

GHANA'S PESTICIDE CRISIS

The need for further Government action



by

NORTHERN PRESBYTERIAN AGRICULTURAL SERVICES AND PARTNERS

April 2012

CONTENTS

SUMMARY	4
INTRODUCTION	9
1. POISONING FARMERS	11
Health impacts on farmers	
Recent deaths from pesticides	
The unsafe use of pesticides	
2. POISONING THE PUBLIC	21
Lack of systematic testing of pesticide residues in food	
3. THE PRIVATE SECTOR AND MARKETING OF PESTICIDES	25
Increasing, and often illegal, imports	
Unlicensed dealers	
The drive to use pesticides	
4. GOVERNMENT POLICY AND REGULATION	29
Existing regulation	
Government policy to implement the regulation	
Resource and capacity gaps	
5. ALTERNATIVES - REDUCING DEPENDENCE ON CHEMICAL PESTICIDES	36
Problems with chemical pesticides, and alternatives	
Successful experiences with organic farming	
Lack of knowledge among farmers	
RECOMMENDATIONS	42

PREFACE BY NORTHERN PRESBYTERIAN AGRICULTURAL SERVICES

This study was conducted by the Northern Presbyterian Agricultural Services in collaboration with her partners. It is meant to unearth the deplorable state of pesticides handling and usage by farmers in northern Ghana and to assess the risk and damage to humans, livestock and environment.

The research results are expected to be used to solicit support from farmers, pesticides dealers, researchers and the general public to feed into a campaign process that advocates for the enforcement of policies and regulations on pesticides.

This study is therefore not a final statement, but a process that seeks to impress on the Parliament of Ghana the need to develop a Legislative Instrument to back up Environmental Protection Agency (EPA) Act 490 and the Pesticides Control and Management Act 528 on the proper use of pesticides in Ghana.

We wish to thank our development partners: ICCO of the Netherlands and most especially Christian Aid of the UK for their technical and financial support throughout the entire process from the field (survey) to the compilation and publishing of the report.

We are also most grateful to seven implementing partners (Zurre Organic Vegetable Farmers Association, the Presbyterian Agricultural Stations of Sandema, Garu, Langbensi and Tamale, Youth Harvest Foundation Ghana and the Community-Self Reliance Centre) in whose operational areas this survey was conducted, and also for their cooperation.

Research and compilation of this report was undertaken by Mark Curtis, Director of UK-based Curtis Research to whom we are very grateful for this wonderful piece and for his personal interest and continued support for the campaign.

SUMMARY

This is a study of the use of chemical pesticides by farmers in northern Ghana, asking: how safe is the current use of pesticides and is the government adequately regulating it? Ghanaian farmers who use chemical pesticides to control insects and diseases on their crops are potentially exposed to pesticides through the skin, on the eyes or through inhalation or ingestion, with key risks being death, cancer, birth defects and damage to the nervous system.

Pesticide poisoning of farmers

Northern Presbyterian Agricultural Services (NPAS) has for years been reporting problems experienced by farmers during and after the application of pesticides. The most common problems include skin irritations, headaches, general body weakness, difficulty in breathing and dizziness. NPAS' survey of 183 farmers in 14 villages in Upper East region has found that more than a quarter had recently suffered from directly inhaling chemicals and one fifth from spillage of chemicals on the body. In late 2010, 15 farmers died from suspected pesticide poisoning in Upper East region. Most of these deaths resulted from poor storage of pesticides, which seeped into food stocks. These deaths may well be the tip of the iceberg: Senior health officials believe that some 'natural' deaths among Ghanaian farmers might be related to pesticide use, partly since poisonings are hard to diagnose.

It is a scandal that the Ghanaian authorities do not systematically test farmers for the impact of pesticides on their health. Numerous academic studies show alarming levels of poisoning. A 2008 study - the most comprehensive analysis of pesticide contamination on farmers in Ghana - found the presence of organochlorine pesticide residues, including DDT, in the breast milk and human blood of vegetable farmers. Some women farmers had accumulated pesticide residues in breast milk above the 'tolerable daily intake' guidelines beyond which they have adverse health effects on their children. Yet policy makers know little about the real extent of pesticide poisonings since there are no official figures.

Unsafe use of pesticides

There are six key aspects of the unsafe use of pesticides by farmers:

- Around seven banned or restricted chemical pesticides – aldrin, dieldrin, endosulfan, lindane, DDT, methylbromide and carbofuran (the latter which is banned above a certain level of toxicity) - appear to be still being used by some Ghanaian farmers. A recent study carried out for NPAS in Upper East region found four banned or restricted chemicals were on sale in local agro-dealer shops – DDT, aldrin, lindane and dieldrin.
- Other dangerous chemical pesticides that the government has cleared for use and failed to ban are also being used, such as atrazine, paraquat and chlorpyrifos.

- Farmers are misusing pesticides by spraying too close to harvest (thus contaminating the crop before consuming it), over-applying the dosage, applying pesticides intended for cash crops to growing food crops or applying pesticides intended for growing crops onto stored crops, using obsolete or expired pesticides and mixing different chemical pesticides together.
- Most farmers fail to use any protective equipment while virtually no farmers use all the recommended equipment. Only farmers contracted to cotton and cocoa companies receive protective equipment, otherwise these need to be paid for. The health hazards are amplified given that some farmers allow their children to do the spraying.
- Storing pesticide containers near to, or even in, food stores is widespread and has contributed to several recent deaths and an untold number of illnesses. There is also widespread re-use of containers for storing food or water for humans or livestock.
- Many problems result from insufficient training, advice and education provided to farmers by the Ministry of Food and Agriculture (MOFA) and its extension service. Training is especially critical given that most farmers are unable to read and write. Less than half of all Ghanaian farmers have received such training; an NPAS survey in Upper East region found that 43 per cent of farmers sampled had had some training on the safe use of pesticides, but only just over half has received such training from MOFA; most of the rest had been trained by local NGOs.

Poisoning the public

The harmful effects of pesticide use go beyond the impact on Ghana's farmers, and include the consumers of food. Residues from six banned or restricted chemical pesticides - DDT, endosulfan, lindane, aldrin, dieldrin and endrin – have been found in food samples in recent academic studies. Academic studies in the past five years show the presence of pesticide residues in fish, water, sediments, fruit and vegetables, meat and human fluids (blood and breast milk) in Ghana. A leading academic working on crop science in Accra says that 'pesticide residue levels are probably in virtually everything we eat from farms'.

Yet just as there is no systematic testing for the impacts of pesticides on farmers, there appear to be no routine tests conducted on the food available in Ghanaian markets. Indeed, officials betray a lack of clarity over exactly which government agency is responsible for conducting such tests. Testing for pesticide residues on export crops such as cocoa is routine and stringent. Yet when it comes to domestic consumption of food by Ghanaians, no such stringency exists. All export-oriented cash crop farmers have been trained in the safe use of pesticides, but most of those producing food for Ghanaian families have not.

The marketing of pesticides

The pesticide problem is compounded by unscrupulous private companies. The increase in pesticide imports into Ghana in recent years is matched by an increase in the number of importing companies, of whom there are now up to 50. Yet many imports are illegal. Surveys conducted by the Environmental Protection Agency (EPA) in 2007 showed that around 30 per cent of pesticides on sale were either unlicensed or smuggled. Officials still estimate that at least 10-15 per cent of all imports are illegal, either brought in by unlicensed dealers or involving expired or adulterated goods. Some imports arrive in bulk and are repackaged into small containers, often carrying inadequate or misleading labeling, often only in French.

Many pesticide dealers do not have licenses to operate and are believed to be selling banned or restricted pesticides. In Tamale metropolitan area, there are several dozen registered agro-dealers but 10-20 unregistered ones too. Unregistered dealers not only sell directly to farmers by visiting the villages but also set up stalls in urban markets. They are unlikely to have the requisite knowledge to correctly inform farmers about the safe use of pesticides. Yet many farmers now rely on agro-dealers for such advice rather than extension officers.

There is an industry of private companies behind pesticides that is driving increased use in Ghana. Advertising, which is prominent on the television, radio and billboards, claims that pesticides are farmers' friends but often say nothing about the potential effects on human health or that protective equipment must be worn. Adverts are meant to be approved by the EPA but often this does not happen. Some donors are also driving the use of pesticides. The Alliance for a Green Revolution in Africa, funded by the Gates Foundation, and the US-based IFDC, have a \$2.5 million project (the Ghana Agro-Dealer Development project, or GADD) training over 2,000 agro-dealers in business skills and safe handling of inputs. Some aspects of this training are surely useful, but are within a programme that is pushing for ever-greater use of chemical pesticides.

Also driving the use of pesticides is the government policy – in place for the past decade – of levying no import duty or the 15 per cent VAT on pesticides, which provides pesticide marketers with financial incentives to import and sell pesticides, in effect subsidized by the Ghanaian taxpayer. Some 'improved' seed varieties, such as for maize, cowpea and cassava are also being introduced in Ghana which require greater use of pesticides than traditional seeds.

Government policy and regulation

Ghana's primary legislation regulating the use of pesticides is the Environmental Protection Act of 1994 while the two main bodies responsible for pesticides surveillance and monitoring are the EPA – whose Chemicals Control and Management Centre is directed by the Pesticides Registrar – and the Plant Protection and Regulatory Services Directorate (PPRSD) - whose Pesticide Management Division supervises and trains inspectors and extension officers. The Customs, Excise and Preventive Service (Management) Law of 1993 regulates all imports into

Ghana including chemicals and gives CEPS officers the power to search people and seize prohibited chemicals.

The government is aware of the dangers of pesticides and has issued several such messages to the public. It is also taking a number of measures to ensure the safer use of pesticides. Following the announcement of 12 deaths from pesticides in December 2010, the regional Minister for the Upper East announced the creation of a five-member task force to monitor and control the use of chemicals and inspect dealers' licences. The EPA regularly urges pesticide distributors to comply with the licensing regulation and organises various regional workshops to train pesticide inspectors, agro-input dealers and extension officers to better understand and enforce the legal framework for the management of pesticides.

Despite these welcome initiatives, the legislation is not being implemented adequately, largely due to insufficient allocation of resources. The capacity for regulation has not kept pace with the liberalization of the pesticides market that the government has been so keen to encourage.

- Although the Environmental Protection Act was enacted in 1994, subsidiary legislation is needed – the 'regulations' – to implement it. But the regulations have been in draft form since 2000, have not yet been passed and remain under consideration by parliament. Until these regulations are in place, there is little hope that the Act will be effectively implemented.
- Evidence suggests that the Ghanaian government is spending only around GC 300,000 a year on pesticide surveillance and training in the EPA and PPRSD.
- The EPA has one pesticide inspector in each of the ten regions plus another five in Accra – thus a total of 15 across the whole country. The PPRSD says it has around 46 inspectors around the country but they do not focus just on pesticides but also on seeds and plants, among other areas. The EPA lacks the capacity to work in the rural areas, a major problem when unregistered dealers sell directly to farmers by visiting villages.
- Government extension services – which can provide vital training and advice on pesticides – are inadequate to reach sufficient farmers regularly. In Upper East region, each of the 9 districts is meant to have 24 extension officers, but most have 9-10; very little of their time is spent on pesticides, even though most farmers use them.

Reducing dependence on chemical pesticides

Alternatives to dependence on chemicals include various sustainable agriculture practices such as organic farming – involving no use of chemical pesticides – and integrated pest management (IPM) – which reduces but does not usually reject entirely the use of chemicals. Organic approaches can involve crop rotation, intercropping, and planting of trap plants and plants that serve as habitats for beneficial insects. If preventive measures are insufficient, insecticides derived from natural plant extracts, natural soap or minerals or plant extracts such as neem can be applied.

The experience of farmers and researchers in northern Ghana is that organic farming approaches can be successful and are often more productive and cost-effective than reliance on chemical pesticides. But they are not being widely pursued in Ghana because farmers have little information about them and the government is mainly promoting pesticides. NPAS' survey in Upper East region found that 73 per cent of farmers wanted further information on sustainable pest management practices and alternatives to using chemical pesticides. The government's flagship agriculture strategy document – the Food and Agriculture Development Policy (FASDEP II), drawn up in 2007 – makes no mention at all of organic farming. There is no coherent government plan to allow farmers to escape dependence on pesticides.

