulch Agro-forestry System (QSMAS) is considered to be a Bright spot of improved land and water management for sub-humid hillside agroecosystems affected by severe seasonal drought periods. This system has contributed to improve livelihoods of more than 6,000 farmer households in the Lempira Department, Honduras. It is based on an improved indegenous technology that manages dispersed native trees in cropping fields through periodic pruning. Competition between plant communities is kept low while provision of plant residues for soil cover and nutrient cycling is maintained favoring soil moisture conservation and fertility maintenance. Annual crops and pastures are planted on no-burned fields with zero tillage/direct planting operations. This system has enabled farmers to increase crop yields and reduce labor inputs associated with weed control. Besides gains in crop improvement, the widespread adoption of the system is associated with strong community participation in the development and promotion of the system; the implementation of local policies to avoid use of fire for agricultural purposes; and incentives to promote the overall welfare of the community. In addition a key element in the success of QSMAS has been diversification of farming systems once household food security has been achieved. This has enable farmers to produce crop and animal products for local markets thereby generating enhanced incomes.

There are a number of positive elements associated with the adoption of this improved land management system including; the acknowledgement by poor farmers of the importance in careful management of natural resources to effect improved food security and wellbeing; a long-term commitment is required by all parties for this Bright spot to develop; access to credit can also be used as a tool in promoting improved land and water management; local support systems are important to drive intensification and diversification processes; and a continuous process of facilitation and capacity building is required for the successful scaling up and out of NRM strategies. It has become evident that reduced labor availability may become factor influencing the intensification and diversification processes. Family labor is decreasing due to the greater number of children attending school and the continuous out migration of young people to the main cities in Honduras and USA. It is plausible that the QSMAS can be transferred to other regions of the world facing similar land and water resource issues and that this should be encouraged.

Introduction

Hillsides constitute an important agro-ecosystem in Central America. Over three quarters of its total surface is dominated by slopes greater than 8%. This influences land management in and around sloping lands by affecting the flow of water, movement of soil, solar radiation and other factors (Scherr, 2000). In Honduras, hillsides comprise over 80% of the territory and it is within this area that 75% of annual crops (maize and beans) and 67% of perennial crops (mainly coffee) are produced.

It is estimated that approximately 4 million people or 60% of the total population in Honduras live on hillsides or in cities nested in hillsides. In these areas endemic poverty is common amongst communities and it is estimated that 93% of the rural population lives on less than one dollar/day (Jensen *et al*, 2003). Besides causing significant suffering, rural poverty is closely associated with natural resource degradation. Stagnation of agricultural productivity over the past

10 years and rapid population increases have resulted in uncontrolled expansion of agriculture into primary forest areas on hillsides causing high rates of deforestation and soil and water losses by erosion and runoff. Extensive cattle ranching within forested areas has further exasibated the situation through increased soil compation and accelerated soil degradation. Added to this, the continuous use of fire and inherent suceptibility of the region to extreme weather events (drought spells, floodings and hurricanes) further contributes to the fagility of the region. Reversing land degradation and slowing agricultural expansion is an urgent research and development (R&D) priority in Honduras. Increasing food production and accesibility is a logical strategy to improve both rural livelihoods and natural resource management.

The Quesungual Slash and Mulch Agroforestry System (QSMAS) has been the basis of a successful development strategy promoted by FAO-Lempira Project that has focused on improving rural livelihoods in the Lempira Department, formerly the poorest region in Honduras. This alternative to the traditional slash and burn agriculture strongly builds on local knowledge and has been a critical option in achieving food security by resource poor farmers in the region. Contrary to other agroforestry systems tested in sub-humid tropics with long dry seasons, where crops and trees coexist under intense competition for water, farmers recognize that a remarkable feature of the QSMAS is the increased availability and enhanced water holding capacity of soils. Increased duration of soil water availability has been associated with a drastic reduction in crop losses under this system.

Although the QMAS has considerable potential to be adopted by resource-poor farmers in similar hillside areas of Latin America, Africa and Asia, an improved understanding of the socio-economic and biophysical forces that were responsible for its adoption and successful performance in the sub-humid areas is important if promotion of this system is to occur. The present paper constitutes an attempt to identify those forces and to extract lessons learnt from its development and widespread adoption. Some challenges for its sustainability are also identified.

