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A Critical Survey of the Logic of Genetic Engineering and the Quest for Sustainable Agriculture towards Development in Africa

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Abstract
The problems of food insecurity, poverty and hunger have currently become the concerns not only of Africa but of the entire human race. Genetic engineering (GE) or modification (GM) is often justified as a humane technology; one that feeds more people with better food. Nothing could be further from truth. With very few exceptions, the whole enterprise of GE is to increase the sales of chemicals and bio-engineered products to dependent farmers. Thus the whole argument for genetically modified seeds from poverty and hunger in Africa is suspect. The argument has not only sidelined the important concerns about the negative implications of genetically modified seeds on farmer's livelihoods, in particular, and sustainable agriculture in general, but has also failed to understand the real causes of these problems in Africa. This paper reflects on these ignored issues. Thus, while rejecting GE as "the" solution to poverty and hunger in Africa, the paper goes further to provide other ways of effecting high-input and sustainable agriculture that will create wealth and change the social, economic condition and status of peasant African farmers and their communities in the new global economy.
Keywords: Logic, Genetic Engineering, Sustainable Agriculture, Development, Africa

Introduction

Today, the problem of food insecurity is a concern not only for Africa and other Third World Nations, but is becoming a global concern. The situation is perhaps worst in Africa and other Third World Countries where the population growth rate continues to outstrip food production to the extent that, it may be feared that the Malthusian prediction may eventually come true in these parts of the world, if drastic steps are not taken by their Governments to change the situation, as it has already created the chain problems of poverty, hunger and underdevelopment. It is true that food, shelter and clothing are the indices of good living and development of any people, as these three factors combine, economically and socially, to put an individual in a better frame of mind towards his self-realisation, his wellbeing and that of the society. Thus, it is believed that any nation that can create the relevant opportunities for the provision of these basic necessities of life to its citizen is already in the path of development.

The idea developed here about development, especially when related to developing nations, entails a change from bad to better condition in various fields including science, technology, culture, economics, education, politics, and so on. "Development", understood in this sense has generally been measured in terms of economic productivity or growth, competiveness, high standard of living, technological and industrial advancement and political stability, among other things.

It is undisputable that Agriculture constitutes the bedrock of Africa's economy. The explanation is that the whole continent is blessed with a large population that places significant value on the dignity of labour. Besides, it occupies a very large geographical land mass, that is not only fertile, but is also rich in human and material resources. Paradoxically, although essentially agrarian, Africa is losing its ability to feed itself, and is remaining industrially unadvanced and underdeveloped. Besides the heinous factors of underdevelopment, such as colonialism and neo-colonialism in their different forms and ramifications, another factor that has been said to seriously thwarted Africa's development is that Africa lacks technology among other things.

The lack of this technical potential has been often used as justification for Africa's inability to explore all her natural resources for the purposes of industrialisation and development. This condition seems to suggest that participation in the modern technological race within the framework of the phenomenon of globally liberalised economy is the only option for Africa's achievement of development. Indeed, this is not merely offered as a suggestion, but as a "sine qua non" condition which the Western industrialised nations and the multinational corporations – the purveyors of global economy – have set for all the nations, especially the Third world economies that need development. It is unfortunate that, African nations are among those that have, through their uncritical policies, fallen victims to the claws of Western domination.

This not withstanding, Africa like other Third World economies tend to conform to the new world economy by directing her efforts towards development and the application of modern Western technologies to almost all spheres of its livelihood and existence. As it will be too ambitious a project to explore all the possible areas of such applications, this paper limits itself to the exploration of the implications of Africa's uncritical acceptance of the new agricultural revolution, namely genetic (gene) engineering (ge), or genetic modification (gm) as the best option towards solving her problems of low input agriculture, poverty and hunger. In order to achieve this

objective, the first section of this paper preoccupies itself with the analysis of the logic behind genetic manipulation in local food production pointing out the inherent residual problems of the enterprise both for farmer's livelihoods and sustainable development in Africa which the proponents have lost sight of.