Recommendations

The government should:

- Establish a Ghana Health Service programme to routinely conduct tests on a sample of farmers to test for pesticide residues
- Establish clarity on which body is responsible for testing for pesticide residues on food, and establish a programme for routine testing
- Review its list of permitted pesticides and suspend those considered dangerous
- Increase resources to pesticide surveillance activities in the EPA and PPRSD by creating a Pesticide Management Fund (to which companies involved in pesticide marketing should be obliged to contribute)
- Review the capacity of government departments to adequately conduct inspections and training of farmers produce a public report stating how capacity will increase
- Subject the draft regulations of the Environmental Protection Act to public scrutiny and take immediate steps to pass them
- Halt the process, especially in the GADD project, by which agro-dealers are increasingly becoming the source of advice to farmers on pesticide use, and require agro-dealers to refer farmers to extension officials for advice
- Announce that government policy is to move away from reliance on pesticides for agriculture in Ghana
- Outline an increase in resources for research on and promotion of organic farming

Parliament should:

- Press the government to promote these policy changes
- Call for a review of government policy towards pesticides encompassing the various aspects of the issue raised in this report.

NGOs working with farmers should:

- Help develop community monitoring of the use and impacts of pesticides in order to raise local awareness, alert the authorities to problems and empower communities.
- Press the government and parliament to support these policy changes.

INTRODUCTION

This is a study of the use of chemical pesticides by farmers in northern Ghana, asking: how safe is the current use of pesticides and is the government adequately regulating it?

Estimates of the proportion of Ghanaian farmers using chemical pesticides* to control insects and diseases on their food and cash crops vary widely, but it is likely to be the majority, with some estimates as high as 80-90 per cent.¹ Most pesticides in Ghana are used in the forest zones in the Ashanti, Brong-Ahafo, Western and Eastern regions.² But pesticide use is also widespread among resource-poor farmers in the north; this study focuses on the Northern and Upper East regions. An official responsible for government agricultural extension services in the Tamale metropolitan area says that up to 80 per cent of farmers in the area use chemical pesticides.³

Yet sporadic academic studies, civil society organizations and others have long raised concerns about the short- and long-term effects of pesticide use on farmers and the general public. Northern Presbyterian Agricultural Services has long seen, reported and tried to mitigate the health effects of pesticide use among the farmers with whom it works. Chemical pesticides can affect farmers by exposure to the skin or eyes or through inhalation or ingestion. Key risks are cancer, birth defects and damage to the nervous system and the functioning of the glands. Symptoms of pesticide poisoning include dizziness, headaches and skin burning. Livestock can also be harmed while pesticides can damage the environment by seeping into water or food systems, destroy local biodiversity or reduce the number of pollinating insects that are often critical for crop yields.

Improving the health and welfare of Ghana's farmers, and the food they produce, is critical to the national economy. Agriculture is the primary activity for most of Ghana's 23 million people and accounts for 40 per cent of the country's GDP. The pesticide industry has taken off in Ghana since liberalization of the market in the mid/late 1990s ended the government's primary role as provider of pesticides at subsidized prices to farmers - the amount of imports, the number of importers, the quantities of pesticides used and the number of farmers using pesticides all appear to have increased.

But a key question is: has the government's ability to regulate pesticide use, to ensure the safety of farms and the public, kept pace?

* Pesticides are insecticides, herbicides, nematicides and fungicides. Pesticides are designed to kill, reduce or repel insects, weeds, rodents, fungi, and other organisms that can threaten public health and national economies

Pesticides globally

Around 5 billion lbs of pesticides are used every year in a global trade worth over \$40 billion.⁴ The world's top 10 pesticide companies, which include the German companies Bayer and BASF and the US companies Monsanto, DuPont and Dow, account for 89 per cent of global sales.⁵ The number of deaths and poisonings that occur globally from pesticide use is not known. The World Health Organisation (WHO) estimates that 1-5 million cases of pesticide poisoning occur every year, resulting in 20,000 fatalities among agricultural workers, most of them in developing countries.⁶ Another estimate is that pesticides cause 14 per cent of all known occupational injuries in agriculture and 10 per cent of all fatal injuries.⁷ African farmers use only around 4 per cent of the world's pesticides but pesticide use is widespread. The use of pesticides on subsistence food crops as well as on export crops represents a particular risk to health.⁸ In West Africa, thousands of cases of poisoning occur each year, especially among cotton, cowpea and cereal farmers.⁹ Yet these are rarely documented by government authorities, and too little is known about the extent of pesticide poisoning and the current impact on human health and the environment.

Background: Research methodology and the northern Regions

This study draws on Northern Presbyterian Agricultural Services' extensive work with farmers in several districts of northern Ghana over a number of years. It has involved fieldwork among farmers in Northern and Upper East regions and interviews with civil servants, academics and NGOs in Tamale, Bolgatanga and Accra, including officials in the Environmental Protection Agency, the Ministry of Food and Agriculture and its Plant Protection and Regulatory Services Directorate.

The Upper East and Northern regions are among the poorest in the country. Around 28 per cent of Ghana's population lives in poverty (defined as living on less than \$1 a day) but this rises to 52 per cent in the Northern Region and 70 per cent in Upper East.¹⁰ In both regions the overwhelming majority of farmers grow food crops rather than cash crops, the key crops being millet, sorghum, maize, rice and yams.¹¹ While the average household landholding in Ghana is 2.1 hectares, over 70 per cent of households in Upper East Region, and nearly half those in Northern Region, have less land than this.¹² Food insecurity is especially serious in Upper East region – 15 per cent of the population there is classified as food insecure.¹³ To cope with food or income shortages, a quarter of families in Upper East report reducing the number of meals they eat and over 1 in 10 endure whole days without eating.¹⁴

1. POISONING FARMERS

All the interviewees and sources consulted in this research agree that there is a ‘very big’ problem in Ghana with unsafe use of pesticides by farmers. The evidence bears this out.

Health impacts on farmers

Northern Presbyterian Agricultural Services has for years been reporting problems experienced by farmers during and after the application of pesticides. The most common are:

- skin irritations
- headaches
- general body weakness
- difficulty in breathing
- dizziness
- sexual weakness.

NPAS’ survey of 183 farmers in 14 villages in the Upper East region has found that more than a quarter had recently suffered from directly inhaling chemicals and one fifth from spillage of chemicals on the body. One official in the Plant Protection and Regulatory Services Directorate (PPRSD) says that symptoms such as dizziness, nausea and skin irritation are ‘very common among most farmers’.¹⁵ There are also several anecdotal reports of impotency among male farmers using pesticides, while one senior scientist with the PPRSD has suggested that improper handling of pesticides can cause such impotence among men and also cause infertility in women. The official has also stated that some farmers have gone blind as a result of the improper application of pesticides.¹⁶

A 2008 study of vegetables farmers in southern and central regions of Ghana, conducted for the US-based International Food Policy Research Institute, found that 69 per cent farmers surveyed had experienced burning sensations on their skin, 47 per cent had experienced headaches after application, 39 per cent reported itchy or watery eyes and third had experienced both dizziness and breathing difficulties. Around 28 per cent of farmers stated that they had sought medical attention at least once.¹⁷

The lack of routine testing of farmers

It is a scandal that the Ghanaian authorities do not systematically test farmers for the impact of pesticides on their health. Very few studies have been undertaken but those that have, by academics, show alarming levels of poisoning.

A study by leading scientists for the CSIR Water Research Institute in Achimota-Accra in 2008, for example, was the most comprehensive study of pesticides contamination on farmers in Ghana. It found the presence of organochlorine* pesticide residues, including DDT, in the breast milk and human blood of vegetable farmers. Some women farmers had accumulated levels of pesticide residues in breast milk above the 'tolerable daily intake' guidelines beyond which they have adverse health effects on their children. The authors noted that the residues raise general 'public health concerns'.¹⁸

An earlier study, in 2001, of pesticide residue levels in farmers in the environs of Akomadan, a prominent farming community in Ashanti region, discovered other organochlorines such as hexachlorobenzene and DDE in most blood and breast milk samples taken from the farmers. The study noted:

'Residues of OC pesticides are present in environmental samples at Akomadan and in human fluids of its inhabitants. The residues have originated from agricultural activities in the area and it is expected that an appreciable build-up of residues with time will occur because of the continuous use of pesticides in the area. Because these compounds are toxic and not environmentally friendly, increased contamination in human fluids could pose serious public health problems'.¹⁹

Yet staff in the Environmental Protection Agency and in the Ministry of Food and Agriculture, as others, know little about the real extent of pesticide poisonings since there are no official figures. 'I'm not sure of the health impacts because no-one is doing the monitoring', a senior MOFA official responsible for one district in Upper East region says.²⁰

Recent deaths from pesticides

The precise number of deaths from pesticide poisoning in Ghana is unknown. In late 2010, 15 farmers died from suspected poisoning from pesticides in Upper East region alone, according to figures provided by the Regional Director for Health.²¹ Most of these deaths occurred due to poor storage of pesticides, which seeped into food stocks.

* Organochlorine pesticides, which include DDT, aldrin, endosulfan and dieldrin, are among the most toxic and many have been banned in Ghana

Table 1: Deaths from pesticide poisoning, Upper East region, November 2010

Garu	In one household, 3 deaths and 7 poisoned from contaminated food In another household, 3 deaths and 9 poisoned from contaminated food
Bawku West	In one village, 5 deaths and 54 poisoned from contaminated food In one other household, 2 deaths and 9 poisoned from contaminated food
Talensi-Nabdam	In one household, 2 deaths and 8 poisoned from contaminated food In another household, 0 deaths and 21 poisoned from contaminated food

In early December 2010, Upper East Regional Minister, Mark Woyongo, announced that 12 farmers had died after eating food infected with pesticides, and that a further 63 had been treated and discharged from hospital.²² That the situation reached alarming proportions was highlighted by a memorandum sent by Dr Koku Awoonor-Williams, the Regional Director of Health Services for the Upper East, based in Bolgatanga, on 1 November 2010. This memo, headed 'Protocol for managing people who report food poisoning due to glysohate', outlined symptoms such as headaches, dizziness and stomach problems, and was sent to all health service directors in the region. It stated:

'Glysohate is a key component of herbicides used by farmers. We are increasingly getting reports of people ingesting food contaminated with herbicides and/or weedicide this season'.

These recorded deaths may well be the tip of the iceberg. Dr Awoonor-Williams says that he strongly believes that some 'natural' deaths among Ghanaian farmers might be related to pesticide use, partly since pesticide poisonings are hard to diagnose.²³ Indeed, although the toxic effects of pesticides on humans and animals are fairly easy to recognize when exposed to large quantities, the effects from long-term exposure to low doses are difficult to identify. In particular, the effects of the regular intake of pesticide residues in food are hard to detect and quantify.²⁴ Routine testing of farmers is therefore critical, but is not happening (see box above)

The unsafe use of pesticides

There are six key aspects of the unsafe use of pesticides:

- The ongoing use by farmers of banned or restricted chemicals
- The use of other dangerous chemicals that the government has failed to ban
- The misuse of pesticides
- Failure to use protective equipment
- The re-use and poor storage of pesticide containers
- Insufficient training and advice

Use of banned or restricted pesticides

Ghana's Environmental Protection Act requires pesticides to be classified as for general use, restricted use, suspended or banned. A pesticide may be suspended or restricted if its application may have unreasonable effects on people, animals or the environment. Ghana currently approves the use of 254 pesticides while 26 have been banned and a small number are restricted.

Table 2: Registered and banned pesticides in Ghana

Category	Registered	Provisionally cleared	Banned	TOTAL
Insecticides	70	43	26	139
Fungicides	19	8	0	27
Herbicides	60	48	0	108
Others	4	2	0	6
TOTAL	153	101	26	280

Source: EPA, *Register of Pesticides as at 30 July 2010, Accra*, July 2010, p.25

It has long been known that various restricted or banned pesticides are still being used by farmers in Ghana to grow food. A 2005 study, for example, found that lindane and endosulfan – which were then restricted to use on cocoa, coffee and maize – were being used on vegetables, along with DDT – which was banned altogether. The study concluded that ‘these more potent agrochemicals are used irrespective of whether they are approved for vegetable production or

not'.²⁵ In 2008, the EPA discovered 71 tonnes of banned pesticides, most of which were found at the warehouses of the Ghana Cocoa Board at Anyinam, the Benso Oil Palm Plantation and the Twifo Oil Palm Plantation.²⁶

The situation may have improved little since then. Our analysis is that around seven banned or restricted chemical pesticides appear to be still being used by some Ghanaian farmers. A recent study carried out for NPAS in Bawku Municipality and Garu-Tempene District, Upper East Region, found four banned or restricted chemicals on sale in local agro-dealer shops – DDT, aldrin, lindane and dieldrin.²⁷ Officials believe that three others – endsulfan, methylbromide and carbofuran - are also being used.²⁸ All these pesticides are generic rather than brand names and are manufactured and imported by various different companies.

Endosulfan – taking too long to act?

