THE GREEN REVOLUTION IN ASIA: LESSONS FOR AFRICA

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INTRODUCTION

Asia, the rice barn of the world, has often been cited as a "succesful" continent in implementing the Green Revolution, particularly in rice production. Some experts and bureaucrats have said that without the Green Revolution in the 1960s and 1970s, "Asia would have suffered from famine". How true this is remains a question.

In any case, yield increases, while certainly important, do not go to the heart of the problem. The real challenge facing the developing world is achieving food security at the national and household levels. The two tables below show that it is the food security situation that needs further scrutiny.

Table 1 shows that there are about 500 million people in Asia (and the Pacific) still hungry. What is even more worrying is that most of the hungry people are in fact from farm households (400 million as in Table 2), who are supposedly the food producers. The fact that farm households are the most hungry must be a point of critical reflection about the current agriculture system.

TABLE 1

Where are the hungry?

REGION	TOTAL (MILLIONS)
India	214
Sub-Saharan Africa	198
Asia & Pacific	156
South America	56
China	135

Source: FAO (2003 from www.developmenteducation.ie)

TABLE 2

Who are the hungry?

REGION	TOTAL (MILLIONS)
Farm Households	400
Rural Landless	160
Urban Households	64
Herders, Fishers and Forest Dependents	56

Source: UN Hunger Task Force (2003 from www.developmenteducation.ie)

The Green Revolution package of high-yielding varieties (HYVs), irrigation and agrochemicals is often seen as mainly a technological intervention to boost food production. However, as experience has shown, the Green Revolution is also a socio-economic and political construct. It also has an environmental dimension as agriculture is mainly based on natural resources.

Many valuable lessons can be drawn from the Green Revolution experience in Asia. Those lessons can hopefully help Africa to make strategic policy decisions before embarking on an agricultural revolution of any kind.

In Asia, a growing number of farmers are turning back to non-chemical or less-chemical agriculture as the costs of the Green Revolution system have risen while yields have stagnated. This in itself is an issue that must be considered carefully for Africa. There is also a whole range of information and knowledge now on alternative systems of agriculture that are adapted from traditional local systems, as well as based on empirical and conventional scientific studies.

PRODUCTION INCREASE NOT SUSTAINABLE

The main achievement of the Green Revolution in Asia has been the increase in grain production. Taking the example of rice, production did increase, and many experts attributed that to HYV seeds and chemical inputs only. However, other factors were important such as subsidies for the inputs and development of new varieties, access to credit and markets, irrigation systems, government price support and infrastructure improvement (mainly roads and transport systems). What is also important is that the single rice crop system was changed to two or three monocroppings of rice, which also explained the increase in overall production. Area expansion contributed to nearly one-third of Asian rice output growth in the 1960s and one-fifth in the 1970s (Pingali and Rosegrant, 1994).

The increase in production is, however, not sustainable over a long period. As early as 1976, a report from the Asian Development Bank (ADB) noted that the

growth rate in rice yields between 1963–67 and 1971–75 was less than 1.5 percent per annum for South and Southeast Asia as a whole and below one percent for several countries. And this was for irrigated (or wet) rice fields; there was no evidence of a major breakthrough in dry land agriculture (Morgan, 1978). Another study reported that rice yield growth in Asia declined sharply in the 1980s, from an annual growth rate of 2.6 percent in the 1970s to 1.5 percent during the period beginning in 1981 (Pingali and Rosegrant, 1994). Disregarding the discrepancy in figures, the conclusion is that the increase in yields is not sustainable.

An interesting example is Indonesia. Real increase in production of up to 3.52 percent per annum was achieved only for ten years during 1979–1989. Since then, total rice production growth has declined to 1.04 percent per year with a productivity increase of only 0.05 percent per year (Swastika *et al.*, 2002, cited in Jhamtani, 2008).

