PEST MANAGENEMENT IN FOOD SECURITY

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Introduction

The proportion of the undernourished in Africa and other developing countries elsewhere around the world has remained constantly high since the mid-1990s despite the combined efforts of national governments and the international community at reducing hunger and malnutrition as outlined within the context of the Millennium Development Goals (MDGs) and other initiatives (FAO 2010). Indeed, there have been some remarkable achievements at reducing hunger; at least up until around 2007. In 2008, there was a global food price crisis and subsequent food price spikes in local markets which subsequently pushed millions of people to food insecurity (Brinkman et al. 2010; FAO 2009a). The main causes of such rise in global and national food insecurity among others were the overly trade restrictions imposed by major food exporters including those that bother pesticide residues and pest risks and management issues, biofuels policies as well as increased food commodity speculation alongside poor national and local governance to cope with such shocks (Nelson et al. 2010; FAO 2011).

Different approaches and a broad range of policy shifts have been proposed and executed to reduce the vulnerability of the poor populations to general food price spike challenges; including the amendments of overly restricting global trade rules (Fan et al. 2011; World Bank 2012a). Only a few of the proposed policies were implemented, and so, the expected lowering of food prices after the 2008 global food price crisis was short-lived (World Bank 2012a). The World Bank food price index peaked in 2008 and early 2011 and had stabilized at about double its 2005 level throughout the first quarter of 2012 (World Bank 2012b). Consequently, the causes of recent food crises and the proposed responses have shown how complex the global food system is and has underscored the rising importance of factors that go beyond agriculture. Yet, interventions to address food insecurity have often focused on agriculture-based approaches and these have been geared towards improving households' access to food. However, the MDG progress assessments have confirmed that the developing world has been particularly and consistently off-track in achieving those goals that are closely linked to food and nutrition security (FNS) (World Bank 2012a). The purpose of this presentation is therefore to examine food insecurity problem and the challenge of pest management in the developing world.

Food Security

Food security has been defined as ''the ability of food deficit countries or regions within countries to meet target consumption level on a year-to-year basis'' (Valdes & Siamwalla 1981). In 1986, the World Bank issued a food security policy paper in which food security was defined as ''access by all people at all times to enough food for an active, healthy life''. Food security has two inter-related components: the availability of food through production, storage and import and the ability of all people in a nation to acquire a calorie-adequate diet. The three central ingredients of food security are food availability or adequate food production; economic access to available food; and nutritional security, which often depends on the availability of non food resources such as child care, health care, clean water, and sanitation.

One of the great challenges facing the world is to ensure that everybody has access to adequate food that is healthy, safe and of high nutritional quality- and to do so in a manner that is environmentally sustainable. At present the current global food system is dramatically failing to deliver on this goal. It is estimated that a billion people go hungry or suffer from lack of

micronutrients, while, at the other extreme, and even greater number of people are suffering from the effect of overweight and obesity as a consequence of eating unhealthy foods. The costs of treating the impacts of this double burden run into billions of dollars. Clearly, there is an urgent need for fundamental change (Hunter, Fanzo and van Walsum, 2011). Form the foregoing, it is very clear that sustainable production of food is a first pillar of food security and this is where agriculture plays a key significant role.

In the 2012 global hunger index, African countries had low to extremely alarming hunger severity due to undernourishment; child underweight and mortality and Nigeria belong to the serious hunger category (Barret, 2002; Clapp, 2005; Barret, 2010; Grebmer *et al*., 2012).Complexities of factors are responsible for food insecurity in developing nations (Dupont and Thirlwell, 2009). These include unstable social and political environments that prohibit sustainable economic growth, war and civil strife, macroeconomic imbalances in trade, natural resource constraints, poor human resource base, gender inequality, inadequate education, poor health, natural disasters, such as floods, pests and diseases infestations, and the absence of good governance (Webb and Block, 2010; World Bank 2012a). All these factors contribute to either insufficient national food availability or insufficient access to food by households and individuals. The world population has been projected to reach 9 billion by 2050 therefore to ensure food security there is the urgent need to advance agricultural productivity and competitiveness.

Attainment of food security in any community demands a multifaceted approach since myriads of factors have made food security a mirage. Insect pests threaten arable crops, high value fruit and vegetable crops and livestock. An important strategic component to raise agricultural productivity and promote global food security is investments in pest management practices that are environment-friendly and economically sustainable for all stakeholders (smallholder farmers, private and public sectors). Investments to enhance crop yields and livestock growth would reduce hunger and malnutrition leading to a sustainable world. Therefore, smart, site-specific agroecological approaches that increase agricultural production, conserve natural resources tailored to specific human and environmental conditions should be favored (von Grebmer *et al*., 2012).