Endosulfan, a toxic organochlorine widely used in cotton growing, was finally 'suspended' by the government in 2009. It had previously been 'restricted' to use on cotton but was suspended because of its widespread diversion by farmers for use on food crops such as cowpea, tomatoes and okra. The Ghanaian government took a long time to act - endosulfan was banned by the EU in 2006²⁹ and was described by the US Environmental Protection Agency in 2007 as 'highly hazardous' ³⁰. In total, 62 countries have banned endosulfan.³¹

Endosulfan is, as noted above, still being used. One PPRSD official says that he recently saw endosulfan on sale in a shop in Bolgatanga, which is illegal. ³² It is absorbed by humans via the stomach, lungs and through the skin and has been linked to congenital physical disorders, mental disabilities and deaths of farm workers in various countries, notably in Benin.³³

Figures provided to the researchers by the PPRSD show that Ghana imported 277,000 litres of endosulfan in 2004 and 156,000 litres in 2007. There may well be thousands of litres of this dangerous chemical around the country that farmers will continue to be tempted to use.

Other dangerous pesticides being used

There are, however, other chemical pesticides that the government has cleared for use and which are being used by farmers but which are also hazardous and may pose significant health concerns, for example:

Table 3: Legal but dangerous pesticides being used in Ghana

<p>Atrazine</p>	<p>A herbicide intended for use on grasses and weeds</p>	<p>Listed by the Pesticides Action Network as ‘highly hazardous’³⁴ and in the EU was restricted to plant growing in 2004, its other uses being banned³⁵.</p> <p>Classified by WHO* as ‘slightly hazardous’.³⁶</p> <p>Ghanaian officials say the government is considering suspending it.³⁷</p>
<p>Paraquat</p>	<p>A herbicide intended for use on grasses and weeds</p>	<p>listed by PAN as highly hazardous and is associated with poisonings in various countries.³⁸</p> <p>Classified by WHO as ‘moderately hazardous’³⁹</p>
<p>Chlorpyrifos (trading name of dursban)</p>	<p>An insecticide used on borers in cereals and vegetables</p>	<p>Listed by PAN as highly hazardous and is reported to be able to damage the developing nervous system and exposure to which has been report to cause adverse effects on brain cell development.⁴⁰</p> <p>Classified by WHO as ‘moderately hazardous’⁴¹</p>

The misuse of pesticides

Farmers misuse pesticides in at least six different ways in Ghana:

- Spraying too close to harvest, thus contaminating the crop after harvest
- Applying the wrong dosage, often over-applying. Farmers often spray hazardous insecticides like organochlorines over five times in a season when two or three can be sufficient.⁴²
- Applying pesticides intended for cash crops to growing food crops. An extension official responsible for extension services in the Tamale metropolitan area says that there is particular mis-use of cotton and cocoa pesticides on cowpea.⁴³ In Ghana’s cocoa growing areas, pesticides intended for cotton are often being used on food crops – since these are subsidized, access to them is easier. A senior official in the PPRSD estimates that three fungicides and also some insecticides intended solely for use on cocoa are being widely used on food crops, even though their active ingredients are unsafe for food.⁴⁴
- Spraying pesticides intended for growing crops on stored crops. A 2003 study estimated that around 20 per cent of farmers in northern Ghana were using cotton pesticides to preserve

* The WHO has four classifications of hazardous: extremely, highly, moderately and slightly

their stored maize or other cereals, while cowpea farmers were using ten different insecticides to combat pests, five of which were meant only for cotton.⁴⁵

- Using obsolete or expired pesticides is also widespread, according to a senior official in the PPRSD.⁴⁶
- Mixing different chemical pesticides together.

Most of these problems result from a lack of knowledge among farmers, which in turn arises from lack of sufficient training and advice provided to them. A related problem, however, is reliance on often unqualified, sometimes unlicensed dealers who sell the wrong pesticides for the wrong crops. We cover both these issues below.

Failure to use protective equipment

Pesticide users are generally advised to wear an overall (or at least long trousers and long shirt sleeves), a hat, gloves, eye protection (a mask or goggles) or a respirator, and good quality boots made of rubber (not porous materials) with socks.⁴⁷ Yet these recommendations highlight the practical difficulties of expecting poor farmers in hot countries to comply, and indeed most do not.

Around Tamale, one estimate is that less than 20 per cent of farmers use any form of protective equipment, such as boots or goggles.⁴⁸ In Upper East region, a MOFA official estimates the figure at less than 10 per cent.⁴⁹ The proportion of farmers using all the recommended protective equipment is close to 0 per cent. A study of vegetable farmers in central and southern regions found that 68 per cent farmers wore long sleeves, trousers or overalls and nearly half wore boots, but only 25 per cent wore gloves and 12 per cent wore goggles.⁵⁰

Only farmers contracted to cotton and cocoa companies receive protective equipment, otherwise these need to be paid for, and a complete set of protective equipment costs around GC90. The hazards to health are amplified given that some farmers allow their children to do the spraying.

Greater vulnerability of women farmers

Women farmers are responsible for 55-60% of agricultural production in Ghana.⁵¹ Yet women are even more vulnerable to the unsafe use of pesticides than men. Women's greater dermal absorption and more body fat make them more vulnerable to adverse health effects. Also, their literacy rates are generally lower, they have less access to advisory services and training while, in the households, women may do the spraying but men tend to take the decisions on what and how to spray.

Re-use and poor storage of pesticide containers

Many farmers are less aware than they need to be that pesticides are truly dangerous. Storing pesticide containers near or even in food stores has contributed to several recent deaths in Ghana and an untold number of illnesses since there are no official figures. There is also widespread re-use of containers for storing food or water for humans or livestock. Indeed, this may well be the most hazardous practice associated with pesticide use in West Africa. One study by PAN found that 75 per cent of recorded poisoning cases in the cotton zones of Senegal and Benin were the result of food and drink contamination by the re-use of containers rather than exposure during spraying.⁵² Again, there are no official figures in Ghana. At Chichonga village, near Sandema in Upper East region, there have been reports of several cases of children becoming sick due to reusing such containers. Many farmers wash the containers before re-use, but often less thoroughly than is needed.

Insufficient training and advice

Many problems associated with the unsafe use of pesticides result from insufficient training and advice provided to farmers by the MOFA and its extension service. Training and advice is especially critical given that most farmers are unable to read and write. Official figures are that 76 per cent of heads of households in rural areas of the Northern Region, and 67 per cent of those in Upper East, have had no schooling.⁵³ An EPA survey of farmers in Upper East region found that 80 per cent of farmers could not write read and write.⁵⁴

Northern Presbyterian Agricultural Services' survey of 183 farmers in 14 villages in the Upper East found that 43 per cent had had some training on the safe use of pesticides; but only just over half has received such training from MOFA, most of the rest had been trained by local NGOs. A senior official in the PPRSD estimates that around 40 per cent of all farmers in Ghana have received some kind of training in safe use of pesticides.⁵⁵ This figure is close to that in a 2008 study for the International Food Policy Research Institute, which found that less than half of farmers in southern and central regions had received training.⁵⁶ Other estimates are, however, much lower - in Upper East region, the MOFA official responsible for extension services says that less than 5 per cent of farmers have received such training.⁵⁷ A senior MOFA official responsible for Navrongo district in Upper East region says that of 25,000 farming households in his district, around 150 farmers have been trained as trainers, but it is unknown how many they have gone on to train.⁵⁸

Officials are unanimous that more training and advice needs to be done by the extension service, but that little is currently taking place due to lack of resources (see section below). Even if farmers have attended a workshop, also critical is follow-through and implementation of what they have learnt; even after basic training, some bad habits can persist. When asked what more needs to be done to ensure safe use of pesticides, an extension officer responsible for Tamale metropolitan area says: 'More officers visiting villages, using more media to get messages across, organizing more training meetings and workshops, and getting more messages across through the Farmers Field Schools'.⁵⁹

The difference training makes

The 22 members of the farmers group in Golinga village, a few kilometers from Tamale, have landholdings ranging from 3-25 acres and all use chemical pesticides to grow their maize, rice, soya bean, groundnut and cassava. In the last few years the group has been trained in the safe use of pesticides by Northern Presbyterian Agricultural Services. 'Before, many of us had skin diseases, headaches, dizziness. Now these have gone away', says Yamale Sayibu, the chairman of the group. At worst, one member of the group had become impotent, which the farmers suspect was the result of unsafe pesticide spraying. The farmers previously used no protective equipment whereas now they at least use boots and sometimes other equipment. They also have more knowledge about which pesticides to use on which crops and are able to resist the hawkers who regularly visit their village selling pesticides which, they claim, are less toxic than they really are. The group otherwise receives little training from the government's extension service.

By contrast, just one kilometer away, in the neighbouring village of Galinkpegu, where farmers have received no training on safe use of pesticides, a number of farmers say they regularly experience burning on the skin and breathing problems. In interviews in November 2010, one man said that four months earlier he began experiencing breathing problems that were still with him.

Yet despite the benefits that training has brought the villagers of Golinga, there is still a way to go to ensure there are no ill effects of pesticides at all. Last season, Yamale accidentally spilt some pesticide on his back, burning his skin and putting him out of work for a month. The farmers still sometimes allow their children to do spraying. And a visit to the village in November 2010 revealed one empty pesticide container lying on the ground near where children were playing and two (albeit unopened, and still sealed) pesticide bottles being kept in the food store, alongside the villagers' maize. These problems highlight the need for ongoing training and follow-up, something that the formal extension service has too few resources to pursue.⁶⁰

The financial costs of pesticides

Aside from the health impacts on farmers, the financial costs of using pesticides can also be significant. There are two aspects to this. One is the financial cost to farmers of using pesticides; the other is the cost to the economy of farmers' illnesses from pesticide use.

The direct financial costs to the farmer include buying the pesticides, protective and application equipment, and often transport costs to dealers or the cost of medical help. The average farmer probably spends around GC600 a year per acre on external inputs such as chemical fertilizer and pesticide, of which perhaps GC200 is spent on pesticides.

The economic costs of unsafe use of pesticides among farmers should also not be underestimated. A 2003 study by Pesticides Action Network found that cotton and cowpea smallholders in Ghana lost an average of 15-21 days off work a year due to pesticide illness, equivalent to \$17-35 in daily farm labour rates. Over a third of cotton farmers suffered from pesticide-related illnesses and medical treatment and work loss cost cotton farmers up to \$90 per season.⁶¹

2. POISONING THE PUBLIC

*'Pesticide residue levels are probably in virtually everything we eat from farms'
(A leading academic working on crop science in Accra)⁶²*

The harmful effects of pesticide use go beyond the impact on Ghana's farmers, and include the food-consuming population. In the past few years, a number of academic studies have been undertaken investigating pesticide residues in food. They show the presence of pesticide residues in fish, water, sediments, fruit and vegetables, meat and human fluids (blood and breast milk) in Ghana.⁶³ Residues from six banned or restricted chemical pesticides - DDT, endosulfan, lindane, aldrin, dieldrin and endrin – have been found in food samples in these studies.

