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"Eco-Papas": through potato conservation towards agroecology

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Carchi, Ecuador's northern-most province is distinct in its culture, terrain and agricultural practices and was never under Inca influence. The countryside has relatively little Quichua, or indigenous, influence. Unlike the other sierran provinces which are dominated by high snow-capped volcanoes, Carchi has well-defined western and eastern cordilleras bordering a rich agricultural central valley. Both cordilleras are topped by an extensive alpine plain, or *'paramo'*, with grasslands. On the western side this region forms one of the country's largest national natural areas, "the El Angel Ecological Reserve." On the eastern side, the inter-Andean slope boasts an extensive 40,000 hectare stretch of forest that is perhaps the best example of relatively pristine inter-Andean vegetation encountered in the northern Andes. The forest lies on steep slopes between cultivated agricultural land and the alpine *paramo*.

Small pre-Colombian populations probably used the *paramo* for trade routes and undertook limited small-scale agriculture in the flat inter-Andean valley floor. Even today, the population of Carchi is small for a sierran province and pressure to cut forest for fuelwood is relatively limited. Colonial population centres formed with large haciendas in the valley floor around the cities of San Gabriel and Tulcan. But colonisation of the valley sides, in rural towns where small-scale farms predominate, only started in the last century.

Initially, rural colonisers -mostly hacienda workers- cleared small patches of land and planted a mix of potatoes and other Andean tubers in a trade and subsistence economy, the classic *"huasipungo"* system. Transport and communication infrastructure was primitive or non-existent and industrialised agricultural techniques were unknown. As highways improved and secondary roads were built, chemical fertiliser and pesticide businesses were among the first to capitalise on the accessibility of a new market.

Loss of productivity and biodiversity

Hard statistics do not exist, but according to older farmers in the region, chemical fertilisers initially increased potato production yields dramatically, often reaching an impressive 40-60 tons/ha. With time yields dropped, apparently due to loss of resistance to insect pests and fungal diseases. This triggered the large-scale application of chemical pesticides. Today, average yields are only 21.3 tons/ha (Crissman et al 1998) despite the continued, heavy, application of chemical fertilisers and pesticides. The use of pesticides has caused severe cases of poisoning among the farm population. The effects of residuals in food products among consumers are relatively unknown but probably important (Cole et al 1995)

The chemically intensive planting system now predominant in the entire province has led to soil fertility loss. Valley floor land, once among the richest in soil quality and some of the first land to be used for the intensive monocropping of potatoes for cash, is now almost exclusively dedicated to pasture and milk cow grazing. The shallow lower valley slopes, with a 20-30 year history of chemically intensive potato production, require ever-longer fallow period between potato plantings. Even so, yields continue to decline. Highest yields and shortest fallow time are now found in steep newly cleared forestlands high on the valley slope. Thus, although pressure to cut forest for fuelwood is relatively low, farmers continue to move up the valley slope to clear land for better potato production (Frolich et al 1998; Frolich & Guevara, in press).

Carchi is the only sierran province that does not have water shortages, probably due to the presence of the large tract of inter-Andean cloud forest. In addition, the forest is an important source of organic matter. However, if forest clearing and soil damage by use of chemicals continue, the system could easily degrade to the rocky-sandy land seen further south where forest land is completely absent. It would seem then, that in the long run, chemically intensive, potato monocropping is unsustainable.

Trying to overcome the loss of productivity, Ecuadorian national agricultural services have introduced a series of genetically improved potato varieties. These now account for over 90% of total production and usually show an initial increase in production and resistance to pests and diseases, especially late blight. However, over time production declines and resistance is lost. New varieties are generally crossed with genetic stock from the old varieties, thus limiting actual diversity. Farmers still cultivate two or three landraces or *"chaucha"* varieties. These are generally planted in small quantities for home consumption or sale on the local market. Although memories remain of tens or hundreds of varieties that were cultivated only one generation ago, these landraces are no longer found in the area.

The Eco-Papas project

The "Eco-Papas" project has a broad approach: reintroducing biological and ecological farming techniques that decrease the importance of chemical inputs and moving towards a more stable and sustainable agroecosystem. Unfortunately, this is not a simple relearning or reintroducing forgotten planting systems. The reality is that the introduction of semi-industrialised agriculture has completely changed the landscape and its elements requiring a reinvention and adaptation to existing conditions.