Causes of food insecurity in developing nations

The concept of food security aims at facilitating the devising of promising pathways out of hunger and malnutrition. However, consequent upon the recent food crises, the concept of food security may extend to a stronger focus on nutrition outcomes such that over time, food security and related approaches to addressing food insecurity could be developed and modified in accordance with the common understanding of the nature of food crises as well as the evolution of a global food system (Maxwell 1996b; Maxwell and Slater 2003). Several factors have been identified as constraints to food security in African countries (Ravallion and Chen, 1997; Diaz-Bonilla et al. 2002; Timmer 2000, 2005; Andersen, 2009; Dupont and Thirlwell, 2009; Breisinger et al. 2012). However a few of such causes are highlighted below.

Extreme weather conditions, especially drought. The occurrence and prevalence of unfavorable weather conditions have remained a major factor that has resulted in poor or failed harvests which led to food scarcity and skyrocketing food prices. This has different presentations either in the form of drought or unstable weather conditions (Toulmin, 2009).

Climate change. This is also related to the extreme weather conditions discussed above. Indeed, the occurrence of drought in West and East Africa has been traced to climate change. Wars and other forms of conflicts. Wars and military conflicts indirectly affect food crisis by aggravating food security. In addition aid workers have been prevented from reaching affected communities because of such political crisis.

Lack of emergency plans, corruption and political instability. Many countries in times past did not have a backstopping mechanism in place before food crisis period. Therefore, when crises struck, they were unable to resolve the issues nationally hence they looked up to international aids. Eventually when such aids are provided, they often do not reach the most vulnerable populations due to high level of corruption and political stability.

Dependence on cash crops. Many African countries encourage production of cash crops at the expense of arable crops. The incomes generated or derived from the cash crops are used to import food. Therefore, any such countries which depend on cash crops are at high risk of food crisis because they do not produce enough food to feed the population, let alone have left over for export.

Pests, livestock diseases and other agricultural problems. Cattle diseases and other agricultural problems such as erosion, soil fertility also plays a very crucial role in creating food insecurity. Food production per unit of land is limited by fertilizers, water, genetic potential of the crop and organisms that feed on food plants called pests. Pests are particularly important because they interfere significantly with plants that are of interest to man, right from the seedling stage to harvest and to post-harvest (Dhaliwal, *et al.,*2004). Pests as constraint to food security comprise invertebrates such as arthropods (insects, mites); vertebrates like rodents and birds; pathogens such as fungi, bacteria, viruses, viroids, mycoplasma-like organisms, nematodes, and weeds.

Worldwide, about US$500 billion has been estimated to amount to total yield losses from different pests on all crops and about 69.8% of attainable production is lost to pest infestations when their activities are not controlled. Animal pests account for 15.6% loss of production and weeds account for 13.2% (Oerke, *et al.,* 1994).

Appreciation of Pest Problem

Pest is any organism which feeds on and damages cultivated plants, attacks plant products in the field or in storage, causes a nuisance or transmits pathogenic organisms to plants, man or domestic animals and livestock is regarded as a pest (Youdeowei & Service 1993). They include insects, fungi, viruses, nematodes, weeds, rodents, birds etc. Pests are as old as the cultivation of plants for food production. Early man suffered little harm from insects other than bites that inflicted physical discomfort on himself and members of his family. But with the dawn of

agriculture and the gradual sophistication of farm production and farming technology over the years, man's pest problems multiplied and because man usually breaks an essential link of a stable ecosystem, pests go on rampage. Pests damage crops at different stages of growth on the field, at harvest, during transportation and in storage. It is estimated that, every year, crop pests take away about 30% of potential food, feed and fibre production worldwide, equivalent to about US$ 300 million (UNDP/FAO, 1992). Crop losses of about 5-40% each year due to pest have also been reported (Stephensons, 1991) while they also account for roughly 30% of the untaken harvest (Erinle, 1992). According to Alabi *et al*., (2006), these yearly crop losses have a serious effect on the food security for the ever increasing population of Nigeria. The management of pests in crops to obtain a better yield is therefore paramount for food security.