Table 4: Some recent academic studies on pesticide residues

<p>'Health Risk Associated with Pesticide Contamination of Fish from the Densu River Basin in Ghana', J. R. Fianko et al., 2011⁶⁴</p>	<p>The study evaluated the levels of pesticides residues in fish samples and the potential health risks associated with exposure to these pesticides. Although present in fish samples, the levels of pesticides did not pose a direct hazard to the general public. However, the levels of four types of pesticides exceeded the reference doses in children between the ages of 0 - 1 year, indicating a great potential for systemic toxicity in children who are considered to be the most vulnerable population subgroup.</p>
<p>'Pesticide residues in fruits at the market level in Accra Metropolis, Ghana – A preliminary study', Ghana Atomic Energy Commission, June 2010⁶⁵</p>	<p>The study monitored pesticide residues, mainly from organochlorines such as aldrin, endosulphin, endrin and DDT, in fruits at five markets in Accra for almost a year. 'The data revealed that 23.8% of the fruit samples analyzed contained residues of the monitored insecticides above the accepted Maximum Residue Limit (MRL) whereas 48.7% were below the MRL. Nonetheless the continuous consumption of such fruits with modest pesticide levels can accumulate and could result in deadly chronic effects'.</p>
<p>'Pesticide residues in the water and fish samples from lagoons in Ghana', D.Essumang et al, 2009⁶⁶</p>	<p>The study tested for organochlorine pesticide residues in tilapia fish in four lagoons in Ghana. It found especially high residues in Chemu lagoon, near Accra. 'This shows some level of exposure of pesticide which would be harmful to humans'.</p>
<p>'Pesticide residues in dairy</p>	<p>The study found 6 organochlorine residues in milk, yoghurt</p>

<p>products in Kumasi', KNUST, 2008.⁶⁷</p>	<p>and cheese and DDT residues in cheese and milk samples. The DDE residues on cheese exceeded the WHO maximum residue level. 'As bioaccumulation of these residues is likely to pose problems in higher organisms, like human beings, there is the need for effective monitoring of these residues in the environment'</p>
<p>'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi', Darko and Akoto, 2008⁶⁸</p>	<p>This study assessed contamination levels and health risk hazards of organophosphorus pesticides residues in vegetables. Health risks were found to be associated with levels of pesticides exceeding the recommended doses in tomatoes and eggplant. The conclusions highlight the lack of routine monitoring of these pollutants in food items.</p>
<p>'Persistent organochlorine pesticide residues in fish, sediments and water from Lake Bosomtwi, Ghana', KNUST, 2008⁶⁹</p>	<p>This study tested organochlorine pesticide residues in tilapia fish and water samples. It found residues of DDE in 82% of water samples, 98% of sediment samples and 58% of fish samples, probably the result of past usage of these chemicals.</p>
<p>'Analysis of some pesticide residues in tomatoes in Ghana', University of Cape Coast, 2008⁷⁰</p>	<p>The study found pesticide residues in tomatoes, especially of chlorpyrifos (dursban) and endosulfan. 'The risk assessment showed cancer risk for adults and children due to the presence of endosulfan and chlorpyrifos'.</p>
<p>'Levels of organochlorine pesticide residues in meat', KNUST, 2007⁷¹</p>	<p>This study tested for residues of organochlorine residues (lindane, aldrin, dieldrin, endosulfan, DDT and DDE) in beef from abattoirs in Kumasi and Buoho. The study found that levels of organochlorine residues in beef fat from Kumasi and Buoho abattoirs exceeded WHO maximum residue levels. 'Although most of the organochlorine residues detected were below the maximum limits set by the FAO/WHO, bioaccumulation of these residues is likely to pose health problems in higher organisms like human beings'.</p>
<p>Pesticide residues on shallots in Keta District, Volta region, Ministry of Food and Agriculture, 2006⁷²</p>	<p>Residues of chlorpyrifos and DDT were found on 90% of the shallot samples. More than 50% of the samples in some of the study areas revealed chlorpyrifos residues above Maximum Residue Levels, which could pose risks to human health.</p>
<p>'Pesticide and Pathogen Contamination of Vegetables in Ghana's Urban Markets', International Water Management</p>	<p>The study sampled vegetables on sale in nine major markets and 12 specialised selling points in Accra, Kumasi and Tamale. Chlorpyrifos (Dursban) was detected on 78% of the lettuce, lindane on 31%, endosulfan on 36%, Karate on 11% and DDT on 33%. Most of the residues recorded exceeded</p>

Institute/KNUST/Water Research Institute, June 2005⁷³	the maximum residue limit for consumption. ‘The study shows that intensive vegetable production, common in Ghana and its neighbouring countries, threatens public health from the microbiologic and pesticide dimensions.’
---	---

The studies cited above are likely to be the tip of the iceberg. A senior official in the Food and Drugs Board in Bolgatanga, responsible for the Upper East and Upper West regions, says:

*‘Most of the food for sale in markets in this area is contaminated in having pesticide residues. You can smell pesticides on beans at the market. Even if you wash them, the long-term effect is there and we don’t know enough about that’.*⁷⁴

The seriousness of the situation is further elaborated by the Regional Health Director for Upper East Region, who says:

*‘There is definitely some level of poisonings among the general population. Not much public education has been done. The problem could be much bigger than what we are aware of now. Pesticides are dangerous in no matter what quantity if they are consumed. Humans are not resistant or tolerant. Each time you eat pesticides, you accumulate them, you don’t excrete them. It is unacceptable even to have a minimum level of pesticide intake’.*⁷⁵

Lack of systematic testing of pesticide residues in food

Yet just as there is no systematic testing for the impacts of pesticides on farmers, there appear to be no routine tests conducted on the food available in Ghanaian markets. The EPA says that only ‘scattered studies’ have been done while an official in the PPRSD confirms that they occur ‘only once in a while so the problem could be much greater’.⁷⁶ A Pesticide Residue Laboratory has recently been established in the Ghana Standards Board, with support from the African Development Bank, but it is unclear whether this will conduct routine testing on food produced in Ghana.⁷⁷

Indeed, officials betray a lack of clarity over exactly who should be responsible for such tests. In Interviews, Food and Drugs Board officials say they are responsible for only processed food and ask whether MOFA is responsible for such tests. Meanwhile, interviews with other officials reveal that they think that either the FDB or else the Ghana Standards Board are responsible. Other officials think the Ghana Health Service might be responsible. It is this lack of clarity which partly explains why routine tests are not conducted – the various bodies all seem to think that the other bodies are responsible.

Another problem is the uncertain long-term effects. A senior official in the Food and Drugs Board in Bolgatanga says:

'The problem is that we are consuming food crops with chemical residues but because there is no immediate effect no-one is testing. The government only responds when things are alarming'.⁷⁸

It is not only food produced in Ghana that is the problem. There is also a problem with pesticide residues on imported fruit and vegetables. A senior official in the EPA says that fruit and vegetables imported from South Africa and the Middle East and sampled from leading supermarkets, including the supermarket Shoprite, show high levels of pesticide residues.⁷⁹

Double standards – what's good for foreigners, what's good for Ghanaians

One irony is that testing for pesticide residues in cocoa is routine and there are stringent standards for these exports. When it comes to domestic consumption of food for Ghanaians, however, no such stringency exists. Ghana's COCOBOD organizes considerable training programmes on safe handling of pesticides, including on the use of protective equipment and 'all export-oriented farmers have been trained in the safe use of pesticides', according to a senior official in the PPRSD.⁸⁰ But the government applies no such commitment to food producers. A senior MOFA official says:

'There's no pesticide residue monitoring of food. We've discussed with the Ghana Standards Board in many meetings. But there's a lack of resources for residue analysis. It means we don't know what the residue levels are. We only respond when other countries query our standards in our exports'.⁸¹

For example, in 2006, a consignment of 2,000 tonnes of cocoa beans from Ghana was rejected by Japan as a result of excessive levels of pesticide residues found in the beans.⁸²

3. THE PRIVATE SECTOR AND MARKETING OF PESTICIDES

Further problems associated with the use of pesticides in Ghana include the proliferation of illegal imports by unscrupulous private companies, the presence of unlicensed dealers and the broad drive to use pesticides by the private sector and some aid donors.

Increasing, and often illegal, imports

There are contradictory figures on Ghana’s imports of pesticides.⁸³ A senior EPA official estimates Ghana’s imports at around \$100 million a year.⁸⁴ According to another reputable source, pesticide imports into Ghana nearly quadrupled from 2002 to 2006:

Table 5: Imports of pesticides, 2002-06

Pesticide group						Average	
	2002	2003	2004	2005	2006	(2002 - 2006)	
Insecticides	4130	5974	8418	10006	12728	8251	%
Herbicides	2186	2939	4578	8566	10718	5797	%
Fungicides	1079	1249	2402	2205	3195	2026	%
Others	368	496	544	707	1224	672	%
Total	7763	10658	15942	21484	27886	16746	100%

Source: Godfred Darko, ‘Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana’, February 2009, p.3, <http://tpsalliance.org>

The increase in pesticide imports has been accompanied by an increase in the number of private importing companies. Up to 50 companies are now believed by officials to be importing pesticides into Ghana.⁸⁵ Yet many imports are illegal. In 2001, EPA officials estimated that 20 per cent of pesticides used by farmers in Ghana were obtained from unauthorized traders and do not enter the official figures.⁸⁶ A senior official in the EPA says that EPA surveys conducted in 2007 showed that around 30 per cent of pesticide products on sale were not known to the EPA, and were either unlicensed or smuggled. A senior official in the PPRSD estimates that at least 10-15 per cent of all imports are illegal, either by unlicensed dealers or importing expired

or adulterated goods. Most of these come from the Ivory Coast.⁸⁷ The EPA planned to conduct a further survey of imports in 2011.⁸⁸ Some of the imports arrive in bulk and are repackaged into smaller containers, often carrying inadequate or misleading labeling. Some pesticides are sold with labels only in French. A senior official in the PPRSD estimates that 2-3 per cent of all the pesticides on the shelves are fakes.⁸⁹

False labeling and food safety risks in Upper West

Poor or false labeling appears to be a widespread problem in Ghana. A joint study by scientists at the University of Development Studies in Tamale and at the Lethbridge Research Centre in Canada found that a significant number of pesticides on sale were not certified by the Food and Drugs Board of Ghana as required by law. The study of acaricides and anthelmintics – used by livestock farmers to control ticks – in the Sissala East District of the Upper West region found that the labels indicated that 14 per cent of acaricides and 30 per cent of anthelmintics were not certified by the FDB. The study suggested that these products were likely to have been illegally imported; most of the anthelmintics bottles, for example, bore labels written in French. It concluded that ‘inappropriate handling and use of livestock parasticals were prevalent and raised serious public health and food safety concerns’. Indeed, in Ghana, meat from small ruminants is prepared by burning off the hair and carcass eviscerated without removing the skin. Meat prepared this way from animals treated with acaricides poses significant food safety risks since the majority of farmers do not observe any withdrawal period or did so for 7 days or less.⁹⁰

The Customs service, CEPS, clearly needs to step up its monitoring of imports, but by itself this is unlikely to stop illegal imports, given Ghana’s porous borders. One problem is corruption among some CEPS officials – undercover journalists discovered in 2009, for example, that CEPS officials at border posts were involved in ‘multiple acts of corruption’ in colluding with rice and other smugglers to evade paying import taxes.⁹¹ The combating of illegal imports needs to be combined with more extensive farmer training and the reduced use of pesticides.

Unlicensed dealers

Many pesticide dealers do not have licences to operate and are believed to be selling banned or restricted pesticides. In November 2010, the authorities in Bolgatanga, capital of the Upper East region, were looking into reports that some banned herbicides were being sold in shops in the area.⁹² An extension officer responsible for Tamale metropolitan area says that some banned and expired pesticides – especially organophosphates and fungicides like DDT - are being sold on the open market, not so much in shops but by hawkers who visit the villages. He says he believes that endosulfan is still being supplied to farmers by such hawkers.⁹³

The number of agro-dealers selling pesticides is over 300 in the Northern region, around 70 in Upper East and around 80 in Upper West.⁹⁴ In Tamale metropolitan area, there are several

dozen registered agro-dealers but a large number of unregistered ones too – an extension official estimates 20, one agro-dealer estimates 10.⁹⁵ Unregistered dealers not only sell directly to farmers by visiting the villages but also set up stalls in urban markets to sell their goods, especially at the beginning of the season in June/July when pesticides sales peak. ‘At this time, there’s a proliferation of illegal dealers’, an extension officer in the Tamale area says.⁹⁶

A major problem with unlicensed dealers is that they are unlikely to have the requisite knowledge to correctly inform farmers what are the appropriate pesticides to use, and how to use them safely. Indeed, a study for the US-based International Food Policy Research Institute finds that the proportion of agro-dealers who report never receiving any formal training is 55 per cent in Northern region and 75 per cent in Upper East.⁹⁷ Yet many farmers now rely on agro-dealers for such advice rather than extension officers. The study of parastaticides in Upper West region noted above concluded that when farmers and herdsman buy their chemicals from MOFA clinics they are usually informed of the correct use of them; however, private veterinary shops and village markets are now where over 70 per cent of those sampled get their supplies.⁹⁸

The drive to use pesticides

There is an industry behind pesticides that is driving their increased use in Ghana.