Methodology

The methodological approach used in this study comprised several steps. The first step consisted of reviewing and synthesizing existing information collected by the FAO-Lempira project during the last ten years. This information was predominantly in the form of PhD thesis, draft publications, internal reports, project documents and technical bulletins. Most of this information is would be classified as falling into the grey literature.

Secondly, the aforementioned information was validated with 15 key informants. Six staff of the FAO-Lempira project, four community leaders and five farmers that adopted the QSMAS were interviewed for their comments on the information collected. Discussion of the information was centered on the validity of the set of drivers proposed for the Bright spots project.

Results

Socieconomic and biophysical characterization of the Lempira Region

The southern part of the Department of Lempira is considered one of the poorest regions of Honduras (Figure 1). It has an area of 2,177 km^2 and a total population of 110,000 inhabitants. Topographically it is dominated by steep hills. Seventy five percent of producers in the region plant maize and beans as subsistence crops; 10% grow coffee and 5% extensively graze livestock. Crop and livestock production is critically affected by severe seasonal dry spells and the predominant use of slash and burn agriculture. The removal of soil cover by burning increases water evaporation, weed competition and soil losses. This leads to the continuous loss of the soil

productive capacity with impacts on water quality for downstream users.

Soils are shallow Entisols that are acid (pH<5.1) with generally low amounts of soil organic matter and available phosphorus. Annual precipitation is approximately 1400 mm (target region of <900 m.a.s.l.) and the rainy season extends from early May to the end of October with a distinct dry season that last up to 6 months. The extent of water deficit in the middle of the dry season is over 200 mm. The average annual temperature varies from 17 to 25°C. During the dry season from early November to April, strong winds blow from the North and the enhanced evapotranspiration rates causes severe water deficits until the onset of rains.

The upper part of the Lempira region is an important component of the Lempa watershed. This watershed provides more than 60% of the water consumed in El Salvador and 57% of the hydro-power required by this country. However, the region as a whole is isolated from the rest of Honduras due to poor infrastructure and limited support from the Central government.

Physical and social infrastructure for the region is poorly, as reflected by the low Human Development Index within the country (FAO, 1999). Land resources development is strongly concentrated around small farms (80 percent with less than 5 hectares) with landless farmers renting land through lease or sharecropping arrangements. Major production systems are based on subsistence crops (maize, millet and beans) with very low yields (600-800 kg/ha maize and 300 kg/ha beans) combined with some livestock at low stocking rates. Small-scale animal husbandry (chicken, pigs), roots and tuber crops, horticulture and fruits tress are important components of household backyard gardens.