The second section is a critical evaluation of the arguments for genetic technology from poverty and hunger in Africa showing the invalidity of attributing the latter problems exclusively to lack of technology, rather than to the real conditions which the peasant African farmers have been facing. The third section, followed by the conclusion, explores the alternative was towards food security and reduction of poverty and hunger in Africa, which will enable Africans cope with the new global environment.

Analysis of the Logic of Genetically Modified (GM) Seeds Towards Africa's High-input Agriculture

The general argument for the need to introduce genetically modified (GM) or engineered (GE) seeds into Africa's agriculture is based on the assumption that the peasant farmers themselves may not meet the increasing food demands of the growing population by restricting their operations to local knowledge or techniques of production. On ground such as this Workineh suggests that;

> ...modern science and technology are required to increase productivity and to satisfy the growing demands. Peasants should enjoy the material benefits that come from novel economic changes (2002:57).

In specific terms, the proponents of genetic engineering (ge) in agriculture have argued that its application will, among other benefits:

1) Provide plants and animals that would lead to a more environmentally sound agricultural production with crops that produce their own pesticides, leading to the reduction in farmers' use of chemical pesticides[2].
2) Provide crops that produce medicine, plants that are tolerant, for example, to salt and drought, and
3) Provide enriched foods that restore micro-nutrients deficiencies.

Given these promises, the proponents intend to convince Africans that, genetic engineering is not only the solution to their poverty, hunger and many health problems, but also a humane technology; i.e. one that feeds more people with better foods, and one that serves as another step, in a continuous process, in their agricultural development. It is true that genetic engineering is a promise – filled revolution in agriculture that has been embraced by many nations that need economic growth. But some reflections show that there are certain important concerns which the proponents' arguments have sidelined.

Indeed, there are certain residual, though fundamental, questions the proponents should address in order to validate their claims. These include, for example, relevant questions like:

i) Who really benefits from genetic engineering?
ii) What are the risks of genetic engineering, and who bears them?
iii) Can genetically engineered crops feed the hungry masses and reduce poverty in Africa?
iv) Are there no competing alternatives to genetically modified crops in agriculture?

When these questions are fully explored the whole project of genetically modified crops become suspect, most especially, as they have far reaching implications not only for sustainable agricultural and economic potentials and livelihoods of small-scale African farmers in particular, but also for Africa's development in general. In the sections that follow, we shall therefore examine the proponent's arguments for genetically modified crops as the only option for agricultural development in Africa. Let us start to do this with the analysis of the four questions posed above.

The first two questions strictly border on the implications of the application of genetic modification (gm) for Africa's development. The third question is on the project of (gm) vis-a-vis the proponents' promises or claim, while the fourth question borders on the possibility of other methods of achieving high input agriculture other than that of GM crops in Africa. The position of this paper at this juncture is simply that the proponents' argument for GM crops are at best, plausible in so far as they sideline certain fundamental concerns that determine high input agriculture for sustainable development. Their arguments tend to ignore important negative consequences of:

i) GM crops on the ecological system (eco-system) into which they are introduced.
ii) The activities of the private seeds company in terms of their appropriation of the livelihood of the organic farmers.
iii) Contamination of organic seeds by GM seeds;
iv) The risks that are involved in the process; and
v) Ignoring the possibilities of other methods of achieving high input agriculture. Let us look at the issues more closely.

The problem of Ignoring the Negative Imparts of GM Crops on the Eco-System

In spite of their many reassuring words, the foreign private seeds companies, and researchers – the producers of GM crops –the Government that support the activity and even the farming communities that make use of the

technology, tend to overlook the negative consequences of GM seeds on the host eco-system. Ehrenfield notes for example that:

> ...The use of Bacilus Thuringiensis (Bt) genes by farmers before was thought to provide a permanent solution to insect problem. But the model of one pest-one-solution, does not work forever as is the case with pesticides; sooner or later resistance build up (2001:4-5).

In the same work, Ehrenfield notes, too, that, "building of herbicide resistant in plants is headed for trouble as it unleashes basic ecological reactions" (2001: 4). The explanation is that excessive applications of herbicides to the soil as the method of weed management will eventually reduce the sensitivity of weeds to the herbicides, thereby creating an even worse weed problem for the African peasant farmer.