Advertising

A senior MOFA official says that there is ‘aggressive marketing and promotion of pesticides in Ghana’, with 5-6 transnational corporations along with small-scale importers all trying to sell their products.⁹⁹ One issue is pesticide advertising, which is prominent on the television, radio and billboards around towns, claiming that pesticides are farmers’ friends and that yields will greatly improve. ‘Without using pesticides, you can’t achieve anything’ is the message of these adverts, according to an agro-dealer in Bolgatanga, who is the chair of the Ghana Agricultural Inputs Dealers Association in the Upper East region.¹⁰⁰ One pesticide marketing company sponsors the morning news on Radio Savannah, the local station in Tamale. Unsurprisingly, these adverts say nothing about the potential effects on human health or the environment and are not required to say that protective equipment must be worn. TV adverts can also show farmers applying pesticides without using protective equipment.¹⁰¹ The adverts are meant to be approved by the EPA but often this does not happen. A senior official in the EPA says: ‘There are adverts we are not happy about. They sometimes don’t follow the prescriptions of the law. They don’t advertise protection and claim they are safe.’¹⁰²

AGRA’s Agro-dealer network

Some donors are also driving the use of pesticides. The Alliance for a Green Revolution in Africa, funded by the Gates Foundation, and the US-based IFDC have a \$2.5 million project - the Ghana Agro-Dealer Development project (GADD) - training over 2,000 agro-dealers in business skills and safe handling of inputs to make agro-inputs ‘more available and affordable in

remote rural areas'.¹⁰³ This training is surely useful, but it is within a programme that is pushing for ever-greater use of pesticides. According to interviews conducted in this research, AGRA does not promote organic farming but is, rather, firmly committed to the increased use of chemical inputs.¹⁰⁴ An EPA official says that around 200 staff of agro-input dealers in the Northern region were trained in 2010, including on advising farmers to use pesticides safely. The training manuals cover up to 15 topics, including transporting, selling, safety, but farming without chemical inputs is not one of them.¹⁰⁵

One GADD leaflet provided to the researcher for this project shows a picture of a woman farmer spraying pesticides on a field without any protective equipment.¹⁰⁶ Also concerning is that, according to the AGRA website, the agro-dealer shop owners will also be trained in providing field demonstrations and soil testing 'thereby transforming them into providers of basic extension services and creating an invaluable source of knowledge and advice to farmers'.¹⁰⁷ Although many farmers need advice, such advice is unlikely to include sustainable or organic farming methods.

Other factors drive the use of pesticides

One is the government policy – in place for the past decade – of levying no import duty or the 15 per cent VAT on pesticides, which provides pesticide marketers with financial incentives to import and sell pesticides, in effect subsidized by the Ghanaian taxpayer.

Another is that some 'improved' seed varieties, such as for maize, cowpea and cassava are being introduced in Ghana, and encouraged by MOFA, which require greater use of pesticides than traditional seeds. One agro-dealer in Bolgatanga who sells improved seeds for maize, soya beans and cowpea, among others, says that with improved cowpea seeds, pesticide is needed otherwise the crop will not grow; with traditional cowpea seeds, however, pesticides are not needed.¹⁰⁸ Thus farmers need to buy more pesticides, reinforcing a dependence on expensive external inputs.

These factors combine with farmers' lack of knowledge of alternatives (see section 5 below) to increase the use of pesticides in Ghana, all with insufficient government regulation.

4. GOVERNMENT POLICY AND REGULATION

Ghana has significant national regulation in place and international regulation to which it is a signatory, to ensure the safe use of pesticides. But the legislation is not being implemented adequately, largely due to the insufficient allocation of resources. The capacity for regulation has not kept pace with the liberalization of the pesticides market that the government has been so keen to encourage.

Existing regulation

International regulation

The main international legal instruments relating to chemical pesticides are:

- The International Code of Conduct on the Distribution and Use of Pesticides (also known as the FAO Code of Conduct, since it has been led by FAO), which is a voluntary international mechanism for countries to regulate the availability, distribution and use of pesticides in their countries. It was revised in 2002.
- The Rotterdam Convention on Prior Informed Consent, which provides a process for sharing information between countries and for countries to prevent exports and imports of banned or severely restricted pesticides. It also encourages identification of pesticides that cause problems to health or the environment. Ghana signed the Rotterdam Convention in 1998 and ratified it in 2003.¹⁰⁹
- The Stockholm Convention on Persistent Organic Pollutants, which aims to protect human health and the environment from persistent organic pollutants (POPs)*. Countries are required to prepare National Implementation Plans which define the commitments and actions that they plan to undertake in the field of POPs management. Ghana signed this Convention in 2001 and ratified it in 2003.

National regulation

Ghana has various legislation on the its books regulating the use of pesticides, most importantly the Environmental Protection Act of 1994 (Act 490). This Act forbids any pesticide imports except where they have been registered, requires the EPA to keep a list of registered pesticides and requires all importers and sellers to keep a record of the pesticides imported or sold. The

* These are chemical compounds that are resistant to environment degradation and persist in the environment, with possible effects on human health and the environment. Many POPS are pesticides.

Act also allows for EPA inspections to take place on grounds of reasonable suspicion that illegal pesticides are being stored and for pesticides and equipment to be seized.

The Food and Drugs Law of 1992 aims to regulate the import, sale and use of food, drugs and chemical substances to protect the health of consumers and establishes the Food and Drugs Board to perform the administrative functions under the law. The law does not make specific reference to banned or severely hazardous chemicals but it defines 'chemical substance' as including pesticides.¹¹⁰

EPA and PPRSD

There are two main bodies responsible for pesticides surveillance and monitoring in Ghana:

- The EPA is the key agency responsible for the registration and management of all chemicals, including pesticides.¹¹¹ The Chemicals Control and Management Centre (CCMC) of the EPA, which is headed by a Director who is also the Pesticides Registrar, is responsible for ensuring the proper labeling, distribution, storage, transportation, use and application of pesticides. It monitors the use of pesticides and takes action against their illegal use and registers and issues licenses for pesticides.¹¹² The CCMC also hosts the Hazardous Chemicals Committee – which monitors imports and sales of chemicals and advises the EPA on regulation – and the Pesticides Technical Committee – which makes recommendations to EPA Board on which pesticides are to be registered or not.
- The Plant Protection and Regulatory Services Directorate of the MOFA, whose Pesticide and Fertilizer Regulatory Division supervises and trains inspectors and extension officers, registers and inspects pesticide dealers, conducts training and provides information materials on pesticides.

Control of imports

The Customs, Excise and Preventive Service (Management) Law of 1993 regulates all imports into Ghana including chemicals. CEPS performs duties on behalf of the EPA, examining documents and certificates granted by the EPA to ensure they cover the particular importation that the bearer of the permit claims. The law gives CEPS officers the power to search persons, premises and baggage and seize prohibited goods, including chemicals, and they are required to prevent the illegal import into Ghana of any pesticide. In fact, to implement this law, CEPS officers are given the same powers as the police. They are also required to keep a list of all pesticides imported into the country for onward submission to the EPA.¹¹³ The PPRSD also has staff – called 'quarantine staff' – at border posts looking for illegal imports of pesticides, among other things.

Pesticide labeling

There is an official standard on pesticide labeling. The EPA has developed a format for labeling which it applies to all those who register their pesticides to sell them on the local markets. This format includes the name of the product, its active ingredient and concentration, a summary of the possible uses, an EPA registration number, batch number, date of manufacture and expiry, the name and address of the local agent, directions for use, hazard symbol and pictograms, first aid measures and a safety or risk phrase, among others.

Health monitoring

The government is in theory committed to monitoring and curtailing occupational exposure, poisoning and residues in food (although, as we have seen, this is not routine in practice). Indeed, the Environmental Protection Act of 1994 (Article 44(6)) states that ‘a person shall not harvest or offer for sale a foodstuff on which pesticides have been used except in compliance with the prescribed practices including the interval between the application of pesticides and harvest’.

Government policy to implement the regulation

The government is of course aware of the dangers of pesticides, and several messages to the public have been made to this effect. In April 2010, for example, a West African regional meeting on persistent organic pollutants was held in Accra during which the Minister of the Environment, Science and Technology, Sherry Ayittey, remarked on the negative effects of pesticides, saying that ‘for a long time the natural environment is considered and treated as a self-renewable resource, but we realize today that humanity is sowing the seed of its own destruction by the way we treat the environment’.¹¹⁴ In October 2009, the Minister said that ‘pesticides have one thing in common – they are poisonous and have the potential to be harmful to humans if ingested in sufficient quantities, handled or sold by untrained people with little or no knowledge about its toxicity’.¹¹⁵

The government is taking a number of important measures to ensure the safer use of pesticides. To list some:

- In December 2010, following the announcement of 12 deaths from pesticides, the regional Minister for the Upper East announced the creation of a 5-member task force to monitor and control the use of chemicals, saying that the taskforce would inspect the licenses of dealers and salesmen and mount radio programmes to educate the public.¹¹⁶
- The government has in the past encouraged the Occupational Safety and Health Unit of the Ghana Health Service to produce new programmes to create public awareness about the dangers involved in the misuse of chemicals.
- In August 2010, the Pesticides Registrar called for the establishment of new laboratories or the upgrading of existing facilities to ensure better quality control analysis of pesticides. He also called for the establishment of stronger collaborative arrangements with academic and

research institutions to monitor the effects of pesticides on the environment, admitting that the existing facilities are inadequate.¹¹⁷

- The EPA announced in late 2009 that it is intensifying efforts to address the influx of pesticides onto the market and would initiate a programme to test them.¹¹⁸
- The EPA has regularly urged pesticide companies and distributors to comply with the licensing regulation to avoid prosecutions.¹¹⁹ In August 2010 the Northern Regional Director of the EPA announced that the Agency was collaborating with the police to seize fake and unlicensed agro-chemicals.¹²⁰
- The EPA has organized various regional workshops to train pesticide inspectors, agro-input dealers and extension officers to better understand and enforce the legal framework for the management of pesticides.¹²¹
- In 2010, MOFA and the EPA started a partnership with CropLife Ghana to produce an inventory of all obsolete and unwanted pesticides. The two-year project, called CleanFarms Ghana, is being implemented by CropLife Ghana and the waste management company Zoomlion and aims to safeguard obsolete pesticides and to collect empty containers.¹²² During the first year, 170 tonnes of obsolete pesticides and 56,000 empty containers were identified.¹²³
- In 2007, the Brong-Ahafo Regional Office of the EPA announced that it would no longer tolerate 'table-top' agro-chemicals traders, warning them they would be apprehended and prosecuted.¹²⁴
- MOFA officials have called on journalists to inform the public about the dangers of using unapproved pesticides.¹²⁵

Despite these welcome initiatives, various problems remain and the government has not gone far enough to address them.

Resource and capacity gaps

'We have concerns that there is a big push for the use of pesticides when our regulation structures are not that strong'. PPRSD official¹²⁶

Lack of subsidiary legislation

Although Ghana brought in the Environmental Protection Act, subsidiary legislation is needed – the 'regulations' – to implement it. But the regulations have been in draft form since 2000, have not yet been passed and remain under consideration by parliament; the delay is apparently due to changing structures in government departments. These regulations are clearly essential. They will inform all stakeholders about the laws and guidelines and specify their role in implementing and enforcing the law, and they cover areas such as advertising, licensing, registration, labeling, transport and storage. Until these regulations are in place, there is little hope that the Act will be effectively implemented.

Insufficient allocation of resources

A senior official in the PPRSD describes its resources as 'woefully inadequate' and says that the PPRSD is spending only around GC 200,000 a year on pesticide surveillance.¹²⁷ The EPA spends around GC 100,000 a year on pesticide surveillance, meetings and training.¹²⁸ This means that the Ghanaian government is spending only around GC 300,000 a year on this critical area.

More resources for pesticide surveillance

Of MOFA's budget of GC 257 million in 2009/10, only a fraction was allocated to activities related to pesticides.¹²⁹ When asked why the EPA does not receive more money for its pesticide surveillance work, a senior official said:

*'The government's focus is on expanding production and the fertilizer subsidy. Protection of the consumer and the environment are not things that politicians can regularly relate to. They only wake up in a calamity, otherwise they don't see the urgency. Maybe they bring their own food in from abroad.'*¹³⁰

Of course, there are huge demands on the government and MOFA budget, so why should pesticide surveillance receive more money? A PPRSD official says:

*'These chemicals are intentionally made to kill living organisms and we are living organisms ourselves. They can also kill us. There can be impacts on food safety and on human health and the environment. Any government that wanted to look after the welfare of its people should pump more money into effective management of pesticides'*¹³¹

Indeed, a proposal has been made by the PPRSD to establish a Plant Protection Fund to spend more resources on enforcing the pesticides laws. It is envisaged that this will be established in 2011, but it is unclear how much budget it will receive.

In 2005, the EPA proposed the creation of a Pesticide Management Fund to increase resources available for pesticide surveillance and training. Industry agreed to contribute 0.1 per cent of the value of their imports to the fund, which would have generated around GC50,000 given that at the time imports were valued at around GC50 million. Yet the proposal was rejected by the Ministry of Finance, arguing that there was already an Environment Fund, managed by the EPA Board, and that this would duplicate the new fund. However, EPA argues that the existing environment fund is inadequate as it covers numerous environmental issues not just pesticides. Indeed, when a new pesticide is registered in Ghana, \$3,000 is contributed to the Environment Fund, but this money is spent on various environmental programmes and there are no specific allocations to pesticide surveillance.