Pest Management practices and the challenge of food insecurity

No doubt, pests constitute a direct major constraint to efforts at making food available right from the point of production in the field, in transit while on its way to marketing as well as in the store (Dhaliwal, *et al.,*2004; Omoloye, 2008; 2009). The peasant nature of African agriculture with its characteristic small holder farming makes the challenge of making food readily available more daunting. The small farm holding as compared to the commercial farms of the developed countries become very vulnerable. Damage is also always high due to poor and inefficient methods of managing pests. The pests attacks eventually create food scarcity and a lot of wastes.

Pest management is supposed to be the science of intelligently preventing, suppressing, or eradicating biological organisms that cause or are capable of causing a problem to the agricultural enterprise. The term "pest management" is often used in place of such terms as "pest control," "plant protection," or other equivalent expressions probably because of the ecological approach to managing pest populations in which population reduction rather that pest eradication is key. The term "pest" on the other and is often used to refer to any organisms but more to invertebrates (arthropods, slugs, etc.) as a group in contrast to plant diseases and weeds which affect humans negatively and cause economic damage that warrants application of control. However, this narrow application of the term "pest" is not right but should apply to any biological organism whether pathogen or weed - especially when the problem is associated with agriculture or environmental concerns.

Pest management practices may be classified in different ways but more according to the *approach* or the *method* that is adopted or used to deal with a pest problem (Omoloye, 2008; 2009). In terms of approach, pest management practices may be designed to achieve any of the following objectives: prevention, suppression or eradication, each of which is elucidated below.

Approaches to Pest Management

Prevention – This describes the action taken in anticipation of a pest problem. This approach which is often described as prophylactic may include any applicable method with proven integrity that is used to prevent or reduce the probability of a significant pest problem from occurring in a given circumstance. This preventive approach may include either chemical or non-chemical methods. For example, when farmers apply granular soil insecticides at planting, it is assumed that the treatment will prevent a significant loss in yield that is caused by soil insect or nematode pests. Similarly, when a grower applies a pre-emergent herbicide before weeds begin

to appear in the farm, the idea is to prevent the weed seeds already present from germinating and creating problems for the crops as the season progresses.

Suppression – This is the term used to describe all actions that are taken after a pest problem has been detected to suppress the pest population. Although in practice, only a few treatments can totally eliminate a pest problem, yet the pest population is reduced to an economically low threshold level at which it is no longer believed or perceived to be a problem. Post emergence application of pesticides to reduce emerging pest populations is regarded as suppression. The use of chemical methods is generally associated with suppression practices, but non-chemical methods may also be employed to suppress a pest problem.

Eradication – This approach is adopted when a pest problem has reached a critical point at which they must be totally eliminated from a designated area. For example, if a new pest such as the Mediterranean fruit fly is detected in a fruit growing area, regulatory agencies may implement widespread actions that are designed to eliminate the pest problem totally before it becomes established. This approach is commonly used where intervention is made to stop a ravaging epidemic. For example, fumigation tactics may be employed to totally eliminate the presence of an unwanted pest from stock identified as infested when a serious pest problem is detected early in a commodity of foreign origin. However, it should be noted that the eradication approach does not apply to elimination of an established pest population from a large area.

Major Techniques in Pest Control

With regard to methods, pest management practices may be classified into a number of categories of which the most common are: chemical; cultural; mechanical; biological; legal.

Cultural Controls

Cultural controls include all modifications to agronomic practice intended to reduce pest damage, or having this effect although primarily introduced for another reason. The reduction may come about by avoidance of the pest or by creating conditions which increase pest mortality. These include the timing of planting and harvest, good husbandry/farm sanitation, cover crops, destruction of crop residues, rotation, poly cropping etc. Other major control techniques are Biological and Chemical (Pesticides).

Chemical Control

Generally, it is widely acceptable that pesticides are the best and fastest means to reduce pest damage, and farmers have become dependent on them to ensure the yields which they now expect. Will intensification of crop production in Nigeria mean a continuous dependence on chemical pesticides for pest management? Perhaps not as it has become apparent that a dependence on pesticides may not be an effective and sustainable way to manage pests. Some of the problems associated with the widespread use of pesticides include:

Elimination of beneficial natural enemies. The free contribution of these natural enemies in pest management is often eliminated by pesticides, which kill them as well as pests.

Resistance to pesticides. Over 500 pest species have now developed resistance to one or more variety of pesticide. In the short term, this means that farmers use even more pesticides, at greater expense and with greater effect on beneficial natural enemies.