Another important negative consequence that has been ignored by private seed industries is that related to the unexpected impact of gene transfer from one organism to the other. For example, it is expected that when genes from one bacterium are transferred to another soil bacterium, a new organism may be created. But the possibility is there, that the new bacterium instead of serving the expected need of farmers turns out to produce unexpected negative result that frustrates their projections.

A practical case of this is also cited by Ehrenfield in USA; how genes from a soil bacterium called "xanthomonas" were transferred to another soil bacterium called "kebsiella planticola", for the creation of a new organism that would ferment stubble into alcohol and thereby provide peasant farmers with extra source of income instead of simply burning away the stubble.

But contrary to the expectation, a test by the authorities showed that, "the wheat planted in the soil containing the new organism was killed by it" (Ehrenfield, 2001:5). The possibility is there, too, that a similar problem will emerge if genes from organisms from another soil are transferred to those in African soil, in the name of agricultural development.

The Problem of Appropriation of the Livelihood of African Peasant Farmers by Private Seed Companies

One of the things that seem to make the practice of genetic engineering unique in the history of biotechnology is that it is almost completely controlled by private multinational or Transnational Corporations (TNCS) or companies, having patent rights. Besides, specialising in the production of the familiar agro-chemicals like herbicides and pesticides, these corporations spend huge amounts of money to conduct researches, field trials, production and sales of GM crops, including those that are herbicide resistant, at very high cost to farmers.

Thus, through patent, the TNCS keep competitors at bay. Even public research institutes have lost ground in access to the knowledge and genetic material. A person therefore has cause to believe that gene technology is not developed because of its problem-solving capacity, but because of its protective rights, and ultimately, because of the economic benefits it can bring to the private companies.

The consequences of this for the small scale farmer in Africa are dreadful as the patent rights to the technology could be used by the transnational GM seeds companies as oppressive machineries to prevent the peasant farmers from preserving their organic seeds for replanting. This implies that the TNCS would promote only agricultural development that would not only be costly, but also one that would force the farmers to buy seeds from them. This is an undemocratic and unjust act that can bring about public opposition, as it amounts to a move toward dehumanising them.

Assessed from this perspective, GM crops have very insignificant role to play in the livelihoods of African peasant farmers. Related to the latter problem is the problem of contamination of organic crops, as a result of the introduction of GM crops. The organic farmers have no guarantee that the seeds they plant are not contaminated by the GM seeds, when one considers the fact that seeds and pollen are spread by various agents, like water, wind, insects, birds and so on. The damages on both the farmers and environment that such contamination may cause are unpredictable; thus raising a further problem of who is to bear the responsibility of paying the cost of contamination.

The Problem of Payment for Damages due to Contamination of Organic Seeds by GM Seeds

The relevance of this question rests in the genuine fear that the cost of such contamination and cost of reduced market shares would in the end, be unjustly imposed on the peasant farmers, consumers and the society at large. Europe and America, where these technologies developed are still grappling with this problem in spite of all their control systems. There is no guarantee that these problems will not even be more complicated in Africa considering the high level of poverty, low levels both of literacy and government responsiveness to the respect and protection of human life.

In this context, a person may instantly propose a ban on importation of GM seeds into the continent as a quick remedy; but neither the ban, I guess, will stop their existence, nor will it stop their being smuggled across borders by international marketers, including Africans themselves for selfish economic ends. Moreover, the possibility is there, too, that some of the organic seeds would have already been contaminated before the ban.

Again, who bears the risk when, for example, the GM crops bring about health hazard, or become a serious ecological threat? Or when an agricultural chemical turns out to have unanticipated side-effects after a number of years of its application? It may be suggested that the solution for this is "a matter of time", as the chemical may eventually disappear from the environment. But this can hardly remove the logical and practical possibility of the GM crops surviving in the wild and spreading their genes through crossing with other plants, leading to continuous contamination and irreplaceable loss.