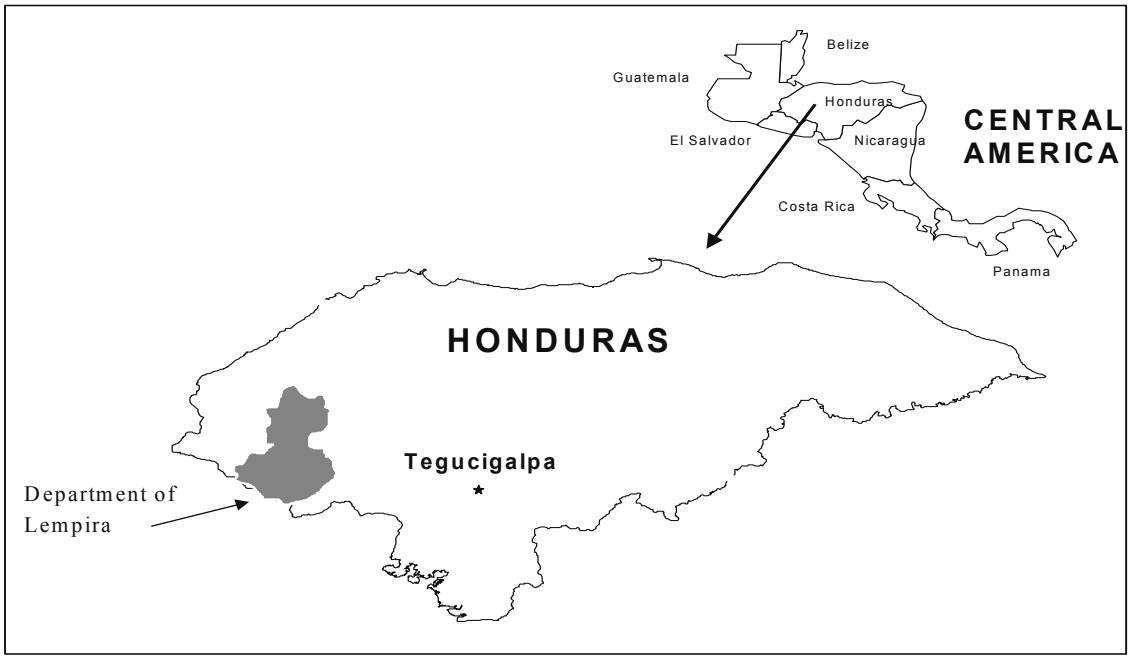

Figure 1. Location of the Department of Lempira within Honduras, Central America.

Local markets are limited and demonstrate low integration with the rest of Honduras. Basic grain production is partly oriented towards self-consumption and local delivery. Cross-border trade with El Salvador is rapidly increasing due to the higher purchasing power available in the neighboring country.

The local labor market is equally limited, but informal labor exchange is a known practice and seasonal migration takes between the Northern coffee producing areas. Remittances from relatives living in the U.S are an important additional source of income for families in the region. In general, labor scarcity is acknowledged as a primary limitation for intensification of land use.

Evolution from the traditional Slash and Burn system to the QSMAS in the Lempira region
Production systems in the Lempira region have evolved through several stages. During the 70´s small households with limited resources and less secure holdings practiced the slash and burn system with fallow periods of 10-15 years. Maize and millet were planted on burnt fields. Crop yields were variable depending on the quality of the land, time after fallow and climate, but in general were low and not sufficient to meet household consumption needs. Increasing weed competition, lower yields and increasing population pressures forced farmers to either search for alternative management practices requiring less labor, or to look for other income sources (off-farm employement, migration).

During the mid 80´s the central government supported the introduction of improved varietes and the use of fertilizers and herbicides in the region. During this decade, reliance on chemical fertilizers and herbicides increased from 25% to almost 80% on the farms (Ruben and Clerx, in press). However, there was limited adoption of these production practices by small scale farmers because of their limited capacity to purchase seeds and fertilizers. Moreover, the practice of slash and burn further promoted resource degadation and the poverty spiral.

In the early 90´s the Central government, with the support of the FAO office in Honduras, started a development project in the Lempira region in order to avoid further economic collapse of the region, allevaite poverty and food insecurity and reverse land degradation problems. During the initial implementation of the project it was found that, although slash and burn practices were extensively practiced by small farmers there was a small group of farmers in a village called Quezungual who planted crops under a slash and mulch system without burning. The project concentrated efforts to improve and generalize this practice in the region.

In the improved 'Quesungual Slash and Mulch Agroforestry System' (QSMAS), dispersed native trees are favored in cropping fields and through periodic pruning, competition is kept to a minimum while the provision of plant residues for soil cover is maintained for soil moisture conservation and as a source of nutrients (Hellin *et al*., 1999; Welchez and Cherret. 2002). Annual crops (maize, sorghum, beans) and pastures are planted with fertilizers, using no burning and zero tillage/direct planting operations on a permanent soil cover. This enabled farmers to increase maize yields from an average of 300 kg/ha in 1992 to almost 540 kg/ha in 1999. Soil organic matter and soil fertility increased over time (Welchez, 1996). Purchasing power for financing of these high input demands were predominatantly derived from an informal credit system, since only a minor share of small farmers had access to formal financial services.

After the mid 90´s the project initiated a process of validation with the active participation of farmers. More than 19 service provider agencies were established in the region. Local organizations, farmer communities and small enterprises grew along with the process of supporting the adoption of improved land and water management practices associated with the QSMAS. Burning was banned by local government officials resulting in an almost 100% reduction of fire in several villages of the region. Children attending rural schools became aware of the importance of natural resource management (NRM) and were engaged in campaigns to validate the technological components of the QSMAS. Farmers practicing the system for more than four years have been able to produce enough maize and beans to meet their household needs

and to sell excess into local markets. Over the last three years more innovative farmers are intensifying and diversifying this system using vegetables and market-oriented cash crops as well as livestock.

