Bt crops are likely to increase the risk of farmers who are already risk-prone. Photo: Bert Lof

Genetically engineered crops
will they feed the hungry and reduce poverty?

Peter Rossett

Small and peasant farmers are the primary producers of staple foods, accounting for very high percentages of national production in most Third World countries. This sector, which is so important for food production, is itself characterised by poverty and hunger, and in some cases lagging agricultural productivity. If these problems are to be addressed by a proposed solution – genetic engineering in this case – we must begin with a clear understanding of their causes. If the causes lie in inadequate technology, then a technological solution is a possibility. Thus let me begin by examining the conditions faced by peasant producers of staple foods in most of the third world.

Historical background

The history of the third world since the beginning of colonialism has been a history of un-sustainable development. Colonial land grabs pushed rural food producing societies off the best lands most suitable for farming. These lands were converted to production for export in the new global economy dominated by the colonial powers. Instead of producing staple foods for local populations, they became extensive cattle ranches or plantations of indigo, cocoa, copra, rubber, sugar, cotton and other highly valued products.

Farming peoples–accustomed to the continuous production of annual crops on fertile, well-drained soils with good access to water– were driven into marginal areas. As a result forests were felled and many fragile habitats were subject to un-sustainable production practices, in this case by poor, newly destitute and displaced farmers. The favoured lands were, simultaneously, being degraded by continuous export cropping at the hands of Europeans.

National liberation from colonialism did little to alleviate the environmental and social problems generated by this dynamic. Post-colonial national elite came to power with strong linkages to the global export-oriented economy, often, indeed, connected to former colonial powers. The period of national liberation, corresponded with the rise of capitalist market and production relations on a global scale, and in particular, with their penetration of third world economies and rural areas. This was the era of modernisation with its dominant ideology that bigger is better. In rural areas it meant the consolidation of farmland into large holdings that could be mechanised, and the notion that the "backward and inefficient" peasantry should abandon farming and migrate to the cities where they would provide the labour force for industrialisation. This ushered in a new era of land concentration in the hands of the wealthy, and drove the growing problem of landlessness in rural areas. The landless rapidly became the poorest of the poor, subsisting as part-time seasonal agricultural or day labourers, share croppers or migrating to the agricultural frontier to fell forests for homesteads.

Thus rural areas in the Third World are today characterised by extreme inequalities in access to land, in security of land tenure and in the quality of the land farmed. By keeping wages and living standards low, the elite guarantees that healthy domestic markets will never emerge, reinforcing export orientation. The result is a downward spiral into deeper poverty and marginalisation, even as national exports become more "competitive" in the global economy. One irony of our world, then, is that food and other farm products flow *from* areas of hunger and need *to* areas were money is concentrated, in the North.

The same dynamic drives environmental degradation. On the one hand, rural populations have historically been relocated from areas suitable for farming to those less suitable, leading to deforestation, desertification and soil erosion in fragile habitats. This process continues today, as the newly landless continuously migrate to the agricultural frontier.

The situation is no better in the more favourable lands. Here the better soils of most nations have been concentrated into large holdings used for mechanised, pesticide and chemical fertiliser-intensive, monocultural production for export. Many of our planet's best soils are today being rapidly degraded, and in some cases abandoned completely, in the short-term pursuit of export profits and competitiveness. The productive capacity of these soils

is dropping rapidly due to soil compaction, erosion, waterlogging, and fertility loss, together with growing resistance of pests to pesticides and the loss of in-soil and above-ground functional biodiversity. The growing problem of "yield decline" in these areas has recently been recognised as a looming threat to global food production by a number of international agencies.

Changes in macro economic policies

The past three decades of world history have seen a series of changes in national and global governance mechanisms. These changes have been made within a paradigm that sees international trade as the key resource for promoting economic growth in national economies, and growth as the solution to all ills. The balance of governance over national economies has shifted away from governments toward market mechanisms and global regulatory bodies like the WTO. Southern governments have progressively lost the majority of the management tools in their macro-economic policy toolboxes. The ability of Southern nations to ensure the social welfare of poor and vulnerable people, achieve social justice, guarantee human rights, and protect and sustainably manage their natural resources, have been critically weakened.

They have been forced to drastically cut government investment and to slash or eliminate subsidies of all kinds, including social services and price supports for small farmers. While such changes have in some cases created new opportunities for poor people to exploit new niche markets in the global economy (organic coffee, for example), they have for the most part undercut both government provided social safety nets and guarantees. The majority of the poor still live in rural areas, and these changes have driven many of them to new depths of crisis in sustaining their livelihoods. Increasingly they have been plunged into an environment dominated by global economic forces, where the terms of participation have been set to meet the interests of the most powerful. Small farmers find the prices of the staple foods they produce dropping below the cost of production in the face of cheap imports freed from tariffs and quotas.

