Technology Fact Sheet for Adaptation

Technology Factsheet: Ecological Pest Management (EPM) [i]	
Technology characteristics	
Introduction	Ecological Pest Management (EPM) is an approach to increasing the strengths of natural systems to reinforce the natural processes of pest regulation and improve agricultural production. Also know as Integrated Pest Management (IPM), this practice can be "defined as the use of multiple tactics in a compatible manner to maintain pest populations at levels below those causing economic injury while providing protection against hazards to humans, animals, plants and the environment. IPM is thus ecologically-based pest management that makes full use of natural and cultural processes and methods, including host resistance and biological control. IPM emphasises the growth of a healthy crop with the least possible disruption of agro-ecosystems, thereby encouraging natural pest control mechanisms. Chemical pesticides are used only where and when these natural methods fail to keep pests below damaging levels" (Frison et al, 1998; 10). Conventional, chemically based pest-management strategies encourage short-term solutions that can be harmful to the environment and to human health. Broad-spectrum chemicals also are ineffective against some pest problems. EPM is based on a broad knowledge of the agro-ecosystem, the range of species of living organisms in the ecosystem, their interactions and the outcomes of those interactions. On any given farm, crops are interacting with all types of living organisms including bacteria, insects, nematodes, ruminants, which are also in dynamic interaction. The knowledge of these interactions constitutes the basis of EPM. The overall goal of EPM is to achieve ecological sustainability whilst maximizing the economic gains of agriculture. It comes with a conscious effort to maintain the equilibrium in the ecology of the agricultural or farming systems. The goal is achieved broadly on the principle of ensuring the generation and transfer of knowledge to the farmers on their respective ecological systems and promoting the application of such knowledge.
Institutional and organizational requirements	Structures that enable farmers to organise themselves so as to jointly implement the proposed solutions are also required. Collective action can increase the successful development and implementation of EPM. Farmers' cooperation can help reduce the costs of EPM implementation. In addition, better linkages between research and extension, more extension services, monitoring services and private consultants can lead to better coordination and feedback processes. Strong efforts in the area of communication with farmers are required so that they appreciate the benefits of applying this

	approach. Communication should be primarily focused on showing the range of advantages of this technology in comparison with other available options (such as longer-term sustainability and no environmental damage). Public sector agencies, such as ministries of agriculture and environment, should lead on these initiatives.
Operation and maintenance	The key components of an EPM approach are: 1. Crop Management: Selecting appropriate crops for local climate and soil conditions. Practices include: • Selection of pest-resistant, local, native varieties and well adapted cultivars; • Use of legume-based crop rotations to increase soil nitrate availability thereby improving soil fertility and favourable conditions for robust plants that better face pests and diseases; • Use of cover crops, such as green manure to reduce weed infestation, disease and pest attacks; • Integration of intercropping and agro-forestry systems; • Use of crop spacing, intercropping and pruning to create conditions unfavourable to the pests. 2. Soil Management: maintaining soil nutrition and pH levels to provide the best possible chemical, physical, and biological soil habitat for crops. Practices include: • Building a healthy soil (soil relatively free of fungi, bacteria and insects, with basic nutrients (nitrogen, phosphorus, and potassium) in optimal level and with acidity or alkalinity levels (pH level) that make them available for crops) structure according to the soil requirements of the different plants (such as deep/shallow soil levels or different mineral contents); • Using longer crop rotations to enhance soil microbial populations and break disease, insect and weed cycles; • Applying organic manures to help maintain balanced pH and nutrient levels. Adding earthworm castings, colloidal minerals, and soil inoculants will supplement this. Microbes in the compost will improve water absorption and air exchange; • Soil nutrients can be reactivated by alleviating soil compaction; • Keeping soil covered with crop residue or living plants; • Cultivating for weed control based on knowledge of the critical competition period; • Managing field boundaries and in-field habitats to attract beneficial insects, and trap or confuse insect pests. 3. Pest Management: using beneficial organisms that behave as parasitoids and predators. Practices include: • Releasing beneficial insects and providing them with a suitable habitat; • Managing plant density and structure so as to deter diseases;

	• Managing field boundaries and in-field habitats to attract beneficial insects, and trap or confuse insect pests. IPM strategies can exist at various levels of integration. Note that integration at all four levels are not common (Frison et al, 1998, p. 11).
Endorsement by experts	EPM is endorsed by national experts
Adequacy for current climate	EPM enables the farmer to work with other critical stakeholders especially scientists and extension workers at all levels, from national to local, to adapt to current climate variability and future climate change.
Size of beneficiaries group	The technology is beneficial primarily to farmers, consumers and other stakeholders in the locality of its application, countrywide and globally.
Disadvantages	There are very strong pests for which the 'biological controller' has not yet been identified (i.e. an insect that destroys it). When these pests emerge it is common for producers to turn to pesticides. EPM is not easy to implement and requires substantial knowledge and monitoring for the combined components of the system to produce success. Perhaps the biggest drawback to the EPM approach is that biological control is not a 'quick fix'. In most cases, biological controllers will take several years to successfully establish a population and begin making a significant contribution. In addition, no single biological controller works in every situation. A controller that works well in one soil type, for example, may not work at all in another soil type. In the long run, more than one type of biological controller may have to be used to achieve uniform control across a variety of different situations and land types.
Capital costs	
Cost to implement adaptation options	The cost of implementing EPM in the identifiable ecological regions and nationwide can be high. For example, one such programme implemented in Nicaragua implemented involving seventy local service providers (such as NGOs, producer organisations, technical service providers, government extension agents), trained over 300 extension agents. These extension agents in turn trained over 8000 farmers but probably reached at least 15,000 farmers through collaborators applying the techniques to farmer groups not directly attended by the programme. The combined cost of the training programme was about US$ 6.6 million over five years (Guharay et al, 2005)
Additional cost to implement adaptation option, compared to "business as usual" (eg. Fully decentralized system)	The fully decentralized system of implementation for Ghana suggests the extension of EPM across the 110 districts of the country. Costs will be high in training agricultural extension officers and organizing training sessions for the relevant farmers.