There are three lines of action within the Eco-Papas project: soil maintenance and improvement; integrated pest and disease management and re-introduction of crop biodiversity.

The Eco-Papas project's guiding principle is the notion that healthy, living soils will provide a stable base from which other adjustments and improvements to the production system can be made and managed. Perhaps the most significant soil damage in Carchi is a virtual dying-off of soil micro- and macro-organisms after repeated potato plantings. The cause of soil "death" is uncertain but more than likely it is related to a nutrient imbalance brought on by the use, and often over-use, of cheap, chemical fertilisers and, possibly, by pesticide fumigations.

Integrated farming techniques

The Eco-Papas project is investigating this loss of soil biodiversity with test plots distinguishing between the effects of fertiliser and pesticide application. In addition, the project promotes integrated farming techniques, such as the use of green manures especially in badly damaged or "dead" soils; inter-cropping and crop rotation, especially with legumes; incorporation of organic matter and animal fertilisers; and limited tillage and cover crops. With a healthy, biologically managed soil base, it may be possible to break the extreme dependence on external, imported chemical inputs. Fertiliser and pesticide use will continue to play some role, but the ideal is a well-managed farm with strong biological fundamentals and minimum use of chemical inputs.

Together with INIAP, Eco-Papas has conducted experiments on the reduction of chemical inputs. Initial results on a one-hectare test plot indicate average yields of about 10 tons/ha, but at less than half the normal production costs, using resistant varieties, integrated pest management techniques, and good soil management. The experimental site had been fallow for six years before potatoes were planted. The use of animal manure and compost maintained soil micro-organisms and only required minimal applications of chemical fertiliser. After harvesting, the usual diversity of soil microflora and -fauna was apparent.

As with the integrated approach to soil management, the Eco-Papas project promotes the use of a range of preventive, biological technologies for treating pest and disease problems (Barrera et al 1998). Trapping techniques are used to reduce adult populations of noxious insects. In addition, the potential for endopathogenic control is being studied. Finally, intercropping and planting hedgerows with naturally anti-insecticidal species have shown positive results. Late blight is a particularly pernicious problem apparently best tackled by looking for resistant varieties.

Re-introducing biodiversity

Perhaps the most important component of the Eco-Papas project has been on-farm conservation and the re-introduction of potato biodiversity. Landraces and genetically improved local varieties may hold the key for natural pest resistance. A strong economic base, predictable over a long term, with many different products to offer is a precondition. An important corollary to the production of a more ecologically produced, healthy potato is the opening up of local market demand for such a potato. Consciousness raising, via farmer field training, schools and public awareness campaigns, is important for the adoption of a healthier potato growing system. A small local agricultural fair organised in 1999, for example, stimulated interest in growing traditional and low-chemical-input potatoes for local on local markets.

In order to re-introduce genetic diversity to the overall potato cultivation system the first step is to develop on-farm, living seed banks of genetically improved potato varieties as well as traditional landraces. This genetic diversity bank needs to be widespread, repeated, adapted to local conditions and managed by local farmers, with help from extensionists. At this moment, some 40 varieties are being cultivated and conserved on two local farms. Ongoing analysis of pest resistance in the landraces that are maintained in the "in vivo" collection is being carried out by farmers in order to assess which varieties can be used in local breeding and genetic improvement programmes.

From an initial collection of 70 cultivars and landraces collected in Ecuador and Colombia, 40 varieties have been found that produce good viable seed and a d esirable tubercle. Of these, 30 are landraces and 10 are genetically improved. Mixed production plots for these varieties employ integrated pest management and other techniques, such as selective thinning of possibly diseased plants, in order to produce high quality seed. Using the harvest from current plots, it should be possible to produce half a ton of seed for each variety within one year. So far, seed production has been entirely managed with local farmers who dedicate small plots to the production of seed in exchange for half the harvest.

Widespread interest

Perhaps the most positive early result of the Eco-Papas project has been the widespread interest and involvement of local farmers. Farmers from the local agricultural cooperative are involved in managing the test plot and in organic seed production. Together with INIAP, these initiatives are now spread to other towns and communities. Several farmers have planted their own gardens with traditional varieties, without the intervention of the project. The next step for the project is to establish local management of the potato variety bank with farmer field courses in the use of new varieties under low-chemical-input regimes. ■

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