Pesticides can be dangerous. Improper use of some pesticides can cause illness, even death, amongst farmers and other users. In Gombe, Nigeria, over 120 students of a Secondary School were poisoned as a result of consuming a meal of beans suspected to have been preserved with poisonous chemicals which analysis showed that the foodstuffs from which it was prepared contained outrageously high levels of lindane (Pesticides News, 2008).
Residues of pesticides on harvested food can affect the health of consumers. They can also affect man and his environment when they are washed off the crop into water bodies and soils. Pesticide residues monitoring efforts in the Nigeria have revealed the presence of pesticide residues in meat (Osibanjo and Adeyeye, 1997), fruits, vegetables and fresh yam tubers (Adeyeye and Osibanjo, 1999), in agricultural soils (Oyekunle *et al*., 2010); in maize samples (Ogar *et al*., 2011); in beans (*Phaseolus vulgaris* L.) (Ogah *et al*., 2012); in cocoa beans (Aikpokpodion *et al.,* 2012) and in cowpea and dried yam chips (Olufade, 2012). Sosan *et al*. (2008) also found residues of lindane, endosulfan, diazinon and propoxur insecticides detected in the blood serum of cocoa farmers in southwestern Nigeria.
Pesticides are expensive. They are imported from abroad using precious foreign exchange.

Apart from the above highlighted problems, the contributions of other stakeholders in the pesticides distribution chain contribute to the pesticide misuse and abuse. These are briefly enumerated as follows:
Dealers have little or no training in advising their customers on the proper use of pesticides. Ignorance of the toxicity of the products is common. For example, agrochemical retailers in Osun State, Nigeria have been found to have limited access to information on proper handling of pesticides that could provide detailed guidance on protection to famers and other customers (Sosan *et al.*, 2013).
Users are also inadequately trained in the proper use of pesticides. They depend on manufacturers' information, word-of-mouth propaganda, and trial and error (most often the last). They tend to regard any treatment as preferable to none. Spraying too much is better than spraying too little.
Because of the massive quantity of advertising by manufacturers and promoters of pesticides and the desire of the developing countries to conform with the "modern" life-and production-style of industrial countries, heavy pesticides spraying has come to be seen as the road to progress and development.

Biological Control (Biopesticides)
Another development in pest management as an alternative to synthetic pesticides are the use of Biopesticides Biopesticides are certain types of pesticides derived from such natural materials, primary microbes, but can also be originally from animals, plants, and certain minerals. These are Microbial and Biochemical pesticides and Plant extracts

Microbial pesticides
These consist of a microorganism (e.g. a bacterium, fungus, virus or prototozoan) as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest(s) For example, there are fungi that control certain weeds, and other fungi that kill specific insects. The most widely used microbial pesticides are subspecies and strains of *Baccillus thuringiensis*

Biochemical pesticides Naturally occurring substances that control pests by non-toxic mechanisms. These include substances such as insect sex pheromones, that interfere with mating, as well as various scented plant extracts that attract insect to traps.
Plant extracts: There is a large spectrum of plant extracts, i.e. unprocessed extracts representing a "cluster of substances' or highly refined products containing one active substance.

Advatanges of biopesticides
Usually inherently less toxic than conventional pesticides
Generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects and mammals.
Often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides.
When used as a component of Integrated Pest Management (IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while crop yield remain high.

Quarantine against Pests (Legal)
Introduction of exotic pests can be avoided by enforcing quarantine control of introduced germplasm. This has enabled some developing countries to avoid serious pest problems; For example, Malaysia maintains a strict control of imported planting materials, especially from South America, chiefly to protect the rubber industry from South American leaf blight *Microcylus ulei.* However, a breakdown in quarantine has resulted in three serious pest problems affecting cassava in Africa, a crop formerly suffering from only one important disease-African cassava mosaic. Cassava green spider mite, *Mononychellus tanajoa,* reached Uganda in 1971, cassava mealy bug, *Phenacoccus manihoti,* reached Zaire in 1973, and cassava bacterial blight, *Xanthomonas campestris* p.v. *cassava* appeared in Nigeria in the early 1970s.