Lagging productivity

Third world food producers demonstrate lagging productivity not because they lack 'miracle' seeds that contain their own insecticide or tolerate massive doses of herbicide, but because they have been displaced onto marginal, rain-fed lands, and face structures and macroeconomic policies that are increasingly unfavourable to food production by small farmers. These then, are the true causes of low productivity. In fact, in many parts of the third world, especially in Africa, *farmers today produce far less then they could with presently available know-how and technology,* because there is no incentive for them to do otherwise - there are only low prices and few buyers. No new seed, good or bad, can change that, and thus it is extremely unlikely that, in the absence of urgently needed structural changes in access to land and in agricultural and trade policies, genetic engineering could make any dent in food production by the world's poorer farmers.

When seen in this light, it should be clear that genetic engineering is only touching at best the conditions and needs of the farmers we are told it will help – it in no way addresses the principal constraints they face. But superficial is a far cry from 'bad.' Now I turn to the question of whether genetically engineered crops are simply irrelevant to the poor, or if they might actually pose a threat to them. First we must ask about the actual circumstances of peasant farming.

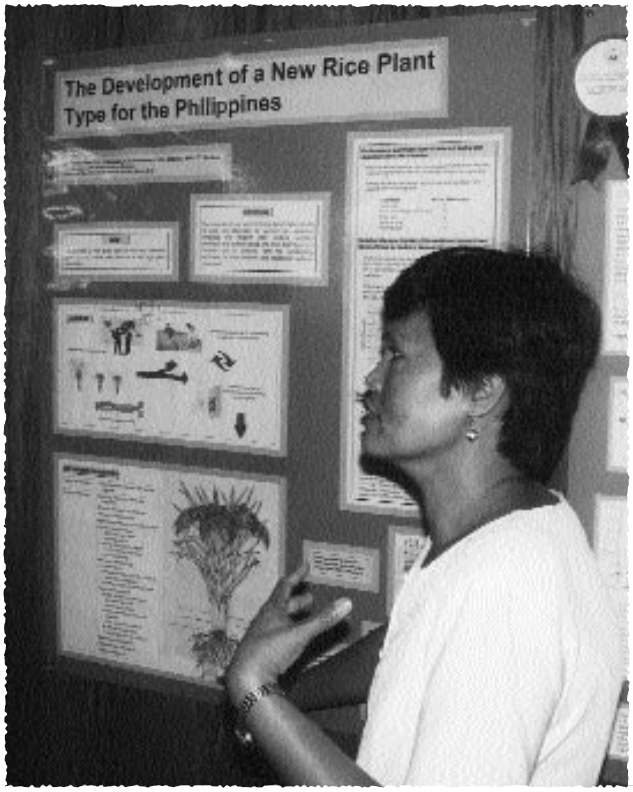
Complex, diverse and risk-prone agriculture

Peasant farmers have historically been displaced, as described above, into marginal zones characterised by broken terrain, slopes, irregular rainfall, little irrigation, and/or low soil fertility. Being poor they are victimised by pervasive anti-poor and anti-small farmer biases in national and global economic policies. As such, their agriculture is best characterised as complex, diverse and risk-prone.

In order to survive under such circumstances, and to improve their standard of living, they must be able to tailor agricultural technologies to their variable but unique circumstances, in terms of local climate, topography, soils, biodiversity, cropping systems, market insertion, resources, etc. For this reason such farmers have over millennia evolved complex farming and livelihood systems which balance risks. Typically, their cropping systems involve multiple annual and perennial crops, animals, fodder, even fish, and a variety of foraged wild products.

Repeating the error of top-down research

Such farmers have rarely benefited from 'top down' formal institutional research and 'green revolution' technologies. Any new strategy to truly address productivity and poverty concerns will have to meet their needs for multiple suitable varieties. Formal research methods are not able to handle the vast complexity of physical and socio-economic conditions in most third world agriculture. This stems from the discrepancy between hierarchical research and extension systems, which value monocultural 'yield' above all else, and complex rural realities. In reality seeds have multiple characteristics that cannot be captured by a single yield measure, and farmers have multiple site-specific requirements for their seeds, not just controlled-condition high yields. These interconnections stand in direct contrast to formal breeding procedures. Given such conditions the inescapable conclusion is that a different approach, participatory breeding by organised farmers themselves, which takes into account the multiple characteristics of both seed varieties and farmers, is essential. Miracle seeds will not just be developed in laboratories and on research stations and then effortlessly distributed to farmers. Yet genetic engineering is in direct contrast to participatory, farmer-led research.