All these suggestions are accommodated because neither the transnational companies who produce the GM seeds, nor the governments that allow their access are ready to pay for these damages as the burden would be too costly for them to remain in the business. On reflection, no sane government would want to involve itself in projects or researches, indeed any venture, that may ruin its economy, most especially, when other alternatives could be explored.

We shall come to the problems that arise from ignoring the gains that could be derived from the exploration of alternative methods of increased food production towards elimination or reduction of poverty and hunger, other than through GM crops. But before this, let us examine briefly the validity of the proponents' argument from hunger and poverty for gene technology in food production in Africa.

Analysis and Critical Evaluation of the Arguments for Genetic Technology from Poverty and Hunger

The arguments attribute poverty and hunger in Africa, essentially to its low input agriculture. And in order to arrest these connected problems, the proponents pose the GM crops method of agricultural development as the only way forward for Africa. The arguments seem to rest on two basic assumptions. First, that GM is a humane technology. Second, that GM crops are consumable by humans. Hence, embracing the new agricultural technology will impact positively on Africa's economic and social status. In other words, Africa's problems of hunger and poverty are problems of technology and the only solution is to participate as a global player in modern technology.

However, it must be noted that this solution is proposed by the producers of GM crops themselves, including their purveyors and researchers, who are only interested in economic gains and do not seem to have clear understanding of the real causes of these problems. The important point we need to emphasize here is that, it is illogical and erroneous to propose a technological solution for Africa, if these problems so associated with Africa, do not rest exclusively on lack of technology.

The task now is to search for possible important causes other than lack of technology; that is, causes that will reduce the proponents' option to suspect or absurdity. Importantly, we need to examine closely the real conditions, especially the ecological conditions that peasant producers of staple foods in Africa face, as well as their economic status.

Exploration of the Real Conditions of Peasant Farmers in Africa

Here we make allusion to the historical conditions created by the phenomena of colonialism and neo-colonialism. Peasant, small and marginal, farmers then were ejected from the farming lands which according to Peter Rosset:

> ...were converted to production of exports in the new global economy dominated by the colonial powers. Instead of producing staple foods for local populations, they become extensive cattle ranches or plantations of cocoa, rubber, sugar cane, cotton and other valued products (2006:6).

Peter notes further that, as a result of this oppressive and plundering attitudes of colonial overlords, while unsustainable production practice, on the one hand, made the displaced farmers poor and destitute, on the other hand, "the favoured lands were simultaneously degraded by continuous export cropping at the hands of Europeans" (2001:6).

The post colonial national elites who came to power could not alleviate these environmental and social problems generated by colonialism because they still had strong linkage to global export – oriented economy, which were still controlled by former colonial powers. And with the influence of global economy, controlled by the capitalistic multinational corporations, having their base in Europe, many peasants in Africa, were forced to abandon farming and to migrate to the cities where they could provide the labour forces for industrialisation.

Lands by this time also got into the hands of governments through the Land Use Laws, as well as into the hands of the wealthy Africans, thus increasing the problems of landlessness for cultivation in the rural areas. This gave rise to increased poverty and marginalisation of rural African farmers even as national export became more competitive in the global economy.

Today, the situation has not changed because we still have rural populations in Africa being relocated from areas more suitable for farming to areas that are less suitable. This has resulted to continuous deforestation, desertification and soil erosion in fragile habitats. And there doesn't seem to be anyway this can be stopped in the future. Moreover, some of the better soils of most African countries have been converted into large holdings

for mechanised, pesticide and chemical fertiliser, intensive, monoculture production for export. The problem of yield – decline in our rural crops, therefore, can better be explained partly in terms of ecological disasters and the capitalistic pursuit of export profits and current competitiveness of global economy, rather than in terms of lack of technology.

