A farmer in the steep lands of southern Honduras using a planting stick to sow his maize in a mulch layer of fallow vegetation. Photo: Alexandra Bot

farmers produced more or less the same quantity as the year before.

Farmers are reporting increases in maize yield of a minimum of 60%. Even more important is that yields remain stable at a higher level for longer periods. The longest period fields have been under continuous maize production is seven years. These fields, with a slope of 35% and poor soil have an average production of 2.9 t/ha. Before, on the same fields, the best yield was 1.6 t/ha while the land had to be left fallow for several years after a two-crop cycle. Besides maize and sorghum the plot is providing the farmer with firewood and poles, which give an extra value to the production. Additionally, from the first year onwards, the farmer can rent his/her terrain for livestock grazing, because of increased stover production on the field. Usually this is done for two months. Efforts are still needed to integrate livestock production better into the system.

Rural development enhanced

The Quesungual system not only meets the household subsistence needs for fruit, timber, firewood and grains, but generates a surplus, which when sold on the market generates cash income. This change is just the beginning of a process of intensifying land use and increasing land and labour returns. Once the farmer feels comfortable with the enhanced food security (maize and beans), (s)he starts to diversify into crops for the local market or home consumption, soya, sugarcane, indigo, pumpkin etc., as well as small animals for the market such as pigs and chickens. Increased grain availability is accompanied by the improvement of the household post-harvest storage system. When basic grain security is assured, families begin to invest time in improving their living conditions and education, and devote time also to community organisation. Women's production cooperatives are now making dairy products. Farmer and trade organisations have also been established. The people themselves are now taking full responsibility for planning improvements in their communities.

Obstacles to adoption

This experience has generated great interest not only in Honduras but also in the region. The south of Lempira is now known as the region where farmers no longer burn - a label they are proud of. Nowadays, the Quesungual system is being adopted elsewhere in the country and is being adapted by farmers according to local conditions. The major obstacle to large-scale change from slash-and-burn to agroforestry is not the small farmer. They are well aware of the problems connected with slash-and-burn agriculture and respond rapidly to sustainable alternatives. It is the extensionists and their professional superiors who clinch to their production-based, single-crop focus and oppose a systems approach. It is their lack of training in demand-driven participatory extension and the still dominant paradigm of rural development projects with their focus on physical, supply-driven indicators. Although much is said about collaboration between local and professional knowledge systems, the practice is still in its infancy. ■

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Experiences in El Salvador

Conservation Agriculture and rural development

Marcos Vieira and Jan Van Wambeke

Besides knowledge, technologies and supplies, adoption of Conservation Agriculture (CA) needs a favourable (policy) environment, motivation and participation of farmers and their communities. The presence of leaders and/or farmers' organisations is important for knowledge sharing and capacity building. The combination of all these parameters with CA at catchment level results in sustainable rural development based on the integrated management of natural resources.

Productivity and conservation

In Guaymango (El Salvador), about 85% of the land area is used for agriculture, and consists of small hills and slopes between 40 and 90%. Half of the agricultural land is used for pastures, the other half for crop production (mainly maize and sorghum). Monoculture, overgrazing, burning of crop residues and intensive tillage rapidly led to severe land degradation, low yields, poor nutrition and increased poverty in the early 1970s. Following the spread of the Green Revolution in wheat and rice, the thinking on research and extension in El Salvador was conditioned by traditional extension methods, combined with a "package" approach. The package disseminated by the Ministry of Agriculture, primarily during the late 1960s and throughout the 1970s, consisted of the following technology, according to Sain and Barreto (1996):

- use of hybrid maize seed,
- use of nitrogen and phosphate fertilisers,
- increased plant densities, through reduced row distances,
- application of herbicides and insecticides.

During a diagnostic appraisal that was held in the area of Guaymango in 1973, three major problems were identified: high poverty levels, food insecurity and recurrent health problems in the community. Based on this appraisal, it was concluded that low productivity of the agricultural system was one of the main causes of the high poverty levels found in the area (Calderon, 1973). Furthermore, it was concluded that the low quality of the soils caused by serious degradation in the area was the main reason for the low productivity of the

agricultural systems. Based on these conclusions, an intensive programme was launched by the Ministry of Agriculture and several private and public institutions to increase maize and sorghum productivity and to improve soil conservation practices. A number of soil conservation measures were added on to the package mentioned above, based on zero tillage and improved crop residue management, and included the following components:

- no burning of crop residues,
- uniform distribution of crop residues over the field,
- use of living and dead barriers, and
- contour sowing.