The system has shown a high degree of resilience to extreme weather events such as the El Niño drought of 1997 and Hurricane Mitch in 1998. This has been attributed to the permanent cover that protects the soil from raindrop impact and crust formation, while minimizing surface evaporation. In addition, surface residues favor nutrient recycling, improve soil fertility and could result in higher carbon storage in soils.

Main components of the strategy to scale up the QSMAS system

The QSMAS, as it emerged, is a value-driven, community-based learning process in which local people and extension service providers share ideas and learn together (Welchez, per communications). The basic strategy to promote its adoption and integration within the whole development process consisted of three main components: 1) collective action; 2) technological innovations and; 3) policies and negotiations (Figure 2).

The collective action strategy promoted by the project strengthened the capacity of household heads (men and women), local groups, educational institutions and development organizations to organize among themselves, identify leaders and negotiate their interests with government representatives, service providers and policy makers. Several Local Development Organizations (CODECOS) learned to devise action plans to increase agricultural production on the basis of QSMAS. Male and female members of the community organized themselves into water committees, small cooperatives and artisan associations. School children started learning about the importance of natural resource management and its linkage with improved rural livelihoods. Entrepreneurial capacity of men and women to transform and add value to agricultural products and sell them in the market was strengthened through continuous training services.

The technological innovation component has enhanced the capacity of farmers and household heads to adapt the components of the QSMAS to their production systems and to develop new and appropriated innovations according to their own land and labor constraints. They were encouraged to learn about the benefits of the systems through participatory validation methods. New ideas were blended with their own knowledge and practices in action learning mode. Innovations were not limited to agricultural management technologies but also included social, organizational and economic innovations.

The bargaining capacity of local communities to negotiate incentives and regulations supporting the adoption of the QSMAS was strengthened. Local government officials were informed of the negative effects of burning on crop production and water availability. This resulted in laws forbidding the use of fire and the creation of severe penalties for those practicing fire. Other laws were promulgated with respect to common forest lands and water reservoirs. Significant improvements in financial services and infrastructure have been negotiated with the Central government.

Impacts and Beneficiaries of the QSMAS system.
The benefits of the QSMAS on crop productivity and food security were initially demonstrated on seventy five farms supervised by the FAO-Lempira Project. Based on the yield increases and labor saving obtained by producers practicing the system, other producers from neighboring communities started testing the systems three years after the project started. Fifty-nine extension

agents and 110 leaders facilitated the scaling out process of the QSMAS. The QSMAS occupies now 46% of the whole area and it is practiced by 80% of households. Table 1 shows a summary of the main impacts and beneficiaries of QSMAS.

More than twenty innovations were developed in cooperation with farmers. These ranged from forest and water management to strategies to improve crop and livestock productivity under the basic components of QSMAS (no burning, zero tillage and residue management). This enabled small farmers to intensify and diversify their production systems. Crop yields increased by more than 100% (maize from 1200 to 2500 kg/ha, beans from 325 to 800 kg/ha) in comparison to the traditional slash and burn system. The main economic gains of the QSMAS are: 1) improved income; 2) less labor for land preparation and weed control; 3) reduced cost of production, and 4) higher net profits (Clercx and Deugd, 2002). The benefits of QSMAS gradually reached the watershed and municipal levels. This process caused a profound change in organizational culture, structure and development processes in the region.