Lack of capacity for inspections

The EPA has one pesticide inspector in each of the ten regions plus another five in Accra – thus a total of 15 across the whole country. The PPRSD says it has around 46 inspectors around the country but they do not focus just on pesticides but also on seeds and plants, among other areas.¹³² The EPA lacks the capacity to work in the rural areas among farmers, a major problem when numerous unregistered dealers sell directly to farmers by visiting villages. It also has little capacity to pounce on unregistered dealers who set up in local markets in urban centres like Tamale. One MOFA official estimates that in the Northern region, the EPA is only able to be active in 4 or 5 of the 22 districts.¹³³ An EPA official in the Northern region says that there are 4 officials in both EPA and PPRSD available to do pesticide surveillance and inspections.¹³⁴ There is one staff person, a programme officer, in the EPA regional office for the Upper East in Bolgatanga¹³⁵ In Upper East region, a senior MOFA official responsible for Navrongo District says that there are no PPRSD staff to conduct inspections, even though the district has 21 dealers and 25,000 farming households, around half of whom use pesticides.¹³⁶

Inadequate extension services and training

Government extension services – which can provide vital training and advice on pesticides to farmers – are inadequate to reach sufficient farmers regularly. Recent figures suggest that only 12 per cent of male-headed households and a minuscule 2 per cent of female-headed households have access to extension services.¹³⁷ In Upper East region, each of the 9 districts is meant to have 24 extension officers, but most have 9-10, the MOFA official in charge of extension says. He adds that ‘very little’ of the extension officers’ time is spent on pesticides, even though the majority of farmers in the region use pesticides. Given that around 600,000 of Upper East’s region’s one million people are in farming households, this means each extension officer covers around 6,600 people or around 900 households. The region’s entire annual extension budget (except for salaries) is around GC 4,000, according to the official.¹³⁸

Thus MOFA lacks adequate resources to undertake sufficient training of farmers. The PPRSD also trains agro-dealers at regional level to promote their knowledge and ability to give advice, but the budget for this is a ‘few thousand cedis’, according to PPRSD officials.¹³⁹

Institutional arrangements

A general problem appears to be the overlap between the responsibilities of the EPA and the PPRSD. Both are responsible for certain aspects of pesticide surveillance, enforcement of the law and training of farmers, yet more clarity and division of labour in the field is needed on their different roles, or else the government may need to create a single body responsible for all aspects of pesticide surveillance.

The FAO Code of Conduct – Ghana’s Failure to Comply

The International Code of Conduct on the Distribution and Use of Pesticides, also known as the FAO Code of Conduct, contains dozens of guidelines to which states are encouraged to abide to promote the safe use of pesticides. Ghana has made efforts to comply with some of them, but a number of key provisions are simply not being met. These include:

Governments ‘should ensure the allocation of adequate resources for this mandate’ [ie, regulate the availability and use of pesticides] (Article 3.1)

Inadequate resources are being devoted to this.

‘Pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided’. (Article 3.5)

This far-reaching guideline is nowhere near being met. Numerous pesticides are being used in Ghana that require protective equipment that is both expensive for farmers or else not readily available.

‘Governments should...carry out health surveillance programmes of those who are occupationally exposed to pesticides and investigate, as well as document, poisoning cases’. (Article 5.1.3) *‘Governments should... implement a programme to monitor pesticide residues in food and the environment’.* (Article 5.1.10)

There appears to be no formal programmes to monitor health impacts or systematic efforts to document poisoning cases.

‘Governments should... utilize all possible means for collecting reliable data and maintaining statistics on health aspects of pesticides and pesticide poisoning incidents’. (Article 5.1.6)

Very little data and statistics are officially collected.

‘Government and industry should cooperate in further reducing risks by... establishing services to collect and safely dispose of used containers and small quantities of left-over pesticides’ (Article 5.3.3)

There are no such services.

‘Governments should control, by means of legislation, the advertising of pesticides in all media to ensure that it is not in conflict with label directions and precautions, particularly those relating to proper maintenance and use of application equipment, appropriate personal protective equipment, special precautions for children and pregnant women or the dangers of reusing containers’.

Advertising in Ghana is poorly enforced and adverts appear to simply be allowed to demonstrate the benefits of pesticides.

5. ALTERNATIVES - REDUCING DEPENDENCE ON CHEMICAL PESTICIDES

'Farmers should be informed about organic farming instead of being reliant on pesticides'. (A senior official in the Food and Drugs Board in Bolgatanga, responsible for the Upper East and Upper West regions)

Problems with chemical pesticides, and alternatives

There is a long standing, global debate over whether the use of chemicals is the optimal farming method for resource poor farmers or is needed at all. Our analysis, supported by considerable evidence around the world, is that chemical pesticides destabilize agro-ecological systems by contaminating the environment, reducing biodiversity and ultimately reducing agricultural yields, in addition to having often serious health impacts noted elsewhere in this report. Soil and water contamination by pesticides (through runoffs from fields, leaching through the ground and direct application) can have devastating and persistent consequences on flora and fauna biodiversity (wildlife as well as insects and micro-organisms).¹⁴⁰ Losses of birds and insects affect agricultural output since they cause the decline of pollinators, a crucial eco-system for plants, and contribute to increasing infestations and the development of new pest species by destroying natural predators. Pesticide contamination also affects soil organisms and bacteria that are essential for the maintenance of soil structure, transformation and mineralization of organic matter, and for making nutrients available for plants.¹⁴¹ Several studies have proved the negative impacts of pesticides on nitrogen fixation processes and the consequences in terms of reduced soil fertility and increased dependence on synthetic fertilizer.¹⁴²

A further problem associated with the use of chemicals is that resistance by unwanted organisms is escalating. During 1970-2000, for example, 250 weeds around the world became resistant to herbicides and 540 insect species became resistant to more than one insecticide.¹⁴³ As a result, pest control has become more and more difficult, and farmers face growing costs due to the need to increase the use of pesticides and test new products, as documented in cotton cultivation in West Africa.¹⁴⁴

Alternatives to dependence on chemicals include practices associated with sustainable agriculture, and can involve methods such as organic farming – involving no use of chemical pesticides – Integrated Pest Management (IPM) and Sustainable Rice Intensification (SRI), which reduce but which usually do not reject entirely the use of chemicals (See Box). Farming without pesticides can include methods such as crop rotation, intercropping, planting of trap plants and plants that serve as habitats for beneficial insects, companion planting to deter pests

and field sanitation. If preventive measures are not sufficient, insecticides derived from natural plant extracts, natural soap or minerals or plant extracts such as neem, lemon grass, garlic, ginger and many more can be applied.¹⁴⁵ Cotton farmers in Benin, for example, show that cotton can be grown without chemical pesticides, notably endosulfan. Practices that can all be successful include encouraging natural predators, selecting resistant varieties, planting early maturing varieties which reduce the risk of pest attacks, use of rotation and trap crops and the use of food sprays for predators to improve the balance between useful insects and pests.¹⁴⁶

Ghana's Successful experiences with organic farming

The experience of farmers and researchers in northern Ghana shows that sustainable and organic farming approaches can be successful and are often more productive and cost-effective than reliance on pesticides.

Certified organic agriculture has been promoted in northern Ghana since the early 1980s, but adoption rates were slow and the results mixed until the mid-1990s.¹⁴⁷ A niche organic sector has since emerged. In 2008, 3,900 farmers in Ghana were practising organic agriculture on 24,449 hectares – the highest figure in West Africa.¹⁴⁸ The majority of the organic products grown are export commodities such as palm oil, fresh fruits, cocoa, bananas, cashew nuts, cotton and vegetables.¹⁴⁹ Since certified organic products earn a premium price on foreign markets, they are often more profitable than non-organic produce. Increased demand from Ghanaian consumers in urban areas for fresh organic fruit and vegetables has also made the organic sector a profitable option for some smallholder farmers.¹⁵⁰ Ghanaian and international NGOs and farmers' groups have started to promote the expansion of organic production in the existing product range as well as in new sectors.¹⁵¹

Gustav Mahunu, a fruit crop specialist at the University of Development Studies in Nyankpala, just outside Tamale, works with the Canadian government development department, CIDA, and the Agricultural Institute of Canada on an organic project with farmers in Upper West region. The farmers, who are among the poorest, with an average of only half an acre, previously used pesticides on tomatoes and cabbage but have now shifted to organic farming, promoting composting, inter-cropping and the use of neem.* 'The organic method is producing as much as before and also has the advantage of reducing costs since organic farming is basically free', Gustav says. He adds: 'In northern Ghana, high-tech agriculture is not appropriate because the soils are so poor. Around here, when you apply fertilizer, the soil loses fertility and you have to apply even more each year. The only way to retain soil fertility is to apply organic materials'.¹⁵²

Similarly, Dr Mumuni Abdoulay, a crop expert working on legumes and cotton at the Savannah Agricultural Research Institute near Tamale, one of Ghana's leading research institutions, says that neem ultimately works as effectively as chemical pesticides if sprayed properly and

* Seeds and leaves from the neem tree are harvested, pounded, a brand of soap is added to them, then soaked in water overnight and can the next day be used for spraying.

throughout the plant life-cycle. He notes that productivity can be higher with pesticides but that using neem is better overall since it reduces costs to the farmer, it is non-toxic and does not pose health hazards to humans or the environment.¹⁵³

The Ghana Organic Agricultural Network says that after training, farmers practicing organic farming produce more than with pesticides and that organically-produced vegetables have a longer shelf-life. Cabbages produced with pesticides rarely last more than five days, compared to two weeks for those organically-produced. GOAN has trained around 9,000 farmers around the country in organic farming techniques, including methods such as green manuring, composting and the use of neem leaves as pesticides. The experience of the Presbyterian Agricultural Services in northern Ghana is that more is produced by organic farming because the organic matter content is higher, especially by those farmers who own farmyard ruminants who use animal manure and composting techniques. An extension official responsible for extension services in the Tamale metropolitan area says that for farmers with two acres or less it is more cost-effective to employ labourers than to use pesticides, although he argues that for those with larger landholdings, pesticides can be more cost-effective than employing labourers.¹⁵⁴

Successful sustainable agriculture

There is now substantial evidence that sustainable agriculture can increase yields significantly, often comparably to conventional agriculture that relies on chemical inputs, and with lower input costs. The largest study of sustainable agriculture projects to date, led by Jules Pretty at the University of Essex in England, has been that of 286 projects whereby farmers in 57 countries were engaged in transitions to sustainable agricultural practices. It found that the average yield increase was around 79 per cent across a wide variety of systems and crop types.¹⁵⁵ Similarly, a 2007 study by the University of Michigan, comparing a global dataset of 293 examples of yields of organic versus conventional or low-intensive food production, concluded that organic methods could produce enough food to feed the world population on a per capita basis. The study also noted – critically – that yield increases from organic farming would be even greater if more agricultural research were focused on sustainable agriculture.¹⁵⁶

Organic agriculture, meanwhile, is a sustainable and environmentally friendly production system that offers African and other developing countries a wide range of economic, environmental, social and cultural benefits.¹⁵⁷ An assessment of 15 case studies conducted jointly by the UNCTAD and the United Nations Environment Programme in East Africa concluded that organic agriculture can increase agricultural productivity and raise incomes with low cost, appropriate technologies and minimize environmental impacts. All case studies where data on production were available reported yield increases. 'Furthermore, evidence showed that organic agriculture can build up natural resources, strengthen communities and improve human capacity, thus improving food security by addressing many different causal factors simultaneously'.¹⁵⁸

Integrated Pest Management, which integrates pest-resistant varieties, natural control mechanisms and the use of some pesticides, has long been shown to reduce the need for chemical pesticides. FAO has promoted IPM throughout the developing world, in particular using the Farmer Field School (FFS) methodology.¹⁵⁹ In a recent evaluation of its West African Regional Integrated Production and Pest Management Programme, FAO documents how the adoption of IPM resulted in improved yields and higher farmers' incomes in Benin, Burkina Faso, Mali and Senegal. Rice farmers experienced dramatic improvements but also cotton and vegetables growers were positively affected.¹⁶⁰ The demand in the marketplace for their products increased due to the improved quality of their production and some FFS groups were able to become certified organic growers.¹⁶¹

Sustainable Rice Intensification is an agro-ecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil and irrigation while reducing requirements of seeds, water and chemical inputs. Originating in Madagascar in the 1980s, it has spread to 40 countries, mainly in South East Asia and more recently in Africa. Since 2000 substantial rice yield increases have been reported in Gambia, Sierra Leone, Rwanda, Benin, Burkina Faso, Mali, Senegal, Guinea and Zambia.¹⁶² In Ghana, the General Agriculture Worker's Union in collaboration with ActionAid-Ghana has supported farmers in implementing SRI under two irrigation projects for three years. In October 2011, rice farmers operating under the Kpong Irrigation Project at Asutware in the Eastern Region called on the

Government to adopt SRI as a policy to help increase rice production in the country.¹⁶³

In East Africa, over 30,000 farmers have adopted a 'push-pull technology' for integrated pest, weed and soil management in cereal-livestock farming systems. Stemborers are attracted to Napier grass (*Pennisetum purpureum*), a trap plant (pull), and are repelled from the main cereal crop using a repellent legume intercrop (push) called desmodium. Desmodium root also controls the striga weed by causing abortive germination and improves soil fertility through nitrogen fixation, natural mulching, improved biomass and control of erosion. Maize yields rose on average from below 1 to 3.5 tonnes/ha and farmers saved money by using locally available plants instead of expensive inputs.¹⁶⁴

Organic farming and chemical pesticides: Some farmers' experience

The 22 members of the farmers group in Golinga village, a few kilometers from Tamale, all use chemical pesticides to grow their maize, rice and vegetables. Group Chairman Yamale Sayibu, who has a relatively large landholding of 25 acres, says that he achieves greater yields with pesticides, and that one acre planted with vegetables will earn him GC50 when using pesticides and GC30 when using organic methods. On one acre of rice, Yamale will need to spend around GC20 on pesticides to yield GC250 worth of rice compared to earning around GC70 without pesticides. Yet despite these yield increases, he and other farmers are increasingly turning to organic farming, especially the use of neem. 'When you spray, the crop grows faster, but when you use neem it's much healthier to eat and the vegetables last longer', Yamale says.