Indonesia was acclaimed by the Food and Agriculture Organization of the United Nations (FAO) for attaining rice self-sufficiency in the 1980s but the country has had to import rice again since 1994. Indeed, farm-level evidence from the rice bowls of Asia indicates that intensive rice monoculture systems (as implemented through the Green Revolution) led to declining productivities of inputs over the long term (Pingali *et al.*, 1997, cited in Lim, 2009).

The decline in yields, but increase in the price of inputs, has also had an adverse impact on the economic welfare of rural communities. This has led to an urban drift and the creation of increasing numbers of urban poor. The Indonesian experience with the Green Revolution indicates that it was focused on increasing rice production rather than farmers' income and that the programme was not cost-efficient and required huge funding (Pribadi, 2001, cited in Jhamtani, 2008). Africa needs to take note of this. The issue is how to sustain productivity as well as farmers' income, in a manner that is cost-efficient.

GREEN REVOLUTION LIMITS

One of the most important features of the Green Revolution is the use of agrochemicals (fertilizers, pesticides, herbicides), a feature that was non-existent before then. Agrochemicals are used because High-yielding varieties (HYV) were constructed to be responsive to chemical fertilizers and were more susceptible to pest outbreaks. In developing countries, these chemicals are costly. And, over a few years, more chemicals have to be used to achieve the same yield. In Indonesia, the application of fertilizers in rice production between 1975 and 1990 rose from under 25 kg/ha to over 150 kg/ha (Fitzgerald-Moore and Parai, 1996, unpublished).

Thus, the increase in yields is offset by the increase in cost associated with increased use of chemicals. In the Central Plains of Thailand, yield increased 6.5 percent but fertilizer use increased by 24 percent and pesticides by 53 percent. In West Java, Indonesia the 23 percent increase in yield was virtually cancelled out by 65 percent and 69 percent increases in fertilizers and pesticides respectively (Rosset *et al.*, 2000, cited in Lim, 2009).

Agrochemicals not only increase production costs but also have health and environmental impacts, whose costs have not been properly internalised in the calculation of yields and production costs under the Green Revolution system. For example, the costs associated with agrochemical pollution of water systems and soils have never been taken into account. Accidents, and even deaths, of farmers and agricultural labourers due to lack of knowledge on safe use of chemicals have also been underreported. A study showed that poisoning episodes occur largely during spraying, mixing, and diluting of pesticides or due to the use of malfunctioning or defective equipment among agricultural workers (Jeyaratnam, 1993). Most farmers are not well educated on this and not enough information has been given to them on the safe handling of the chemicals.

Easy access to pesticides has also meant that these chemicals have become a common means of committing suicide among farmers when they go bankrupt or are embroiled in debts that they cannot repay. In many cases debts were

incurred when they borrowed money to buy expensive inputs such as seeds and agrochemicals; when the harvest failed or prices dropped, they could not pay back their debts. These are externalities that can cancel out the benefits arising from increased yields.

At the consumer level, pesticides have contaminated food, leading to health problems. In Indonesia, Dicloro-Difenil-Tricloroetan (DDT) residue was found even in mother's milk (Buchory, 1999, cited in Jhamtani, 2008). The price paid for chemical contamination thus goes far beyond the agriculture fields to our daily diet.

It is interesting to note that since at least the year 2000, the International Rice Research Institute (IRRI) has recognised that high dependence on agrochemicals may not be the solution to the challenges confronting agriculture. In a press release in July 2004, IRRI said that 2,000 poor rice farmers in Bangladesh have proven over the course of two years – four seasons – that insecticides are a complete waste of time and money. When they stopped spraying, yields did not drop – and this was across 600 fields in two different districts over four seasons.

This was a finding from the Livelihood Improvement Through Ecology (LITE) project, a joint project between IRRI and the UK Department for International Development (DfID), which has demonstrated that insecticides can be eliminated and nitrogen fertilizer (urea) applications reduced without lowering yields. Similar studies in the Central Luzon province of the Philippines and in certain parts of Vietnam have already demonstrated that pesticides were not required (Sharma, 2004). Again, this is a valuable lesson for Africa as it considers whether to embark on chemical-intensive agriculture.