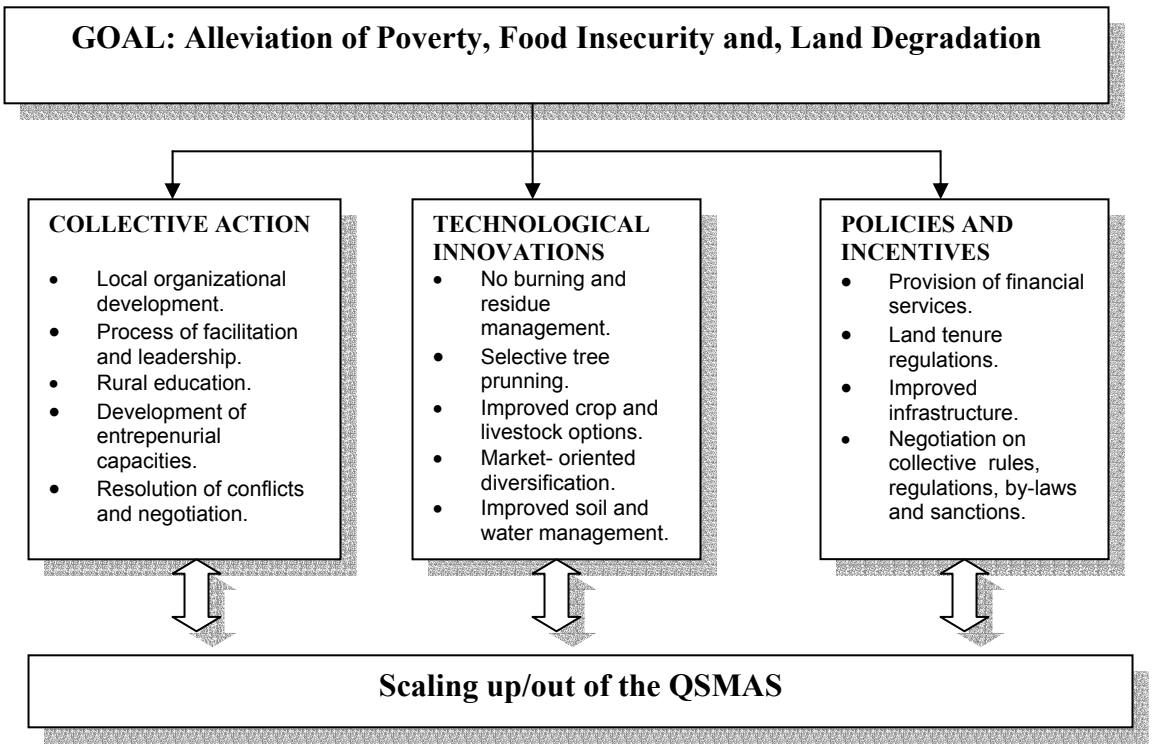

Figure 2. Main components of the strategy to develop and scale up the QSMS in the Lempira region.

Key drivers effecting the adoption of QSMAS

QMAS has been the basis of an integrated strategy to improve farmer livelihoods and rehabilitate land and water in the Lempira region. Although the development process was initially driven by short-term benefits at the farm level, its widespread adoption among thousands of farmers and numerous communities can not be explained on the basis of a single productivity approach but on

a complex interaction between enhanced productivity, social and political factors. Factors contributing to enhanced adoption of the QSMAS are discussed below.

Integration of diverse elements without losing focus

Integration of the socioeconomic and environmental factors related to poverty alleviation, food security and land degradation into a single and well focused strategy was a major challenge for the implementation of the QSMAS. However, keeping all of them together with a strategic focus on land and water resources was the key driver for the successful implementation of the QSMAS. Farmers and local institutions desired improved food supply, to have better access to clean water, health, and education and to have higher income opportunities. However, early in the process they realized that in order to improve their livelihoods, careful management of land and water resources was a prerequisite. For this reason, most development plans were based on the introduction of the QSMAS.

Table 1. Impacts and beneficiaries of the adoption of the QSMAS in the Lempira region

MANAGEMENT COMPONENTS	IMPACTS	BENEFICIARIES
Sustainable Management of Forest Resources:		
• No Burning	• 6,000 ha managed withouth burning	• 12,000 small farmers
• Integrated Pest Management	• 1,137 ha saved from the attack of ***Dentroctonus frontalis*** • Economic losses reduced by half.	• 137 families in 17 communities
• Improved utilization of forest resources	• 1,118 ha under improved management • Local communities trained in the use of timber products.	• 4 communities organized to manage forest resources • 40 wood artisans producing more efficiently timber products
• Improved knowledge of forest resources	• Potential utilization of two native species documented	• Wood artisans and small timber enterprises started using these two species to build furniture.
Improved Water Quality and Availability:		
• Participatory watershed management	• Methodologies for the integrated use of water resources disseminated among upstream and downstream users	• 1,150 producers benefited with irrigation projects on 43 ha
• Improve water storage capacity in the soil	• Water holding capacity increased from 8 to 29%	• Small farmers practicing the QSMAS
Increased soil fertility and agricultural productivity:		
• Increase soil cover at the farm and landscape level.	• Averaged soil cover biomass increased by 7 ton/ha. • Length of the drought stress period reduced by 38 days	• Small farmers adopting QSMAS
• Soil, water and nutrient losses reduced	• Soil losses reduced from 300 to 16 ton/ha. • US$ 360/ha saved by reduced nutrient losses by	• Upstream farmers and downstream water users.

