Food Security and Biotechnology in Africa

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MODULE 3: PUBLIC RESPONSE TO THE RISE OF BIOTECHNOLOGY

Unit 2: Public; Who Constitutes the Public and how do They Respond to the rise in Biotechnology (3 hrs, 2 hours lecture & 1 hour discussion)

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INTRODUCTION

The controversy

The outcomes of the invention of DNA-based molecular techniques and their application to agriculture have been very controversial both within the agricultural subsector and out of it. Increased food production including other benefits was the hoped-for end point by scientists who pioneered agricultural biotechnology. At this early stage, public scepticisms and even vociferous oppositions were not anticipated. Agricultural reforms seem unavoidable and with the growing global population, plant biotechnology and genomics as a tool for innovation will likely play a key role in this reform. New developments in genomics, such as Marker Assisted Selection (MAS), now promise to offer solutions that make agriculture sustainable and environmentally responsible. They open up possibilities for targeted breeding in ways that simply were not feasible in the past because genotype selection makes it possible to cross wild distant relatives without too much loss of the beneficial characteristics of the used cultivar (Collard and Mackill, 2007; de Vriend and Schenkelaars, 2008). The controversy and stalemate that resulted from the debate over GMOs produced a dichotomy amongst stakeholders that will have long lasting effect; and will influence future use of the technology (Nap et al., 2002). GM foods were from the beginning never viewed in isolation from the wider issues of agricultural practices, nature preservation and integrity of food. They have to make for themselves a place on tables and supermarket shelves, as harbingers of a new method of agricultural production, in competition with food produced through more familiar

'natural' means. In each country, the acceptability of GM crops and foods has to be evaluated in relation to dominant framings of the problem of biotechnology, and against the backdrop of food production and consumption that had been selectively naturalized or taken for granted. In each nation, moreover, consumers had various means of opting out of the dominant eating traditions, critiquing them, or resisting perceived alterations to the food supply. As will be observed later, naturalness or otherwise of GM foods, food sovereignty and food culture and other related issues in crop biotechnology have these as their basis.

BIOTECHNOLOGY: A NEW SCIENCE / INNOVATION?

The term biotechnology has been used to refer to many biological processes that produce useful products including the very ancient ones like beer, wine and cheese. Current usage refers to the DNA based molecular techniques used to modify the genetic composition of agricultural useful plants and animals. Organisms whose genetic composition has been modified by moving DNA from one organism to another using DNA-based technique, i.e., not breeding, are called transgenics, genetically engineered, or rDNA. These terms are preferred to genetically modified organisms (GMOs) because the genetic composition of virtually all agricultural crops and animals have been modified by humans over the past 200 or so years.

As early as 1974, one of the first individual to develop recombinant DNA (rDNA), Paul Berg, had cleaved the monkey virus SV40, then cleaved the double helix of another virus; an anti bacterial agent known as bacteriophage lambda. Following this he fastened DNA from the SV40 to DNA from the bacteriophage lambda. The final stage involved placing the mutant genetic material into a laboratory strain of *Escherichia Coli*. Berg did not complete this final step due to pleas from his colleagues who feared the bio-hazards associated with the last part of the experiment. The fear among the scientists was that the final step could create cloned SV40 DNA that might escape into the environment and constitute risk to laboratory staff who could become cancer victims. Fear over the potential biohazards of the technology and other unresolved issues led to the convening of a conference by the President of the National Academy of Sciences of the United States to discuss the biosafety ramifications of the new

technology. The meeting ended with a resolution to halt further experiments in the area until a resolution of a fixed international conference. The conference held in 1975 at Asilomar. Conference resolutions dealing with potential risks was that containment should be made an essential consideration in rDNA experiments among others.

The participants of the conference also endeavoured to bring science into the domain of the general public thereby for the first time bringing science into the public eye to avoid being accused of a cover-up. This created two scenarios; bringing rDNA to the knowledge of the industrial world and also getting the public to have concerns over what scientists are doing. By this two stakeholder groups were created; the press and the scientists themselves.