In a similar manner, the use of HYVs is also not sustainable mainly due to their characteristic of being genetically uniform. The FAO has warned of a large-scale loss of plant genetic diversity and the erosion of biodiversity. This happens at two levels. First, genetic diversity is reduced when monocultures of rice and wheat replace mixtures and rotations of diverse crops such as wheat, maize, millets, pulses, and oil seeds. Secondly, genetic diversity is reduced because the HYVs of rice and wheat come from a narrow genetic base. As the genetic background of such crops is narrow,

their ability to resist diseases and pests has declined relative to the ability of diseases and pests to overcome the resistant traits that have been bred into the seeds (Fitzgerald-Moore and Parai, 1996, unpublished). Each new HYV that has become susceptible to pests and diseases has to be replaced, which involves costs.

Although HYVs are bred to resist insects, diseases and environmental stresses, when planted over a large area, they are in fact more vulnerable to pests. When single cultivars, such as the IR-36 rice, cover large numbers of fields, infestation can spread like wildfire, as was the case in Indonesia. By 1977, 1.5 million ha of rice fields in the main growing areas of Java, Sumatra and Bali islands were infested by the brown hopper, followed by the tungro virus a few years later. The pests had become resistant to pesticides by then. Replacing IR-36 with the IR-64 variety did not solve the problem as IR-64 became susceptible to stem borer after a few years (Oka, 1995, cited in Jhamtani, 2008). Indonesia also lost about 1 000 local rice varieties when it implemented the Green Revolution system.

The lesson to be learnt is that intensive double or triple monocropping of rice has caused degradation of the paddy micro-environment and reductions in rice yield growth in many irrigated areas in Asia. Problems include increased pest infestation, mining of soil micronutrients, reductions in nutrient-carrying capacity of the soil, build-up of soil toxicity, and salinity and waterlogging (Pingali and Rosegrant, 1994). Thus, areas that have not experienced intensification and the Green Revolution system need to undertake a different strategy and technique to achieve food security.

COHERENCE IN DEVELOPMENT POLICY KEY TO FOOD SECURITY

The Green Revolution system has shown that increase in yields does not necessarily translate into food security; a “one size fits all” technological strategy does not guarantee food security or even social equity. But it has also shown that when governments act, they can make a difference. The so-called success of the Green Revolution system was due to heavy government intervention in terms of providing

subsidies, building infrastructure and providing guarantee for credits. Yet even at the government level, there is lack of policy coherence and sustainability of implementation to sustain agricultural development. This is true not only in Asia but in many other developing regions.

Environmental and natural resource management

Agriculture is based on natural resources, whether soil, water or seeds. Agricultural policies are, however, often disengaged from the management of natural ecosystems that would sustain water supply, prevent erosion of topsoil and provide genetic diversity for crops. Millions of dollars that have been pumped into the Green Revolution system are wasted when environment-associated disasters (floods, landslides, water shortages) occur due to lack of policy coherence between the agriculture and the environment/natural resource sectors. Dams and irrigation systems built as part of the Green Revolution system are rendered useless when forests are allowed to be cleared, causing soil erosion and damage to the water supply system.

Whatever agricultural revolution Africa wants to undertake, it needs to take into account the carrying capacity of the natural resources and adapt to it. As reported by Pingali and Rosegrant (1994), emerging sustainability problems in intensive rice agriculture show the need for a greater understanding of the physical, biological and ecological consequences of agricultural intensification and greater research attention to long-term management of the agricultural resource base.

Industrial and other development policies

In Indonesia, one of the important factors in the decline of rice production over the last few years was reduction in farmlands. Many fertile lands, especially in the more developed islands, have been converted to industrial complexes, tourism facilities or housing facilities. This phenomenon came after the success of the Green Revolution when the government decided to embark on industrial development.