	erosion and runoff	
• Improve soil organic matter	• SOM increased from 1% to 3 %.	• Small farmers after using QSMAS for more than four years.
• Increased crop production	• Maize yields increased from 1.2 to 2.4 ton/ha. • Bean yields increased from 300 to 800 kg/ha. • Seven soil management technologies adopted.	• 6,000 farmers located in different positions in the landscape
• Agricultural outputs diversified	• 11 new crops adopted	• Small farmers
• Dissemination of improved soil and water management technologies	• 7 Farmer schools • Reduced crop losses due to drought	• 400 community leaders trained to help farmers
• Improved livestock production	• 5 new grass species validated and disseminated. • 2 new feeding options for the dry season. • Increased milk production during the dry season • Calf mortality during the dry season reduced by 40% because improved feeding options	• Small livestock producers. • Small milk processing enterprises established in three municipalities. • 10 women groups participating actively in the production of cheese
Local capacity to revert land degradation strengthened:		
• Local governments able to identify their own priorities and develop alternative solutions	• 27 Development Committees established.	• 27 municipalities develop action plans and prepare proposals to support execution.
• Increased economical value to improved land use systems	• A system to assign economic value to different land use systems developed	• Two municipalities using QSMAS receive higher land price (La Campa and Tomalá)
• Individual capacity to drive the change	• Improved assistance to farmers to validate QSMAS	• 670 communal leaders formed (43% women)
• Improved financial availability	• 105 communal Banks. • 3 Cooperatives • 3 small milk-processing enterprises	• 962 members benefited (55% male and 45% women).
• Entrepreneurial capacity	• Several financial system developed	• 185 direct jobs and 254 indirect
• Improve capacity to develop projects	• 648 development projects	• 20 municipalities
Education oriented to test and introduce innovations in NRM:		
• Teachers with better knowledge about NRM	• 5 Communal technical institutes	
• Rural education including innovations to improve land and water use	• 4 Communal Technical Institutes incorporate NRM principles in their curricula	• 867 students learn and apply new knowledge in 2001
• New education materials available	• 4 manuals	• Available for the students in all five ICT

Source of information: Cherret and Welchez, 2002 a, b, c and d and FAO-Lempira 2002.

Increased production and reduced labor

Improved agricultural practices associated with the QSMAS resulted on the one hand, in enhaced productivity and resource quality and on the other, reduced risks that contributed to improved economic viability and social acceptance of the system. Increased crop productivity allowed farmers to reduce the area devoted to traditional crops and allowed the introduction of new crop options with market potential. Forty four percent of the producers assisted by the FAO-Lempira project are currently trying new crop options on 10% of their farm area. Some are using irrigation, improved grain storage facilities and improved varieties. They are also purchasing cattle and accesing formal and informal credit markets. Due to improvements in soil fertility and water availability under the QSMAS, crop production can be doubled allowing further intensification of the system. In addition, the system results in a 27% reduction in labor requirements and 18% reduction in land preparation and weed control (Clercx and Deug, 2002).

Integration of local and technical knowledge

A major factor that promoted the rapid adoption of the QSMAS was the familiarity of producers with the main components of the system. As mentioned previously, the QSMAS was developed on the basis of an existing indigenous system found in the region. Further improvement of the system was achieved including farmer perceptions (labor, local demands, etc). Local knowledge of people who have been interacting with their environment for an extended period can offer many insights into sustainable soil and water management (Barrios and Trejo, 2003).

Most farmers participating in the validation of the system were able to recognize improved soil quality under the QSMAS: increased productivity, darker soil color, loose soil structure and improved moisture retention. This capacity to understand soil improvement was a key factor for improved communication among farmers and enhanced adoption of the system.

Effective participation

Participatory design and management of the intervention process was a major driver for integrating research and development process in the QSMAS. Events and problems in the implementation of management systems were dealt with as they occurred within farmers´ specific conditions, rather than being anticipated. As a result, the technological focus and interest of participating farmers and communities broadened over time to include other issues such as water supply, strengthening the participation of local organizations, health and education. Matching technology providers with the farmers´ own goals, was the guiding principle in the development and adoption of the QSMAS. The strategic orientation of the project was complemented with an effective operational framework.