In the mid -1970s, agricultural chemical companies began acquiring seed companies, possibly anticipating a period when biology would replace their agricultural chemicals. Sandoz, later to become part of Syngenta acquired Rogers seeds. Monsanto acquired Jacob Hart, and DuPont acquired Pioneer, then one of the world's largest seed companies. Bayer, Advanta, and Limagrain also acquired companies (Herdt, 2005). By 2005, these six owned half the commercial seed sales capacity in the world.

The concentration of crop seed production capacity in the hands of a few multinational companies has generated vocal opposition by advocacy organizations including the Third World Network, , Rural Advancement Foundation International now called the ETC Group, Technology and Concentration, Greenpeace and Genetic Resources Action International (Grain).

These organizations constituted another pressure group 'public' with their opinions on crop biotechnology. The groups generally seize on issues such as the possible introgression of transgenes in Mexican maize or toxic effects on Monarch butterflies. They also conflate these with information about seed industry concentration among a few multinational corporations, farmer's rights to use seeds and gene patenting or biopiracy. Other allegations of the innovation include genetic pollution, corn grenade. These groups tend to ignore all the benefits of the technology and disputed aspects of wrong allegations against the technology. One fear is that the largest companies will control the supply of seeds and food and may eventually control the fundamental rights of access to food as is the case with the price of pharmaceuticals (ETC Group 2005). According to Herdt (2005), an early vehicle for international intellectual property rights in plants was provided by the International Union for the Protection of New Varieties of Plants (UPOV). UPOV protection provides for plant

breeders rights in which breeders are permitted to use previously recognized varieties as parents in new plant breeding efforts. As a result of the dynamic interaction of patents on plants, changing technology and market forces, private investment in plant breeding and seed production boomed. In 1994, private companies supported two third of the crop breeding in the USA and a growing proportion throughout the world (Frey 1995; Pray et al., 2005)

Opposition to agricultural biotechnology, especially to transgenic crops, has become a topic of serious research among applied ethicists some of whom examine intrinsic concerns like the acceptability of moving genes across species, becoming what one eats, or playing God. These with the denial of seeds as common heritage question the ethical standing of the application of biotechnology. These created their own interest group including religious, economists, and sociologists. In the debate on gene technology, the traditional social partners, employers and employees, were joined by environmental and consumer organizations. Biotechnology also captured the attention of academics in environmental philosophy and ethics who questioned the moral acceptance of this specific of man with his natural environment-playing God, Sanctity of nature.

Among the issues that have spurred some of the highly controversial debates on crop genetic modification are; the ecological effect of releasing GM seeds into the environment, the impact of GM crops on the global seed markets, farmer and consumer preferences in the adoption of GM products, the role of risk assessment in evaluating the safety of transgenic seeds and finally the impact of the global use of genetically engineered crops on biodiversity (Krimsky, 1982).

In ecological terms, transgenic crops are new and the possibility of their producing environmental harm is a concern. These may include possible negative effects on friendly insects, birds, and plant species. There is also the fear that biotechnology adoption will result in reduction in agricultural biodiversity which are key for the sustenance of agro-ecosystems, its structure and processes for, and in support of, food production and food security (FAO, 1999). Another concern is gene flow from crops to weeds and other crops and for herbicide resistant gene may potentially make weeds more difficult to control. These are responsible for the wakeup call on the environmentalist and ecologists. The issues of potential health risks were also a major tool in the fight against crop genetic engineering as seen in the case of ‘Franken foods’.

Another major worry over crop biotechnology which has attracted more open discontent is the change in the food/agricultural systems that GE would bring about. The thinking is that crop biotechnology is a monoculture/ mono cropping system best implemented in large scale to make sense of the inputs and management. This would have the tendency to eliminate some crops and thereby limit access to food varieties. This practice, it is feared will bring about a reduction in genetic diversity as some crops will be chosen in place of others. It is a response in support of some anti-biotechnology organizations who preach that food insecurity is due more to lack of access to food than productivity. It is feared that biotechnology adoption will lead to globalization of world food system with some crops being neglected for other crops. This will also limit choices of what is available to people as food. It would result in interference with peoples cultural food habits and preferences and hence, denying the people of their food sovereignty.