One reason for using pesticides is the farmers' lack of animals to provide manure. 'If we had animals, we would reduce our pesticides and maybe not use them at all. Chemicals have a bad effect on the soil but manure is good.' Yamale says that by using pesticides, each year more and more pesticides have to be applied to maintain the same yield. He also says that organic produce lasts much longer, giving the farmers a better chance of selling all their crop. 'With pesticides, leafy vegetables last only one day after harvest. Organic ones will last 3-4 days', Yamale says.¹⁶⁵

Abaziuk John, the chair of a group of 12 farmers in Chondema near Bolgatanga in the Upper East region, says that the reason his farmers use pesticides is that they cannot obtain enough neem to use it on all their crops. 'We use neem oil, which works, but we need it in large quantities and need a lot of leaves and a lot of labour to collect the leaves and seeds and apply it. It is because of the limited amount of neem and the cost of labour that we use pesticides. If we had more leaves, we wouldn't be wasting our time and money on chemicals'. Abaziuk says that their production of tomatoes is higher using neem than using pesticides.¹⁶⁶

Lack of knowledge among farmers

Although organic farming alternatives can be successful, they are not being widely pursued in Ghana because farmers have little information about them and the government is mainly promoting pesticides. NPAS' survey of 183 farmers in 14 villages in the Upper East found that 73 per cent wanted further information on sustainable pest management practices and alternatives to using chemical pesticides. Neem oil to be used for spraying cannot be found for sale while other organic alternatives to chemical pesticides have been barely promoted at all:

- The suchrudaka shrub (*Securidaca longipendunculata*), for example, produces leaves that can be wrapped around grain and used for storage.
- Another shrub, striga, produces leaves that can be burned and the ash used as a pesticide.
- Ash from firewood and charcoal can also be effective on vegetables like cowpea and okra.

The problem is that few farmers know of these techniques and the extension service is barely training farmers in their use. Even an agro-dealer in Tamale says:

'Organic farming is very good but needs a long time to enable farmers to grow. Pesticides are more immediate. But if farmers were trained in organic farming, they could increase production and reduce illnesses among their families and this might be just as good as using pesticides'.¹⁶⁷

Lack of a government plan to escape farmer dependence on chemicals

Although MOFA is promoting IPM and organic farming, it is not doing so very strongly. The government's flagship agriculture strategy document – the Food and Agriculture Development Policy (FASDEP II), drawn up in 2007 – makes no mention at all of organic farming, for example. Some government support is given to the EPA to train farmers in organic pest control, but these activities appear to be low level, and underfunded, reaching few farmers.¹⁶⁸ A study for IFPRI found that only 5-10 per cent of farmers use organic fertilizers, compared to 21 per cent using chemical fertilizers.¹⁶⁹ This was even before the government's fertilizer subsidy programme was introduced in 2008.¹⁷⁰ Overall, there is no coherent government plan to allow farmers to escape dependence on pesticides. A unit exists in the PPRSD that promotes IPM and informs farmers of alternatives to pesticides, and IPM is always a part of the PPRSD's training programmes, according to officials, which often includes training on organic farming.¹⁷¹ But most extension officers are better able to advise on the use of external inputs – such as pesticides and fertilizers – than on organic or IPM farming methods. For farmers with small plots, there is a strong argument to promote intensive organic farming that enhances the soils and preserves the environment. But to do this, the extension system needs to be equipped with knowledge and technologies.

RECOMMENDATIONS

The government should:

On health impacts

- Establish a Ghana Health Service programme to routinely conduct tests on a sample of farmers to test for pesticide residues
- Establish clarity on which body is responsible for testing for pesticide residues on food, and establish a programme for routine testing
- Ensure that health officials are capable of diagnosing and treating pesticide poisonings.

On permitted pesticides

- Review its list of permitted pesticides and suspend those considered dangerous

On resources

- Increase resources to pesticide surveillance activities in the EPA and PPRSD by creating a Pesticide Management Fund (to which companies involved in pesticide marketing should be obliged to contribute)
- Review the capacity of the EPA, the PPRSD and the CEPS to adequately conduct inspections and produce a public report stating how their capacity will increase
- Review the capacity of MOFA, especially its extension service, to provide training to farmers in the safe use of pesticides and produce a public report stating how this will improve
- Establish an immediate public campaign to reach all farmers in Ghana warning them of the dangers of pesticide use and directions for safe handling of pesticides

On legislation/regulation

- Subject the draft regulations of the Environmental Protection Act to public scrutiny and take immediate steps to pass them

On pesticide marketing

- Require all pesticide advertising to carry a health warning, saying that these are dangerous chemicals for which protective equipment must be worn.
- Halt the process, especially in the GADD project, by which agro-dealers are increasingly becoming the source of advice to farmers on pesticide use, and require agro-dealers to refer farmers to extension officials for advice

- Stop encouraging the use of 'improved' seeds that require greater pesticide use

On alternatives

- Announce that government policy is to move away from reliance on pesticides for agriculture in Ghana
- Outline an increase in resources for research on and promotion of organic farming

Parliament should:

- Press the government to promote these policy changes
- Call for a review of government policy towards pesticides encompassing the various aspects of the issue raised in this report

NGOs working with farmers should:

- Raise awareness among farmers as to the dangers of pesticide use
- Work with farmers to develop community monitoring of the use and impacts of pesticides in order to alert the authorities as to the health and environmental impacts of pesticide use
- Empower communities through training and other support to engage with the local government to address their concerns on pesticides use
- Do more to publicize to the Ghanaian public the environmental and health impacts of pesticide use
- Press the government and parliament to support necessary policy changes

ANNEX

Banned pesticides in Ghana, as at July 2010:

1. 2,4,5-T and its salts and esters
2. Aldrin
3. Binapacryl
4. Captafol
5. Chlordane
6. Chlordimeform
7. Chlorobenzilate
8. DDT
9. Dieldrin
10. Dinoseb and its salts and esters
11. Dinitro-*ortho*-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)
12. Endrin
13. HCH (mixed isomers)
14. Heptachlor
15. Hexachlorobenzene
16. Parathion
17. Pentachlorophenol and its salts and esters
18. Toxaphene
19. Mirex
20. Methamidophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l)
21. Methyl-parathion (emulsifiable concentrates (EC) with at or above 19.5% active ingredient and dusts at or above 1.5% active ingredient)
22. Monocrotophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l)
23. Parathion (all formulations - aerosols, dustable powder (DP), emulsifiable concentrate (EC), granules (GR) and wettable powders (WP) - of this substance are included, except capsule suspensions (CS))
24. Phosphamidon (Soluble liquid formulations of the substance that exceed 1000 g active ingredient/l)
25. Dustable powder formulations containing a combination of Benomyl at or above 7%, Carbofuran at or above 10% and Thiram at or above 15%
26. Methyl Bromide

REFERENCES

- ¹ Many officials interviewed for this research believe that up to 90 per cent of farmers use chemical pesticides at some point during the farming season. A 2008 study of vegetable farmers in Ghana's southern and central regions for IFPRI found that 86 per cent of farmers surveyed used insecticides (Daniela Horna et al, 'Insecticide use of vegetables in Ghana: Would GM seed benefit farmers?', *IFPRI Discussion Paper*, August 2008, p.9) A 2003 study estimated that 87 per cent of farmers use chemical pesticides: B.Dinham, 'Growing vegetables in developing countries for local urban populations and export markets, *Pest Management Science*, 2003, cited in Kwadwo Asante and William Ntow, 'Status of environmental contamination in Ghana: The perspective of a research scientist', *Interdisciplinary Studies on Environmental Chemistry*, 2009, p.253. However, a 2007 study for IFPRI suggests that the proportion of farmers using insecticides ranges from 1 to 22 per cent across Ghana's regions, and from 1 to 21 per cent for herbicide. Jordan Chamberlin, 'Defining Smallholder Agriculture in Ghana: Who are Smallholders, What do they do, and How are they linked with Markets', *GSSP Background Paper 6*, August 2007, p.20
- ² E.Owusu-Ansah, 'Assesment of lindane pesticide residue in cocoa beans in the Twifo Praso district of Ghana', *Journal of Chemical and Pharmaceutical Research*, 2010, p.580
- ³ Interview with Abdukari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ⁴ Environmental Justice Foundation, *End of the Road for Endosulfan: Pushing for a global ban on a deadly pesticide*, undated, p.4; PAN, *Communities in Peril: Global report on health impacts of pesticide use in agriculture*, 2010, p.3
- ⁵ ETC Group, *Who Owns Nature: Corporate Power and the Final Frontier in the Commodification of Life*, November 2008, p.15
- ⁶ WHO, *Childhood Pesticide Poisoning: Information for advocacy and action*, May 2004, p.7
- ⁷ International Labour Conference, 88th Session 2000, Report VI (1), *Safety and Health in Agriculture*, ILO, Geneva, 1999
- ⁸ PAN, *Communities in Peril: Global report on health impacts of pesticide use in agriculture*, 2010, p.23
- ⁹ PAN, 'The Hidden Costs of Pesticide Use in Africa', *Food and Fairness Briefing No.2*, undated, p.3; Abou Thiam and Mamadou Bamba, *Monitoring Pesticides at Grassroots Community Level*, PAN Africa, Dakar, December 2009
- ¹⁰ World Bank, *Program Document for a Second Agriculture Development Policy Operation*, 3 May 2010, p.12
- ¹¹ Republic of Ghana, *Comprehensive Food Security and Vulnerability Analysis*, May 2009, p.48
- ¹² Republic of Ghana, *Comprehensive Food Security and Vulnerability Analysis*, May 2009, p.94
- ¹³ Republic of Ghana, *Comprehensive Food Security and Vulnerability Analysis*, May 2009, p.14
- ¹⁴ Republic of Ghana, *Comprehensive Food Security and Vulnerability Analysis*, May 2009, p.126
- ¹⁵ Interview with Eric Dzimado, PPRSD, in Accra, November 2010
- ¹⁶ 'Pesticides cause impotence if not properly handled', *Daily Graphic*, 12 February 2010
- ¹⁷ Daniela Horna et al, 'Insecticide use of vegetables in Ghana: Would GM seed benefit farmers?', *IFPRI Discussion Paper*, August 2008, p.10
- ¹⁸ W.Ntow et al, 'Accumulation of persistent organochlorine contaminants in milk and serum of farmers from Ghana', *Environmental Research*, January 2008, www.ncbi.nlm.nih.gov; Godfred Darko, 'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana', February 2009, p.9, <http://tpsalliance.org>; Kwadwo Asante and William Ntow, 'Status of environmental contamination in Ghana: The perspective of a research scientist', *Interdisciplinary Studies on Environmental Chemistry*, 2009, p.255
- ¹⁹ Kwadwo Asante and William Ntow, 'Status of environmental contamination in Ghana: The perspective of a research scientist', *Interdisciplinary Studies on Environmental Chemistry*, 2009, p.256; W. J. Ntow, 'Organochlorine Pesticides in Water, Sediment, Crops and Human Fluids in a Farming Community in Ghana', *Environmental Contamination and Toxicology*, Vol. 40, No. 4, 2001, pp. 557-563. doi:10.1007/s002440010210
- ²⁰ Interview with Dr Quest, MOFA Director for Navrongo district, Upper East, in Sandema, November 2010
- ²¹ Interview with Dr Koku Awoonor-Williams, Regional Director of Health Services for the Upper East in Bolgatanga, November 2010
- ²² 'Ghana: Twelve die after poisonous food', 4 December 2010, www.afriquejet.com