Instead of planning industrial development in areas that are less fertile, it was done in the same areas where the Green Revolution system was developed, mainly on the islands of Java, Sumatra and Bali. As a result, agriculture had to compete with industries for water and land; inevitably agriculture is always the loser. No agriculture revolution can be a success without protection of farmlands.

With industrial development, which is usually more rapid than agricultural development, an imbalance is created between urban and rural development. This leads to urbanization, especially among the younger generation. The Green Revolution could not solve this in Asia or elsewhere, whatever powerful technology is used, since policy coherence is the key.

Social issues

The Green Revolution system is often thought of only as technological innovation. It has, however, a social construct that is against small-scale production and has impacts on food security. For instance, increased production happens more in larger farms because small farmers cannot afford to buy the expensive inputs. In fact, in many countries studies have shown that the Green Revolution has displaced large numbers of smallholder farmers. This has led to increased concentration of land ownership and more intensive urbanization.

The disparity in the distribution of benefits is very clear, even at the national level. The ADB report in 1976 said that the Green Revolution technology covered much of the irrigated areas of Asia, but cannot be easily extended or intensified due to deficiencies in infrastructure and to institutional obstacles (Morgan, 1978). In the case of Indonesia, it was developed well on some of the most developed islands such as Java, Bali, Sumatra and Sulawesi, but not in the eastern part of the archipelago where infrastructure was at a minimum in the 1970s. Thus, the Green Revolution actually increased inequality at the national and at the community levels.

The Green Revolution has also taken away the independence of farmers over management of resources and makes them dependent on external inputs. It has also negated their role as "field scientists", as seed developers and as water managers. Farmers have also become dependent upon government price support and the market system. When this support was dismantled during the economic crisis of East Asia in 1997, farmers found they had to learn to struggle on their own. When farmers wanted to shift to organic integrated agriculture, they found that they had lost many adaptive seeds and the associated knowledge.

Finally, the Green Revolution, because of the mechanical, monoculture, market and yield-based approach, has deprived many communities of their cultural ties to agriculture. Many aspects of local cultures ranging from seed-saving systems to cuisine and even arts were not compatible with the Green Revolution system and had to be abandoned in many areas. This has led to a crisis of cultural identity among many communities.

DIVERSE ALTERATIVES EXIST

Governments in Asia applied the Green Revolution as the only technology for food production during the 1970s, to the exclusion of everything else. Funding (even for research), policy and institutional support were mostly directed towards the Green Revolution. Potential existing technologies and systems, at the farm and at the academic levels, were ignored, or even considered non-existent. These technologies and systems, such as the System of Rice Intensification (SRI), crop rotations, alternative green manures, companion planting and multi-cropping, have now been proven to be viable and sustainable.

Africa can learn from the fact that diversity, at the farm level, cultural level, and technological level, even at the market level, is the key to food security. Diverse agro-ecosystems need diverse approaches. "One size fits all" and "business as usual" scenarios are no longer viable to attain food security and rural development.

CONCLUSION

The lessons of the Green Revolution in Asia can be used by Africa as inputs for considering strategies and approaches to food security. The entire range of lessons, together with knowledge on existing potential technologies and systems in Africa, need to be analysed and considered before any agricultural revolution is undertaken in Africa.

The most vital consideration may be about local agro-ecosystems and what they can offer, rather than applying technologies that are developed detached from the local systems. Agro-ecosystem development may be more important than any revolution. Africa still has that legacy, which can be further improved with appropriate and people-based technology.

The world has changed compared to the 1960s when the Green Revolution was adopted in Asia. We now face multiple crises of natural resource erosion, climate change, globalization and, most recently, the financial crisis. A different approach is needed to develop agriculture and food security for communities and nations. Africa may hold the answer, by learning from the experiences of the Green Revolution in Asia, but also by building on its own strengths of local knowledge, biodiversity and community systems for agriculture and food security.

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