What is Food Sovereignty?

This is the right of peoples to define their own food and agriculture; to protect and regulate domestic agricultural production and trade in order to achieve sustainable development objectives; to determine the extent to which they want to be self reliant, to resist the dumping of products in their markets, and to provide local fisheries-based communities the priority in managing the use and the rights to aquatic resources. Food sovereignty does not negate trade, but rather it promotes the formulation of trade policies and practices that serve the rights of peoples to food and to safe, healthy and ecologically sustainable production. These run counter to the basic principles of crop biotechnology and food sovereignty movement Via Campesina as opponent of the technology was created. The livelihoods and incomes of a huge number of rural and urban dwellers are dependent on the local manufacture of farm inputs and on the local storage, processing, distribution, sale and preparation of food. Localised food systems generate many jobs and help sustain small and medium scale enterprises.

These interest groups were responsible for alerting the populace about the potential ‘evil’ in the technology and are also responsible for interfacing the biotechnology companies, the governments the farmers and the general public. The rapid and widespread adoption of transgenic crops shows that they have some attractions to the farmers. Studies have indicated increased yield and profit to the farmers from reduced pests on crops and reduced pesticide use. (Marra et al,. 2002). Economic benefits and costs are widely used promotional basis for

GE and environmental costs and benefits are another. Concerns about GE crops represent important consideration in many cases especially on the part of the public. These have to do with the risks, benefits and impacts of the technology. Questions normally asked include; do transgenic crops represent solution (partial or complete) to world hunger; unacceptable risks to the environment and human health or means of equitable sharing of the benefits scientific innovation? The technology is presented as a solution to agricultural transformation that will bring about an end to world hunger; poverty reduction and promotion of equity among many of the world's poorest countries. The technology is believed to improve crop production while promoting environmental conservation. It is however doubtful how the technology will address world hunger in view of the multifaceted causes; poverty, inequitable distribution of food, land tenure inequity, overpopulation, poor health, poor education etc.

It is known that modern intensive agriculture adversely affects the environment through its reliance on chemical inputs for optimizing soil nutrient conditions, seeds of varieties correspondingly responsive to such conditions, and pesticides for controlling insects, pathogens and weeds (Harvey, 1998). Crops engineered to suit the environment better through incorporation of genes for tolerance to biotic and abiotic stresses represent improvement in crop production. However, farmlands, and the surrounding non farmed environments could be affected by the introduction of new technologies. For example, GE of crops for reduced fertilizer requirement through *in planta* nitrogen fixation could be beneficial through reducing the negative impact on the soil and the subsequent effects of run-off into rivers and seepage into ground water.

POPULAR MISCONCEPTIONS IN CROP BIOTECHNOLOGY

Genetic modification is a highly technical field requiring considerable training and experience. It is not unusual therefore that the society found it difficult to comprehend it capabilities and limitations of its application in agriculture. Compounding this is the fear and awe of any new powerful technology. It is therefore natural that the non technical public should be concerned and have questions to ask about GE; Is it safe? What are the benefits? What are the costs not only in income terms but also to society and the environment? Conclusions from studies and workshops and symposia trying to answer these questions conducted by professional medical and scientific societies was that genetic modification was not entirely risk free, but carried the same kinds risks as traditional means of genetic improvement. The big question is 'why is the same concern over agricultural biotechnology not extended to medical and pharmaceutical applications of rDNA? If there were something

inherently hazardous with the process of recombinant DNA technology, then those GM medical and pharmaceutical products would be just as hazardous. But they are not.