Will the "super" rice presently being developed by IRRI meet the needs of small farmers? Photo: Bert Lof

Proponents of genetically engineered varieties are repeating the very 'top down' errors, which led first generation green revolution crop varieties to have low adoption rates among poorer farmers.

Yet it is clear that the biotech juggernaut is moving ahead a full speed. What then, are the risks associated with 'forcing' genetically engineered varieties into complex, diverse and risk-prone circumstances?

Risks for poor farmers

The most common transgenic varieties available today are those that tolerate proprietary brands of herbicides, and those than contain insecticide genes. Herbicide tolerant crops make little sense to peasant farmers who plant diverse mixtures of crop and fodder species. Chemicals would only destroy key components of their cropping systems.

Transgenic plants, which produce their own insecticides – usually using the 'Bt' gene - are rapidly failing as pests build up resistance to insecticides. Instead of the failed "one pest-one chemical" model, genetic engineering emphasises a "one pest-one gene" approach, shown over and over again in laboratory trials to fail, as pest species rapidly adapt and develop resistance to the insecticide present in the plant. Bt crops violate the basic and widely accepted principle of "integrated pest management" (IPM), which is that reliance on any single pest management technology

It is not a lack of technology that holds farmers back... photo: Bert Lof

tends to trigger shifts in pest species or the evolution of resistance through one or more mechanisms. In general, the greater the selection pressure across time and space, the quicker and more profound the pests' evolutionary response. Thus IPM approaches employ multiple pest control mechanisms, and use pesticides minimally, only in cases of last resort. An obvious reason for adopting this principle is that it reduces pest exposure to pesticides, retarding the evolution of resistance. But when the product is engineered into the plant itself, pest exposure leaps from minimal and occasional to massive and continuous exposure, dramatically accelerating resistance. Most entomologists agree that Bt will rapidly become useless, both as a feature of the new seeds and as an old standby natural insecticide sprayed when needed by farmers that want out of the pesticide treadmill.

At the same time, the use of Bt crops affects non-target organisms and ecological processes. Recent evidence shows that the Bt toxin can affect beneficial insect predators that feed on insect pests present on Bt crops, and that windblown pollen from Bt crops found on natural vegetation surrounding transgenic fields can kill non-target insects. Small farmers rely for insect pest control on the rich complex of predators and parasites associated with their mixed cropping systems.

In fact Bt retains its insecticidal properties after crop residues have been plowed into the soil, and is protected against microbial degradation by being bound to soil particles, persisting in various soils for at least 234 days. This is of serious concern for poor farmers who cannot purchase expensive chemical fertilisers, and who instead rely on local residues, organic matter and soil microorganisms (key invertebrate, fungal or bacterial species) for soil fertility, which can be negatively affected by the soil bound toxin.

When the Bt genes fail, what would poor farmers be left with? It is entirely possible that they would face the serious rebound of pest populations freed of natural control by the impact Bt had on predators and parasites, and reduced soil fertility because of the impacts of Bt crop residues plowed into the ground. These are farmers who are already risk-prone and Bt crops would most likely increase that risk.

In the Third World there will typically be more sexually compatible wild relatives of crops present, making pollen transfer to weed populations of insecticidal properties, virus resistance, and other genetically engineered traits more likely, with possible food chain and super-weed consequences. With massive releases of transgenic crops, these impacts are expected to scale up in those developing countries, which constitute centres of genetic diversity. In such biodiverse agricultural environments, the transfer of coding traits from transgenic crops to wild or weedy populations of these taxa and their close relatives is expected to be higher. Genetic exchange between crops and their wild relatives is common in traditional agroecosystems and transgenic crops are bound to frequently encounter sexually compatible plant relatives, therefore the potential for "genetic pollution" in such settings is inevitable.

In sum, these and other risks seem to outweigh the potential benefits for peasant farmers, especially when we consider the factors that currently limit their ability to improve their livelihoods, and the proven agroecological, participatory and empowering alternatives available to them

No role for GM crops

It is not a lack of technology which holds such farmers back, but rather pervasive injustices and inequities in access to resources, including land, credit, market access, etc., and other anti-poor policy biases. Two approaches make the most sense under such conditions: 1. technologies, which have pro-poor diseconomies of scale, like agroecology and 2. organisation into social movements capable of exerting sufficient political pressure to reverse policy biases. There is little useful role that genetically engineered crops can play.

The next time we hear of the latest 'magic bullet' invention altruistically developed in private sector labs for the benefit of the poor, we would do well to keep in mind the true causes of hunger, poverty and lagging agricultural productivity in the third world. ■

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