Scaling up of the QSMAS was possible through the effective participation of extension agents of the FAO-Lempira Project and farmer groups. The process was built on the adaptive capacity of people to use and adapt the QSMAS to their own conditions and on the use of participatory validation models. The usefulness of this approach was confirmed by the rapid adoption of the QSMAS and the enhanced social organization around Improved Natural Resource Management (INRM) issues: improved soil management, efficient use of water and forest resources and elimination of burning. Scaling up from individual farms, to communities and municipalities was effected through social and political dimensions. Local development committees and community leaders strongly supported replication of the QSMS. Students formed rural schools that were

integrated into the whole innovation process by exposing them to the different technological alternatives and making them aware of the importance of INRM.

The scaling-out process was facilitated through farmer learning tours and exchange visits across farms, communities and municipalities and between farmers and other sources of innovation. The learning process was backed up by the production of reference materials based on farmer's own experiences with technologies.

Enhanced competence of farmers and communities

Farmer's capacity to innovate and solve problems improved over time. Due to this there was an increasing spirit of experimentation with soil and water management options and other NRM technologies, continually improving their effectiveness and management. More than 100 leaders were appointed by their own communities to learn the main principles of the QSMAS and assist farmers in the implementation of the system.

In some communities, social capital became strong enough to deal with NRM issues confidently by themselves. Rules and by-laws to forbid fire and manage common resources were set up. Articulation of women in general increased to the extent that they competed for income with males. All these changes demanded a continuous process of facilitation and capacity building to engage in innovative approaches and entrepreneurial activities. Continuous support from the service providers was fundamental to scaling up the QSMAS. They raised awareness of communities to innovate and familiarized them with options to improve land and water management.

Integration to markets

The development path followed by farmers practicing the QSMAS showed that market orientation was an important consideration after they produced sufficient food for household consumption and the establishment of linkages to outside markets. Increased maize and bean production permitted QSMAS farmers to produce a crop surplus and to introduce new crops into the system such as vegetables.

The construction of a bridge between the Lempira region and El Salvador during the 90´s was a key event that accelerated the integration of small farmers to markets and cross-border trade. Although the coffee and livestock markets were substantially better developed, small farmers practicing the QSMAS benefited by selling their maize and beans surpluses at elevated prices. Opening of the region to new markets has been the key driver for increased crop diversification observed during the latter years in the QSMAS. It has also been the cornerstone for the emergence of a new agribusiness culture among rural communities in Lempira. Farmers are learning to solve their processing problems and to administer land and water resources especially for irrigation purposes.

Rural financing

According to the study conducted by Ruben and Clercx (in press) "Provision of rural credit and savings services created the conditions for adopting the *Quezungual* agroforestry system¨, access to rural finance enabled farmers to purchase better seeds, fertilizers and herbicides to improve crop production and invest in irrigation systems for subsequent diversification of their production systems. In the same study it was found that communal banks were another important financial mechanism supporting the implementation of the QSMAS. Their role was not limited to credit

provision but also as an agency for collective action and enforcement of community control. Credit was restricted to farmers that did not burn their land. Membership of the communal banks thus developed a new moral order that facilitated the subsequent adjustment of their farming systems and livelihoods.

Supportive policies

Sustainable management of natural resources requires policies and incentives for its adoption (Penning de Vries *et al*, 2002). QSMAS emerged in an environment where specific policies to reverse land and water degradation and improve food security were absent. However, during the process of implementation of the QSMAS, awareness by local communities to problems associated with fire, deforestation and extensive grazing grew over time. As a result of this, municipal development committees and community-driven associations develop over time and enforcement mechanisms to eliminate fire from agricultural practices. Consciousness about theses problems has reached equally upstream and downstream users.

Land ownership is positively associated with the use of conservation practices (Jensen *et al*, 2003). In the case of QSMAS small farmers owing their own land initially adopted the system. However, the practice has been extended over time to rented lands. Farmers growing crops on rented lands are now obliged to maintain the forest and permanent cover without burning. Interestingly enough the value of land under QSMAS is higher than that under conventional management systems.

The capacity of local communities and municipalities to protect, regulate and negotiate the use of their own land and water resources has been lately supported by the decentralization of power and decision making promoted by central government. This is producing a positive impact on the scaling up of the QSMAS.