It has been found that this discrepancy in appreciation of agricultural biotechnology and its medical and pharmaceutical counterparts is not due to ignorance by the public. According to Mohr and Topping (2010) not all anti-biotech sentiments are based on ignorance of agriculture or of the rDNA technical mechanisms; the motivation at least in some cases seems based primarily on commercial and socioeconomic factors, not on health or environment. Often cited include such concerns as increased domination of the food supply by private corporations, or the likelihood of benefits of GE crops accruing disproportionately to large rich farmers at the expense of the small holder, poorer farmers or of disrupting international trade dynamics.

One of the often mentioned concerns about GM is that it is unnatural, in that GM invariably transfers genes from one species to another thus violating the natural barrier which does not occur in conventional breeding.

Secondly, GM is believed to hazardous because it is fundamentally different from traditional breeding which to the public is limited to cross pollination working in plants of the same species.

Another misconception is that organic farmers are told that if a pollen grain from a neighbours GM crop floats into the organic crop, the farmer may lose organic status, followed quickly by the company owning the patent on the GM crop claiming legal ownership of the organic farmer's crop. Furthermore, regarding herbicide tolerance (HT), it is being bandied about that GM crop farmers are able to use the HT crops to kill all weeds leaving the GM crops to thrive. Implicit in this believe is that HT crops are immune to any dose of herbicides and can only be created by GM technology. This is the basis of popular press assertion that GM technology could create supper weeds or that super weeds , resistant to herbicides are spreading almost everywhere modified crops are grown, often because they have acquired the genes via cross pollination.

There are other localized misconceptions aimed at discouraging farmers from growing GM crops. In 2004, in America, voters in Mendocino County, California, banned the cultivation of GMOs and at the same time legally redefined DNA as proteins.

The President of Zambia rejected food aid for his country as he was counselled that the GM corn food aid was poisonous.

A judge in the Philippines asks just how strolling through a GM cornfield can cause a man to become gay.

Farmers in India are told that GE seeds carry a Terminator gene that renders the seeds sterile and will infect other crops causing them to be sterile too (McHuhen and Wager, 2010).

None of these misconceptions are true, in spite of some peoples sincerely held belief that they are true.

Transgenics and Human Health

Plants are the basic ingredients for human food. A major worry of the public, apart from the mainstream concerns is that transgenic crops contain ethically sensitive genes including antibiotic marker genes and promoter sequences derived from viruses. Some scientists and journalists have raised concern that human health will be adversely affected by consumption of transgenic crops and products derived from them (Coghlan *et al.,* 1999). The effect of this misinformation to the public led to some restaurant chains having to remove GM foods from their menu. In a similar way, some schools have banned GM products with increasing demand for organic foods in supermarkets. The real fear is that antibiotic marker genes could be recruited into humans and possibly domestic animals thereby rendering antibiotics ineffective in curing bacterial infections. It is also a worry that transgenic foods will be toxic and allergenic. The response to this is screening for toxins and allergens in GM foods to reduce the chances of releasing dangerous foods to the public. Careful labelling is also advocated for individuals with allergies and those averse to consumption of transgenic foods.

According to Robinson (1999), human health already suffers as a consequence of agricultural systems /practices. Commercial banana production for example requires applications of large amount of pesticides which pollute the environment, and whose residues accumulate in plantation workers. Question is; would it not be ethically justifiable to produce a transgenic banana variety that would allow for reduction in pesticide application and a subsequent improvement in health of plantation workers?

Stakeholder Positions

Scientists and policy makers were among the key stakeholders that were familiar with the debate on GMO issues and national agricultural policy. Based on the methods of stakeholder