The promotion of these measures was the starting point of a new phase in land management in the area, based on conservation tillage. Through this programme and later through land reform, farmers improved agricultural production, increased their net income more than 2.5 times and adopted "conservation" practices at the same time. Close collaboration between institutions and organisations participating in this programme was also an important factor, which has contributed to the successful adoption of Conservation Agriculture practices by farmers.

Integration of crop and livestock

The interaction of crop production and livestock within the agricultural production system is vitally important in understanding the adoption of conservation tillage practices by farmers. Livestock in the farming system is probably the most difficult challenge, particularly when there are other uses for crop residues than cattle feed, like mulching and soil improvement.

At the end of every crop cycle, the improved maize-sorghum system in Guaymango produces almost 10 tons of crop residue per hectare. At the end of the dry season, nearly 6-7 tons of crop residue per hectare remains for use as mulch. Compared to similar regions (2.3 tons per hectare) this is a substantially greater quantity and can be explained by three main factors:

- farmers here value the use of crop residue as soil cover more than elsewhere;
- the high economic importance of cattle in the farming system (number of cattle and duration of grazing period);
- the high degree to which a fodder market has been developed (trade of grazing rights).

The experience of Guaymango is one of the few that reports successful integration of the crop and livestock components of the farming system, without creating competition in the allocation of crop residues. The amount of residues produced by the system is enough to serve both the conservation purpose and as fodder for livestock (Choto and Saín, 1993). This is precisely why farmers do not sow hybrid varieties of sorghum in Guaymango, but local varieties that have a high straw/grain ratio (Choto et al., 1995) instead.

Farmers' perceptions

According to local farmers, the adoption of conservation tillage practices and the improved crop production technologies have induced a considerable change in their livelihoods. The most apparent differences are the increased yields - it has doubled and in good years even tripled; and the labour required for sowing has been reduced by 75%, which according to the farmers is because the soil has become softer and easier to work with. When residue burning was used to clear the fields, the soil was very hard and it took almost a day and 10 people to sow a hectare, compared to 5-6 people needed now in half a day.

The mulch effect of crop residues has additional advantages. According to the same farmers, it conserves more soil moisture, which allows them to harvest in dry years. It also prevents seeds from being washed away by rain showers, just after sowing, and facilitates rainwater infiltration. The decomposing mulch layer gives the soil a darker colour, which is usually an indicator of better soil fertility. The presence of more earthworms was mentioned as a positive change because 'their excrements are like fertilisers'. "Tilling the soil at this stage would mean destroying the existing fertility (residues and roots) and soil life", said one of the farmers.

After 25 years of managing crop residues optimally, some farmers are even applying less fertilisers to their maize fields than when burning residues was a common practice.

Pest and disease incidence has been reduced. One of the insect species, white grub ('*gallina ciega*') (*Phyllophaga* sp.), which was formerly reported as a pest in maize, is still present in the fields, but is no longer a problem. Farmers think that the larvae now feed on the roots and residues of the previous crop, instead of attacking the roots of the crops growing in the field. The mulch layer also prevents birds from feeding on recently sown seeds. The birds, which still visit the fields, are now a form of biological pest control, because they feed on caterpillars and larvae found in the crop residues or on the plants.

Full adoption after only ten years

The expectation of increased yields and the increased awareness of the value of appropriate crop residues management as a soil conservation measure are the main reasons given by farmers for not burning crop residues when preparing their fields. Although many farmers were initially sceptical about changing from burning crop residues to more conservation-oriented soil management, full adoption of the technological package was achieved in just 10 years. Both the successful agricultural extension programme and the link between practical recommendations, incentives and restrictions were key elements that induced this change in soil management. ■

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Table 4. Increase of yield and farm income with CA (in monetary units)

Covered distances (km) by man (m/f) for the cultivation of one hectare of maize, using animal traction under conservation agriculture and conventional tillage (Melo, 2000).

Operation	Conservation Agriculture	Conventional Tillage
Ploughing	–	40
Harrowing	–	15
Furrowing	–	10
Planting	5	5
Fertilisation	10	10
Knife roller	7.5	–
Weeding	–	30
Nitrogen application	10	10
Bending over of the cobs	10	10
Harvest	15	15
Total distance (km)	**57.5**	**145**