Development impacts, indirect benefits	
Reduction of vulnerability to climate change, indirect	EPM contributes to reduction of vulnerability to climate change by strengthening ecosystemic resilience and stability. The impact of pest attacks on farm yields are reduced and enables farmers to harvest appreciable crops.
Economic benefits Employment	Where large numbers of farmers are trained in EPM farming practices, there is sustainability of farming in the respective agro-ecological zones. In Ghana where about 65 per cent of the population are supposed to be employed in agriculture-related activities, sustainability is an important issue to address.
Investment	Investment in implementing EPM programmes can be high depending on the scale of implementation. However, with the EPM approach, farmers can avoid the costs of pesticides as well as the fuel, equipment and labour used to apply them. A 22-year trial comparing conventional and organic corn/soybean systems found that organic farming approaches for these crops use an average of 30 per cent less fossil energy (Pimentel et al, 2005). Although this can cause a slight drop in productive performance, the risk of losing an entire crop is reduced dramatically.
Public and private expenditures	EPM reduces public and private expenditures on climate related crop losses. The reduction in the use of pesticides can also lead to increase in yields. This is the case when there are specific controllers for a determined pest, for example, in West Africa the introduction of the wasp has been a spectacular control of the slug of cassava, thus saving the staple food crop for millions of Africans (FAO, 1996).
Social benefits Income	On the average, farmers' incomes are the lowest in Ghana especially for those in the Northern parts of the country. Cash crop farmers e.g. cocoa and oil palm farmers are known to be earning higher incomes. The implementation of EPM is likely to enhance the incomes of farmers as they harvest higher yields of their crops.
Learning	EPM depends greatly on knowledge impartation to farmers and all those involved in the production component of agriculture value chain. Training is a necessity for capacity building in operation and maintenance of systems at various levels.
Health	There are benefits coming with the practice of EPM. Farmers' minimal use of pesticides impacts positively on their health. The residual traces of pesticides in foods produced from farms where there have been excessive applications of pesticides will be reduced with EPM.
Environmental benefits	Effectively planned and executed EPM programmes lead to

	invaluable environmental benefit. There is reduction in chemical pollution coming with pesticide use in farming. The ecological balance of agro-ecosystems is better sustained with EPM practices.
Local context	
Opportunities and Barriers	In Ghana, the barriers to implementation of EPM are generally in line with what are already known. The agricultural system in Ghana shows the typical constraints of a developing African economy and some of the technical and socio-cultural barriers are more pronounced. The major constraints to the development and adoption of EPM programmes fall into four categories: 1. Technical: lack of studies and complexity of EPM; 2. Economic: competing simplicity and apparent efficacy of chemicals; lower prices for EPM-produced goods (cosmetic damage); high cost of selective pesticides; lack of fiscal policy that favours EPM over pesticide use; high perceived risk if spraying is not carried out; failure to consider long-term advantages). A major obstacle to the implementation of this technology is that farmers generally prefer commercial pesticides because they are easier to apply and manage 3. Institutional (poor linkages between research and extension; lack of extension services, monitoring services, private consultants) 4. Educational (lack of understanding of EPM by farmers/extension, lack of EPM specialists) (Frison et al, 1998; 16-17). EPM is complex and for farmers to understand and adopt EPM strategies they frequently have to change their whole pest control philosophy (Frison et al, 1998; 21). There is also a common misconception that pesticides are essential for high yields. This is not necessarily the case. However, there are opportunities for implementation. In agricultural production systems where the environment is relatively free of polluting elements (such as pesticides), and pests and diseases are becoming progressively more aggressive, conditions for EPM development are better. This is because there is no need to 'clean' the environment first in order to conduct research into which biological controllers are required. When EPM is used, farmers can benefit from the opportunity to sell their goods as healthy organic products that can fetch a higher market price.
Market potential	The Ghanaian farmer is ready to learn. Already the concept has been implemented in some parts of the country with some successes such as in the cocoa industry where organic cocoa is being exported. EPM has potential.
Status	Ghana already has some experiences in EPM implementation. The

	Ministry of Food and Agriculture and other stakeholders such as the agricultural research institutes and universities have implemented EPM programs.
Timeframe	The implementation of EPM can start now.
Acceptability to local stakeholders	EPM is acceptable to local stakeholders.

Source: Based on expert's knowledge and information in the climatetechwiki (http://climatetechwiki.org/content/ecological-pest-management-0)

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment Report – Ghana. You can access the complete report from the TNA project website http://tech-action.org/**