selection that was adopted from the policy network approach developed by Laumann and Knoke, (1987), policy makers and scientists were selected due to their roles on GMO issues in Ghana and Nigeria. It was surmised that policy makers and scientists are in the best position to inform the national government on how to adopt GMOs as they are the two stakeholder groups responsible for the development of regulatory frameworks across various government departments. They were chosen because they assume most responsibility for decision making and play significant roles in agricultural developments. While most scientists in both countries believe that biotechnology could benefit agricultural growth, they are of the opinion that biotechnology may not be the most appropriate solution to their agricultural problems. These include lack of credit facility to purchase farm inputs, and lack of right information due to poor extension services (Ademola, 2014). However, there is a high degree of agreement among scientists from both countries that adoption of GM crops may bring some advantages to agricultural development in light of inefficiency of the traditional plant breeding and food security problems. According to a focus group interview with scientists, Council for Scientific and industrial Research, (CSIR), Crops Research Centre, Kumasi, Ghana 2011, GM technology is a new approach to support traditional plant breeding ...simply to identify the desirable gene from alien sources beyond the species level and transfer the gene from distant related crop to make the production of improved varieties much faster and more directly to help a farmer with a product that reduces impact of agro-chemical practices through the production of herbicide tolerance and bring about quality improvements such as improving protein levels, Vitamin levels and reducing fatty acid content.

According a Nigerian policy maker, 75 % of over 150 million people in Nigeria live in poverty...agriculture is the only way to survive and we may have food security problem as our population continue to rise and there is no doubt that biotechnology can be part of the solution. However, It is essential that the risks and the benefits are carefully taken into consideration and that those who stand the most to lose are farmers and not those actively involved in the decision-making process. Moreover, GM crops bring with them potential socio-economic risks, such as patents and biological mechanisms for companies to control the seed supply. These have profound impacts on agriculture and should be considered in the evaluation of the risks and benefits. Given the clear risk of GM crops, a precautionary approach to their release should be implicit, but often is not. The issue of biological

mechanisms to control abuse of GE seed, 'the terminator seed technology' has been addressed earlier.

Specific issues discussed included disease and insect –resistant GM crops, requiring little or no insecticide sprays, drought resistant GM crops, GM crops with high yielding varieties and improved performances. Also GM crops with higher nutritional value and those with longer shelf-life. The African scientists were of the opinion that GM technology can play a significant role in increasing crop productivity, assuring food security through sufficient production both in quality and quantity, and in reducing human or environmental exposure to chemical pesticides thereby saving energy, time and costs and improving the health of farmers. Additionally, the scientists were emphatic that improving common staples like maize, yam, rice and cassava via micronutrient enhancement will address issues pertaining to malnutrition and Vitamin A deficiency. Furthermore, human health implication was not seen as major due to lack of convincing evidence, though there are concerns about potential environmental impact. It is feared that some valuable traditional crops could be affected due to gene flow and suppression of these indigenous crops could spell doom for their traditional agricultural heritage (Ademola, 2014).

The promoters of the technology

The multinational companies that fund research and production of GE crops are staking their resources for two reasons; investment with potential high return premiums and efforts to address world hunger and malnutrition including shortcomings of the traditional agriculture.

The moral imperative of agricultural biotechnology

Agriculture is unique in that it has natural and unnatural side united in its core. Without human intervention, there will be no such thing as modern agriculture. However, we remain dependent on very natural and given systems too, since otherwise no agriculture will be possible (Haperen et al., 2012). There is no such thing as completely artificial agricultural production, just as there is no agriculture without human intervention. With the increasing fall –out from agricultural expansion, it has become clear that the very success of the technological innovation now seem to threaten the natural system that agriculture depends. This is the basis of the link between discussion about biotechnology, nature and natural boundaries. In the case of GMOs, questions were raised of whether this technology is or no longer is, natural and whether the creation or introduction into the environment of living organism that are 'unnatural' can be accepted as a means to attain sustainable and responsible

agriculture. To most plant scientists, the process is nothing short of mimicking nature. However, in the light of these arguments, global population is expected to rise above 9billion by 2050; average living standards are also rising, impacting on food consumption, demand for grain for livestock sustenance and finally on the agricultural land use. To meet the target of 70% more food by 2050, an average annual increase in cereal production of 44 million metric tonnes per year is required (Tonelli, 2012). These are in the faces of several challenges including, dwindling resources, impacts of climate change both on weather patterns but on disease and pest dynamic. Viewed from these perspectives, the moral basis of unnaturalness of biotechnology as potentially the most up to date innovation in agriculture will be taken more seriously. In addition, most of the potential shortcomings of the technology according to the opponents fail to take into cognisance the fact that comparisons being made are between something new and the very old that were adopted without the current suspicion and scrutiny.