Integrated Pest Management

The term "*Integrated Pest Management*" (IPM), is used when several approaches and methods are intelligently combined in an ecologically friendly manner into a pest management system. Thus, such takes into consideration the ecology of the environment and all relevant interactions that pest management practices may have upon the environment in which one or more pest problems may exist. It is generally assumed that probable environmental impact and economic risks would be minimized when IPM principles are applied correctly to a given pest situation. Since IPM considers all relevant applicable methods, it also assumes that the undue emphasis on chemical methods would be reduced when non-chemical alternative methods with proven effectiveness are available (Omoloye, 2008; 2009).

IPM is an acceptable direction in crop protection which aims to conserve and enhance naturally-occurring limiting factors, such as parasites and predators, as much as possible, in order to contain pest organisms below thresholds causing economic damage. In this approach, chemical pest control is applied selectively, and only when other methods and techniques have proven unsuccessful in keeping pest populations below acceptable levels.

IPM offers the best prospects for meeting Africa's needs for pest management in support of increased crop production. At the heart of IPM is the concept that pest organisms are of concern

only when they reach damaging levels in the crop. This means that we must understand the relationship between the numbers of a pest species, the damage which those numbers cause, and the effect of this damage on yield. With all these information available, we can determine when we need to use measures to control a pest and when we do not. Thus, IPM with its various techniques is often thought of not as a specific package for pest management, but as a 'basket' from which a suitable combination of techniques is selected and modified for a particular locality, crop and pest complex. Use of sampling techniques and traps can be important means of assessing population densities and forecasting outbreaks. However, it is the farmer who must practice IPM, and he or she must therefore be involved in its development.

Although the need for sound crop protection methods and IPM systems in small farming situation is generally recognized, the implementation of such system in the tropics is advancing at a very slow rate arising from difficulties and constraints in implementing IPM in developing countries which include general poverty and low agricultural outputs of small farmers, inability of government to always recognize the necessity of increasing the small farmer's output and profit in order to improve crop production, underdeveloped scientific infrastructures and instability of institutions and their personnel and lack of facilities for essential research which can modify external experiences of IPM for a particular crop to the local situation. These restraints are aggravated by generally inadequate levels of funding.

New Technologies in pest management

There are fresh technologies now available for managing pests in agriculture. This ranges from the high tech sterile male techniques, advanced use of pheromone which have recorded remarkable successes to the now genetically modified organisms. Perhaps the most common is the use of Bt-gene in developing pest resistant corn varieties. These approaches are new and currently and in the front burner of global politics. Bill Gates Foundation and other philanthropist have identified these new approaches as panacea to food security (Riely *et al.* 1999). Unfortunately, these have not attained the expected level of acceptance as the needy countries are not sure yet of the consequences of consuming such new products. While the debate is on, it yet remains a potential answer to the much awaited food security. There is also the nuclear technology already in place which can help in the effective and environmentally friendly control of insect pests.

Pest management practices and implications for food security

The pest management practices in operation have serious implications on the availability or otherwise of food in the continent. The issue of food security is in the front burner of global politics that is hinged on several other contemporary issues such as climate change, regional conflicts and wars and pest management issues. Food insecurity in whatever guise has serious consequence for human and livestock survival and so, the underlining political tone should be understood (Dupont and Thirlwell, 2009; McDonald, 2010; Foresight 2011). Food insecurity could be direct lack of access to food or its manifestation in the form of nutritional deficiency. It also involves the fear of the potential use as tool by terrorists or poisoning that may result from bad pest management practices especially pesticide abuse. All these consequently affect food security and the implications could be summarized as follows:

- The burden of pest management in the form of capital at different levels either at government or individual levels; for managing pest challenges are enormous. To date, the bulk of pest management practices is hinged on the use of pesticides. This unarguably is capital intensive. In addition, the pesticides are usually not readily available as at when needed. Therefore, the lack of access to pesticides and other farm inputs either in terms of non-availability or lack of fund to purchase often cause crop failure and preventable wastages in the field and store.

- The introduction of genetically modified crops with specially reference to those carrying the Bt- gene among others have come as a revolutionary pest management approach but this technology and others like it are being received with mixed feelings. There had been so much global politics on the use of GM- crops. There had been expressed and unexpessed fears particularly in many developing countries whether it is perceived to aid; whether adoption for use of any GM-crop could trigger undesirable consequences. The implication of this is that; although the advent of GM-crop brought with it a promise of meeting food security challenges, it appears that it has not gained the expected world wide acceptance even in the needy poor countries.