The Negative Impact of Current Changes in Macro-Economic Policies of World Economies on Rural Farming in Africa

From the foregoing discussion we need, too, to reflect on how the current changes in national and global governance mechanisms, have negatively impacted on the performances of our rural farmers. These changes have been effected within a paradigm that passes "International Trade" as the key resource for promoting economic growth in national economies and "growth", as solution to all problems. But this paper describes this practice of global economic as a new, "smart" way which the industrially advanced nations of the world use in coercing the Third World nations – described as those that "need growth" – to participate in global economy, in which the policies and liberization programmes concerning economic growth are strictly determined by international regulatory bodies like the International Monetary Fund (I.M.F.), World Bank (WB), World Trade Organisation (W.T.O.) and so on; and world market mechanisms (Presbey, 2001:293).

The implications of these for African governments, like those of other participating Third World Nations, is that they are gradually loosing grip on their policies towards economic growth; as they have been forced by the strict terms of global economy, to drastically cut down, or remove subsidies of all kinds, including social services and price supports for peasant farmers. Consequently, the farmers have been increasingly lunged into an environment dominated by global economic forces, where the terms of participation have been set to meet only the interest of economically advanced nations of the world.

Within this changed global environment, our peasant farmers find the prices of staple food which they produce, dropping below the cost of production in the face of cheap import, freed from tariffs and quotas. From this assessment, one may describe the phenomenon of global economy as a strategy of foreign domination in Africa.

These constraints then are the true causes of low productivity of food, hunger and poverty and not because African peasant farmers lack the technology required for the production of "miracle seeds" (the GM seeds). Now, in the face of these realities, the curious question is, what should we Africans do?

Exploration of the Way Forward Towards Food Security and Reduction of Poverty in Africa

In the foregoing section we have shown, by the examination and analysis of the true causes of low food production, that it is not the lack of new agricultural technology, that holds the small scale farmers in Africa, but rather the pervasive injustices and inequalities in access to resources, including land, credit, market access and so on. In other words, if African nations are able to bring about structural changes in access to land, and in agricultural and world trade policies, then genetic engineering, its promises notwithstanding, would make no significant mark in rural farmers' food production.

Land has always been seen as a very critical productive asset in agriculture. Beside, checking rural conflicts, African governments can contribute immensely to high input in food production and reduction poverty by supporting greater democratic access to land by men and women and the generality of the peasantry. African governments should therefore support small holder initiatives as well as resist large scale land alienation to serve agribusiness. This responsibility entails effecting land reforms. And Songsore has told us that:

> ...in the countries or regions within countries where customary communal tenure regimes are dominant, land reforms means the adoption of these regimes to changing circumstances in such a way that protects peasant livelihoods (2003:180).

But besides such changes we can think of, at least, three approaches that would make the most sense under the conditions so faced by small scale farmers. The first is the exploration of other methods of food production that have pro-poor diseconomies of scale like agro-ecological model. The basic assumption here is that there may exist in nature certain sidelined ecological potentials for farmers to select and breed varieties of plants that provide clues for better pest and weed management, as well as plants that have whatever characteristics they want. In this context, this approach will necessarily involve the skilful management of interactions between genetic potentials and environmental conditions rather than technological management as the determining factor for high yield. This a natural approach that could be used to avoid both the economic and technological risks that GM crops pose. For example, in Madagascar in 1980s, the "System of Rice Intensification (SRI)" experience led Norman Uphoff, one of the researchers, to conclude that:

> ...There appear to be a large genetic potential in existing (local) rice varieties that can still be tapped through agro-ecologically sound practices. This would imply that genetic modification efforts are not necessary (2001:15).

Besides, promising alternatives to weed and pest control have also been developed through researches

conducted in other places that can be recommended for application by African peasant farmers. For example, in Kenya, although the B+ maize is being aggressively promoted, a promising organic alternative called "Push-Pull system" has been developed, which according to Flemming Nielsen, "relies on the natural repellents and trap plants"(2001:17). This also provides a natural, less risk and less costly means of addressing the stemborer (maize pest) and "striga" ("witch-weed") problems that faced Kenya rural farmers. The procedure, Nielsen further noted, involves either intercropping maize with grasses having strong stemborer attracting odours like "napier vetiver" and "Sudan grasses" that produce a gummy substance that traps the pest; or with repellent grasses like molasses and leguminous silver leaf, that repel stemborers by releasing a complex mixture of volatile substances called "terpinoles nonatrieness". Besides repelling the pest, "silver-leaf grass", Nielsen adds, "is nitrogen fixing, a good forage crop and very efficient in suppressing witch weed that is spreading fastly in Africa" (2001:18).