Conclusions

The Quesungual system has been the basis of an integrated development strategy to improve farmers livelihoods and rehabilitate land and water resources in Lempira. Its widespread adoption by more than 6,000 farmers has been driven by concrete impacts at the household and community levels. The strenghtened capacity of individual farmers, rural communities and local goverments to manage efficiently their land and water resources has been the key for this adoption. Women are now participating actively on the process.

The QSMAS not only meets household subsistence needs for grains, construction timber and firewood but generates surpluses, which when sold into markets generates income. There is clear evidence to suggest that once household food security is achieved through the production of maize and beans, farmers are able to consider diversifying into alternative crops that satisfy demands with within local markets. In addition, diversification into livestock rearing (pigs and chickens) for home consumption has been observed thereby varying dietary intake.

There are a number of general lessons that can be drawn from this successful ‘Bright’ spot:

1. Natural resource management can be used as an entry point for improving livelihoods of poor farmers in hillside ecosystems. Without careful management of soil, water and vegetation resources in this region it would have been impossible to attain crop improvements and enhanced food security and welfare of rural community.

2. There is a need to take a holistic approach to land degradation where biophysical aspects are placed within the social, economic and policy contexts that often are the key drivers of degradation processes.

3. It is important to understand local perceptions associated with major constraints before advancing with alternative solutions. Ensuring local stakeholder participation in the whole process is essential for system adoptability and sustainability.

4. Institutional and team continuity and long-term commitment are critical because solutions to land degradation are invariably long-term. In the respect the development effective municipal organizations and community associations that have a strong sense of autonomy and are prepared to take a long-term position in effecting changes is important.

5. Some general principles of the QSMAS that are transferable include no burning and no-till management for steep environments that promote soil cover. Presence of trees and slash and mulch management is likely to influence soil organisms and processes in ways that may reduce needs for agrochemical inputs.

6. Rural financial services can contribute not only to the early adoption of soil and water conservation practices by small farmers but also to the diversification process of the QSMAS. Access to credit can also be used as a tool to promote improved land and water use.

7. A continuous process of facilitation and capacity building is required for the successful scaling up and out of NRM strategies. This is becoming more important in the process of diversification and integration to markets.

8. Local support systems are important to drive intensification and diversification processes. The formation of small seed production systems, and processing food and milk factories were important to support crop and livestock gains that occurred.

9. Successful rehabilitation of degraded land requires a strong capacity of local authorities and communities to develop and deliver policies supporting improved land and water technologies.

10. Although there is great potential for the QSMAS to be adopted in other regions of the world it is important to realize that any project supporting its validation has to commit time and resources within the context of a long-term framework. Changes in social capital take much more time than changes in other capitals.

Current trends and future challenges for the sustainability of the system.
The evidence reported in this document demonstrates the feasibility of the QSMAS to reverse land and water degradation and improve livelihoods of small farmers in sub-humid hillsides of Honduras. Food security and income generation has been improved through increased crop production and reduced labor costs. On the other hand, the environmental damages caused by burning and soil erosion under traditional agricultural systems have been almost eliminated. All this is enabling small farmers to intensify and diversify their production systems.

Lately, these processes are being strongly accelerated due to the increasing pressure to integrate local markets to regional and global demands. An opening to new markets brings new opportunities for farmers. However, it also poses some challenges to farmers and their production

systems. Intensification and diversification is possible to some extent under the QSMAS. The question then is up to what level the system will support these intensification and diversification without losing its resilience and its main attributes (improved water storage, recycling of nutrients, environmental services for downstream users). New production systems will probably require different soil and water management strategies. Emerging problems (most likely pest and diseases) will demand increasing use of new knowledge and inputs. Research and continuous assistance is required to assess trades-offs and identify best alternatives for farmers. Organic agriculture could be the best management option under the QSMAS.

Reduced labor availability will become another factor influencing the intensification and diversification processes. Family labor is decreasing due to the greater number of children attending school and the continuous out migration of young people to the main cities in Honduras and USA.

In spite of the significant improvement of local communities in the Lempira region to deal and negotiate appropriated allocation of land and water resources, there is a need for broader policies to ensure the benefits of improved land and water use for both upstream and downstream users. Economic returns of improved water availability for downstream users should be shared with small farmers in upper catchments.

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