- Perhaps one of the greatest challenges of the late 1990s was the public scare about pesticide poisoning. The issues surrounding the occurrence of the killer beans in markets in the southwest Nigeria were classic. Military governors in the southwest states especially Lagos had to publicly consume bean cakes made from such beans to demonstrate safety. Even then, this resulted in several consignments of such commodities being thrown away or destroyed. All these have serious consequence for food safety and security.

- Another major implication of pest management practices is land contamination. Land is a major resource for agriculture. Most often, the damaging effects of all pest management practices eventually settle on the land. In the process, most living organisms in the soil are killed while the soil structure is deformed. When the land for food production is rendered poor and unfertile or toxic, the result is food insecurity. The proportion of land available for productive agriculture is reduced.

Food Security Strategy: Nigeria's Effort

In mid-2007, the FAO raised an alarm indicating that the whole world was in a food crisis situation, when it was observed that food prices had soared to an unprecedented level of 40% in the past year. This situation was soon to resonate with a global meltdown in the financial market to trigger the recession of the world economy at large, which poses a major challenge to many countries. FAO is a long-standing partner to the Federal Government of Nigeria for the purpose of agricultural development. The world body implements several projects in partnership with the community and other partners at different locations in the country.

Thereafter, in 2007 FAO launched an initiative to boost food production in the short term namely Initiative on Soaring Food Prices (ISFP). Part of the initiative is advising governments on policy

measures in response to the crisis, including a general guideline to provide an overview of different policy responses to higher food prices, their possible effects, advantages and disadvantages. The National Programme for Agriculture and Food Security (NPAFS) is the latest effort of the Federal Government of Nigeria towards repositioning agriculture sector in general for better performance, based on a strategy document produced on National Food Security Programme which adopts the value chain approach.

The National Programme for Food Security NPFS was designed as an integrated initiative to promote the development of synergies between the various components and decentralize project implementation to attract greater project ownership at State, Local Governments and beneficiary levels. The objective of the NPFS is to improve national food security and reduce poverty on an economically and environmentally sustainable manner, using the "twin-track approach", whereby food production and ready access to food are addressed. This is a direct effort to achieve the objectives of the Millennium Development Goals, in particular the MDG -1. In specific terms, the NPFS programme is expected to improve household food security and incomes through increases in agricultural production and productivity, diversification and sustainable use of natural resources, enhance food security of consumers through improved access to and availability of food and also increase the income of producers through more efficient marketing, enhance farmers' and consumers' access to support services such as extension, credit, nutrition and health education and foster participation of the poorer sections of the rural population in the development of their communities. The recent mid-term technical report showed that NPFS is already enhancing sustainable food security; promote beneficiary empowerment, and revenue generation as well as achievement of improved nutrition, health, and well being and livelihoods of beneficiary communities (NPFS Mid-term Technical Review, 2011)

Conclusions

From the foregoing, it thus appears that food insecurity remains a major development issue for Africa with many periodic food and humanitarian crises caused by droughts and other natural calamities, wars and displacement of populations, lack of agricultural inputs, high international prices, overdependence on imported food stuffs, and more importantly, pest management practices. It is important, therefore, that food security remains high on the continent's development agenda.

Although the advent of chemical pesticides in modern agriculture was revolutionary as it solved critical pest problems in the past, yet it also presents fresh challenges to food security in the form of high cost, negative effects on the environment and non availability. Consequently however, the new technology of genetically modified crops which is also revolutionary but not yet accepted could be a right step in achieving food security particularly in the developing world. Since human and livestock populations keep increasing, it is important that direct efforts are made towards achieving food availability. As it is at the moment, intensified agricultural research through its inventions for appropriate management of pest issues such as the development of host crop resistance, biological control in addition to the aforesaid introduction of genetically modified crops appear to have the answer.

There is no doubt that efforts to promote development and improve food security cannot succeed in the long run without well-qualified local personnel and indigenous institutions to provide right incentives for, motivate, and manage these efforts. Though a great challenge, building this local capacity is essentially the responsibility of government at all levels with additional complimentary efforts from international agencies on terms clearly dictated by national governments.

Transferring knowledge in agricultural research from Universities and Research Institutes to productivity gains in farmers field remain a challenge for many nations including Nigeria. The iterative process between **policy** of **science** is completely non-existent. This is quite unfortunate. The Nigerian government should take this up as a challenge. Capacity building in Agricultural Research, extension and education must be strengthened if the nation is serious about achieving effective pest management for adequate food security.

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