However, unlike Maxine Singer, who professed to be eager to bite into a raw Flavr Savr from her supermarket shelf, many alternative consumers found the idea of genetic modification profoundly alien to their sense of the natural order of things. For these affluent and increasingly more numerous consumers, the process of food production was itself a valuable product (Jasanoff, 2005). Accordingly, buying organics is like buying into a mode of production that reinforces basic ethical commitments towards community and nature by using economic power to sustain a moral and political order. The same argument holds for the people in the developing world with food crops developed from conventional breeding. These in spite of their level of food insecurity, should not throw away their age long cultural standing just to avoid starvation. As later stated by Jasanoff (2005), concern about the food safety and integrity of food supply is not the prerogative of any single nation or particular segment of the consuming public. Thus, GM foods were never viewed in isolation from wider issues of agricultural practices, nature preservation, and the integrity of food.

HISTORY AND SHAPING OF THE POLITICS / CONCERNS OVER GM FOODS

Starting sometime in 1986, Bovine Spongiform Encephalopathy (BSE) erupted into a full blown national issue in Britain and beyond a decade later in 1996 British authorities announced that contrary to the governmental assurances, the disease had crossed the species barrier and was causing deaths among infected people. As BSE in cattle, the fatal disease in man occurs as variant Creutzfeld-Jacob Disease (CJD). The outcome was loss of confidence in the Ministry of Agriculture, Fisheries and Food (MAFF). Thereafter, MAFF was

dismantled and its responsibilities transferred to Department of Environment, Food and Rural Affairs (DEFRA), and a new Food Standards Agency was formed for expert advice to the government on foods. Among the findings of the commission on BSE was that British health and safety experts had acted as a narrow and secretive community: they were complacent about empirically unverifiable risks yet unwilling to commission new research to improve on available knowledge and display any uncertainty to a public they saw as irrational, and prone to panic (UK Govt, 2000). These revelations shook people's faith in a decision making system founded on the premise that governmental experts know best. Doubts were indeed raised whether, at moments of crisis, appropriate experts are available to cater to urgent public needs. This spurred the call for the need to democratize decision making in scientific matters instead of what hitherto obtained; leaving the decisions to the experts. Thus, when the British environmental and consumer groups rose to protest against GM foods, it is obvious that BSE was the beginning of their discontent. Both involved industrialization of food supply, with techniques not seen as natural. What caused BSE? Unnatural modern feeding practice as found in modern agriculture was fingered as the cause. There was again panic resulting from premature press release in 1998 about the findings of Arpad Pusztai regarding the potential health effect of feeding transgenic potatoes to rats. To the Americans, their position is exemplified by statement credited to Senator Christopher Bond ' I am passionate because I believe the greatest risk associated with biotechnology is not to the Monarch butterfly larvae, but from the nay-sayers, who may succeed in their goal to undermine biotech and condemn the world's population to unnecessary malnutrition, blindness, and environmental degradation (Bond, 2000) . About the unnaturalness, Americans believe that the thing to fear most was not genetic modification in agriculture, but opposition to it. Certified by science as safe, genetic modification of crops and foods was seen to be natural as any other agricultural practices, indeed more so than treating growing things with unnatural chemical pesticides. GM crops and foods are safe, and indeed, the science that underwrites this conclusion, is embedded in a longer historical process of coming to terms with uncertainty about this mode of production.