Another approach that may be useful in rural farming is the organisation of social movements capable of exerting sufficient political pressure to reverse policy biases. It is such movement that can dialogue and negotiate with governments and their agencies to attract loans and other forms of aids to the local farmers for increased agricultural input. There is, therefore, a need to develop a closer collaboration between farmers and environmental movements if African farmers' situation is to improve (Bhardwaj, 2010:254).

Finally, African governments should refrain from being uncritical in their reliance on economic advice from foreign countries that are based strictly on global economic policies and world scientific and technological innovations. It must be noted that, such policies do not always support Africa's social and economic interest; and, of course, Jacques Ellul (1972:86 has pointed out that, "all technical progress exact a price". African farmers need support from their governments in order to improve their agricultural yield in terms of conserving biological diversity[3], adopting new varieties and using local techniques to preserve their crops for replanting and consumption. In all these, the social, economic and ecological risks, high cost of production, health hazard and other problems to small scale farmers are drastically reduced, compared to the use of genetically modified crops, which is based on a technology that is subservient to human interest.

Conclusion

Lack of technology has been identified as the major factor that holds African small-scale farmers' capability to produce enough food that would feed and reduce poverty in Africa's teaming population. But from our foregoing analysis and discussion we have shown that, the proposed project of GM crops as the best option is suspect, most especially as this option is risk-filled and very costly, whereas better promising alternatives exist, that can be explored for the benefit of local farms, in terms of high yield, low cost of production and risk-free production.

Moreover, the problems of hunger and poverty do not rest on technology, needing technology for solution. It rather pivots on the economic and ecological conditions which the local African farmers have faced in history. Now, from the careful exploration of the way forward towards solving Africa's problems of hunger and poverty, the paper submits that instead of preoccupying themselves with genetic modifications, researchers in agricultural development projects should direct their attention to studying and improving the factors that are most important in increasing yield. And we can immediately see the skill factor coming in here to play in terms of how much farmers themselves should observe the crops in their fields and how carefully they should manage the plants, soil health, water and nutrients – whole procedure that is subsumed under the context of agro-ecological management.

Viewed from this perspective, our discussion on Africa's problems of chronic hunger and poverty suggest that protection of the environment and promotion of economic development are complementary, and are the basis for sustainable development. It also suggests that success in the elimination of hunger and poverty in this context depends more on enabling government policies, especially those related to credit facilities, democratic land reforms, rural extension and participatory researches, than on acquisition of technology.

There is need to understand, too, that the adoption of GM technology is not a "stand-alone policy" for the improvement of agricultural production; it is only a part of the "Green Revolution package" of some nations. Moreover, the new technology cannot be adopted in a context where there is a considerable withdrawal of the welfare functions of the State, since the void cannot be filled by the private sector of our economy. Thus adoption of seeds without supportive governmental policies or institutional structures to facilitate their adoption exacerbates the risks faced by small and marginal African farmers.

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Notes

1. Genetic engineering is actually a part of Biotechnology. Traditionally biotechnology has greatly been transformed by increase in the knowledge of biological sciences – biochemistry, molecular biology and genetics, which involve huge capital supplied by national governments and transnational corporations, skilled human resources and very high risks; hence has become specialised and private research attracting high cost.
2. Apart from economic concerns, there are also environmental concerns. Scientists have warned against the intensive use of herbicides as these chemicals can have harmful effects on soil bacteria responsible for nitrogen fixation.
3. Biological diversity: Modern biological scientists and researchers assume that soil diversity – i.e. the vast and complex communities of bacteria, fungi, mycorhiza, actinomycetes, protozoa and nematodes as well as earthworm and other soil mega fauna – holds they key to high productivity method of crops like rice and soybeans.