In the late 1950s and throughout the 60s, the concept of green revolution was developed. Establishment of seed banks, developments in genetics and public-private partnership, quickly led to greatly improved technologies for targeted breeding (Kloppenburg, 2004). New cultivars multiplied productivity in agriculture in a way that had previously been unforeseen by concentrating breeding on yield characteristics and by compensating for the

lack of natural robustness of these crops with synthetic chemical inputs for nutrition and disease control. The development of bumper crops in combination with the chemical approach also marked the conversion from a rural to an industrial and capitalized agro-production process. However, during the 1970s and 1980s, the downside and limitations of this industrial production in comparison with the natural approach was very apparent. The green revolution produced a growth of large scale agriculture at the expense of small holders, affecting the livelihood of small producers in the developing countries. The increased use of fertilizers, herbicides and insecticides led not only to environmental degradation and pollution but also to the concentration of agricultural power in the hands of big companies (Murphy, 2007; Goodman, 1987). The focus on production and quantity was found to be leading to loss of quality as well as leading to complaints by consumers of loss of taste and texture by the agro-products. Following this is the spread of disease caused by mono-cropping and development of resistance to pesticides. At this stage, the genetic base of popular cultivars have become so narrow that breeding efforts to improve quality became difficult, giving rise to yet another concern this time of biodiversity. The features of peak green revolution characterized by a) concentration of farms in the hands of big corporations and take over from small scale holders; b) increased use of fertilizers and pesticides with concomitant pollution and environmental degradation; c) loss of quality by agro-produce; d) increasing incidents of diseases; e) emergence of mono-cropping as an agricultural culture and finally loss of biodiversity. These are the sins for which biotechnology is being accused punished in the opinion of the public. The implication is that as a new innovation in agriculture, people are weary of their not so distant experiences and feel that biotechnology may after all not be so different with the bad sides of green revolution.

The fall-out is the modern environmentalism, criticizing the over exploitative and chemical approach to agriculture resulting in the advent of the opposite of the natural forms of agriculture and food. Organic (ecological) agriculture presents itself as a more equitable alternative compared to industrial, capitalistic approach. Biotechnology is tantamount to playing God by crossing the species barrier supposedly placed by God which is considered unnatural. Naturalness of plants refers to its inherent nature, wholeness, completeness, species specific characteristics and being in balance with the environment, all through evolutionary adaption. The intervention by introducing artificially created life forms is thought to interfere or infringe on natural schemes and to create an imbalance that has negative impacts (Levidow, 2000). Proponents of biotechnology see a world of opportunity

and benefits, the arguments of naturalness expresses the reluctance of people to allow science in this domain because they cannot comprehend the extent to which it could lead to changes that upset our lives and society. Similarly, Fukuyama (2003), acknowledged that knowledge of genomics opens the door to altering ourselves and our society beyond recognition.

On the issue of the potential benefits to consumers, the morality and trusts on the gatekeepers of biotechnology is being tested. Consumers seem to have become more cynical of the technology especially when they have wide concerns about its impact, because they have started believing that such innovations only serves the interest of the producers and manufacturers (Frewer et al., 2003). Critics argue that genomics in agro-biotechnology is simply the latest incremental intensification of agricultural production created by an exploitative industrial system that has steadily built up momentum over the years. This questions the integrity of commercial actors and their role in influencing the trajectory of agricultural system. There is need for proper representation in the social institution that have control over the benefits of genomics technology to assure that a fair distribution remains more than just a well-meant intention with serious doubt in the globalizing world. Gen tech developments could contribute to food security in the developing countries (Buchanan, et al., 2000). For biotechnology to contribute to food security in developing countries, issues such as Intellectual Property Rights (IPR), the conflicts between the breeders rights, farmers privilege, biotechnology patents and the genomic data base, will need to be resolved first. There is fear that a system that treats genetic data, combined with the biotechnology inputs and outputs, as ordinary tradable factors under a global IPR system leaves the distribution of its benefits to market forces. According to Hardt and Negri (2009), neither life nor its building blocks should be appropriated by private enterprises because they belong to the commons. Here in lie much of the challenges that face adoption of biotechnology in agriculture and food.

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