-
- ²³ Interview with Dr Koku Awoonor-Williams, Regional Director of Health Services for the Upper East in Bolgatanga, November 2010
- ²⁴ Godfred Darko, 'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana', February 2009, p.14, <http://tpsalliance.org>
- ²⁵ P.Amoah et al, 'Pesticide and Pathogen Cotamination of Vegetables in Ghana's Urban Markets', International Water Management Institute/KNUST/Water Research Institute, *Archives of Environmental Contamination and Toxicology*, Vol.50, 2006
- ²⁶ 'Agric Ministry to Dispose of Obsolete Pesticides', *Daily Graphic*, , 8 April 2008, <http://www.modernghana.com/news/162193/1/agric-ministry-to-dispose-of-obsolete-pesticides.html>
- ²⁷ Joseph Laary, 'Agrochemical Application by Farmers: A Common Practice or a Necessity?', PAS, undated
- ²⁸ Interviews with Vesper Suglo, Director of PPRSD and Ernest Osei-Assibey, PPRSD, in Accra, November 2010
- ²⁹ PAN. 'Which Pesticides are Banned in Europe', *Food and Fairness Briefing, No.1*, April 2008
- ³⁰ 'Endosulfan to be banned, poses "unacceptable risks" to farm workers and wildlife, EPA says, 10 June 2010, www.environmentalhealthnews.org
- ³¹ Environmental Justice Foundation, *End of the Road for Endosulfan: Pushing for a global ban on a deadly pesticide*, undated, p.3
- ³² Interview with Ernest Osei-Assibey, PPRSD, in Accra, November 2010
- ³³ Stephanie Williamson, 'Pesticide Provision in Liberalised Africa: Out of Control?', *AgREN Network Paper No.126*, January 2003, p.8
- ³⁴ PAN, *Communities in Peril: Global report on health impacts of pesticide use in agriculture*, 2010, p.155
- ³⁵ PAN. 'Which Pesticides are Banned in Europe', *Food and Fairness Briefing, No.1*, April 2008
- ³⁶ WHO, *The WHO Recommended Classification of Pesticides by Hazard*, 2009, p.34
- ³⁷ Interview with John Pwamang, Pesticides Registrar, in Accra, November 2010
- ³⁸ See PAN, *Communities in Peril: Global report on health impacts of pesticide use in agriculture*, 2010
- ³⁹ WHO, *The WHO Recommended Classification of Pesticides by Hazard*, 2009, p.30
- ⁴⁰ Daniel Kotey et al, 'High chlorpyrifos levels on vegetables in Ghana', *Pesticide News No.80*, June 2008, p.6
- ⁴¹ WHO, *The WHO Recommended Classification of Pesticides by Hazard*, 2009, p.25
- ⁴² Kwadwo Asante and William Ntow, 'Status of environmental contamination in Ghana: The perspective of a research scientist', *Interdisciplinary Studies on Environmental Chemistry*, 2009, p.254
- Interview with Abdukari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ⁴⁴ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁴⁵ Stephanie Williamson, 'Pesticide Provision in Liberalised Africa: Out of Control?', *AgREN Network Paper No.126*, January 2003, p.7
- ⁴⁶ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁴⁷ PAN, *Communities in Peril: Global report on health impacts of pesticide use in agriculture*, 2010, p.22
- ⁴⁸ Interview with Abdukari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ⁴⁹ Interview with Ben My-Issah, MOFA, in Bolgatanga, November 2010
- ⁵⁰ Daniela Horna et al, 'Insecticide use of vegetables in Ghana: Would GM seed benefit farmers?', *IFPRI Discussion Paper*, August 2008, p.10
- ⁵¹ IFAD, 'Rural poverty in Ghana', <http://www.ruralpovertyportal.org/web/guest/country/home/tags/ghana>
- ⁵² Stephanie Williamson, 'Pesticide Provision in Liberalised Africa: Out of Control?', *AgREN Network Paper No.126*, January 2003, p.8
- ⁵³ Republic of Ghana, *Comprehensive Food Security and Vulnerability Analysis*, May 2009, p.58
- ⁵⁴ EPA, 'Pesticides for Horticulture Production', Presentation, unpublished, undated, p.2
- ⁵⁵ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁵⁶ Daniela Horna et al, 'Insecticide use of vegetables in Ghana: Would GM seed benefit farmers?', *IFPRI Discussion Paper*, August 2008, p.10
- ⁵⁷ Interview with Ben My-Issah, MOFA, in Bolgatanga, November 2010
- ⁵⁸ Interview with Dr Quest, MOFA Director for Navrongo District, in Sandema, November 2010
- ⁵⁹ Interview with Abdukari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ⁶⁰ Interviews with farmers in Golinga and Galinkpegu, November 2010
- ⁶¹ PAN, 'The Hidden Costs of Pesticide Use in Africa', *Food and Fairness Briefing No.2*, undated, p.3

- ⁶² Interview in Accra, November 2010
- ⁶³ Godfred Darko, 'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana', February 2009, p.4, <http://tpsalliance.org>
- ⁶⁴ J. R. Fianko et al., 'Health Risk Associated with Pesticide Contamination of Fish from the Densu River Basin in Ghana', *Journal of Environmental Protection*, Vol.2 No.2, April 2011, p. 121
<http://www.scirp.org/Journal/PaperInformation.aspx?paperID=4342>
- ⁶⁵ C.Bempah and A.Donkor, 'Pesticide residues in fruits at the market level in Accra Metropolis, Ghana – A preliminary study', Ghana Atomic Energy Commission, June 2010, www.ncbi.nlm.nih.gov
- ⁶⁶ D.Essumang et al, 'Pesticide residues in the water and fish samples from lagoons in Ghana', *Bulletin of the Chemical Society of Ethiopia*, 2009, <http://ajol.info>
- ⁶⁷ Godfred Darko and Sameul Osafo Acquah, 'Levels of organochlorine pesticides residues in dairy products in Kumasi, Ghana', *Chemosphere*, Vol. 71, Issue 7, March 2008, www.sciencedirect.com; Godfred Darko, 'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana', February 2009, p.8, <http://tpsalliance.org>
- ⁶⁸ G.Darko and O.Akoto, 'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana', *Food and Chemical Toxicology*, Volume 46, Issue 12, December 2008, pp.3703-3706
<http://www.sciencedirect.com/science/article/pii/S0278691508005462>
- ⁶⁹ Godfred Darko et al, 'Persistent organochlorine pesticide residues in fish, sediments and water from Lake Bosomtwi, Ghana', KNUST, 2008, www.sciencedirect.com
- ⁷⁰ D.Essuman et al, 'Analysis of some pesticide residues in tomatoes in Ghana', University of Cape Coast, 2008, www.informaworld.com
- ⁷¹ G.Darko and S.Acquaah, 'Levels of organochlorine pesticide residues in meat', *International Journal of Environmental Science and Technology*, Autumn 2007; Godfred Darko, 'Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana', February 2009, p.6, <http://tpsalliance.org>
- ⁷² Daniel Kotey et al, 'High chlorpyrifos levels on vegetables in Ghana', *Pesticide News No.80*, June 2008
- ⁷³ P.Amoah et al, 'Pesticide and Pathogen Cotamination of Vegetables in Ghana's Urban Markets', International Water Management Institute/KNUST/Water Research Institute, *Archives of Environmental Contamination and Toxicology*, Vol.50, 2006
- ⁷⁴ Interview with Zakaria Braimah, Zonal Officer for Food and Drugs Board, in Bolgatanga, November 2010
- ⁷⁵ Interview with Dr Koku Awoonor-Williams, Regional Director of Health Services for the Upper East in Bolgatanga, November 2010
- ⁷⁶ Interviews with John Pwamang, Pesticides Registrar and Ernest Osei-Assibey, PPRSD, in Accra, November 2010
- ⁷⁷ 'Standards Board to upgrade laboratories for international competitiveness', 2 April 2009, Ghana News Agency, www.modernghana.com
- ⁷⁸ Interview with Zakaria Braimah, Zonal Officer for Food and Drugs Board, in Bolgatanga, November 2010
- ⁷⁹ Interview with John Pwamang, Pesticides Registrar in Accra, November 2010
- ⁸⁰ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁸¹ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁸² Daniel Kotey et al, 'High chlorpyrifos levels on vegetables in Ghana', *Pesticide News No.80*, June 2008, p.4
- ⁸³ Information provided to the researchers from PPRSD gave the following figures for Ghana's pesticide imports:

	2009	2008	2007	2006	2005	2004
Solids (metric tonnes)	1,385	3,263	1,444	2,529	1,375	12,035
Liquids (000 litres)	13,317	9,550	2,951	21,459	4,024	3,586

- ⁸⁴ Interview with John Pwamang, Pesticides Registrar in Accra, November 2010
- ⁸⁵ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁸⁶ Stephanie Williamson, 'Pesticide Provision in Liberalised Africa: Out of Control?', *AgREN Network Paper No.126*, January 2003, p.3
- ⁸⁷ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁸⁸ Interview with John Pwamang, Pesticides Registrar in Accra, November 2010
- ⁸⁹ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ⁹⁰ W. Addah et al, 'Knowledge and Practices of Smallholder Farmers and Herdsman in the Use of Acaricides and Gastrointestinal Anthelminthes in Ghana', *Livestock Research for Development*, 21 (11), 2009

-
- ⁹¹ ‘CEPS-aided smuggling scandal uncovered’, 5 May 2009, www.modernghana.com
- ⁹² Interview with Dr Koku Awoonor-Williams, Regional Director of Health Services for the Upper East in Bolgatanga, November 2010
- ⁹³ Interview with Abdulkari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ⁹⁴ Marika Krausova and Afua Branoah Banful, ‘Overview of the Agricultural Input Sector in Ghana’, *IFPRI Discussion Paper*, September 2010, Tables 2 and A1
- ⁹⁵ Interviews with Abdulkari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, and Evans Addo Gyau, Vansadoo Enterprises, in Tamale, November 2010
- ⁹⁶ Interview with Abdulkari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ⁹⁷ Marika Krausova and Afua Branoah Banful, ‘Overview of the Agricultural Input Sector in Ghana’, *IFPRI Discussion Paper*, September 2010, Table A7
- ⁹⁸ W. Addah et al, ‘Knowledge and Practices of Smallholder Farmers and Herdsman in the Use of Acaricides and Gastrointestinal Anthelmintics in Ghana’, *Livestock Research for Development*, 21 (11), 2009
- ⁹⁹ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ¹⁰⁰ Interview with Simple Prince, Simple Prince Enterprises, in Bolgatanga, November 2010
- ¹⁰¹ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ¹⁰² Interview with John Pwamang, Pesticides Registrar in Accra, November 2010
- ¹⁰³ AGRA, ‘AGRA partners with IFDC to launch agro-dealer program in Ghana’, 25 November 2008, www.agra-alliance.org
- ¹⁰⁴ Interview with Kehuda Makinde, AGRA, in Accra, November 2010
- ¹⁰⁵ Interview with Salifu Wahabu, EPA, in Tamale, November 2010
- ¹⁰⁶ ‘Ghana Agro-Dealer Development Project’ leaflet
- ¹⁰⁷ AGRA, ‘AGRA partners with IFDC to launch agro-dealer program in Ghana’, 25 November 2008, www.agra-alliance.org
- ¹⁰⁸ Interview with Simple Prince, Simple Prince Enterprises, in Bolgatanga, November 2010
- ¹⁰⁹ Rita Mensa-Bonsu, *The Implementation of the Rotterdam Convention in Ghana*, FAO, September 2006, p.2
- ¹¹⁰ Rita Mensa-Bonsu, *The Implementation of the Rotterdam Convention in Ghana*, FAO, September 2006, p.6
- ¹¹¹ Rita Mensa-Bonsu, *The Implementation of the Rotterdam Convention in Ghana*, FAO, September 2006, p.3
- ¹¹² ‘Chemicals Control Management Centre’, www.epa.gov.gh
- ¹¹³ Rita Mensa-Bonsu, *The Implementation of the Rotterdam Convention in Ghana*, FAO, September 2006, p.8
- ¹¹⁴ ‘Government to ban importation, sale and use of POPs – Ayittey’, Ghana News Agency, 27 April 2010, <http://ghananewsagency.org/details/Science/Government-to-ban-importation-sale-and-use-of-POPs-Ayittey/?ci=8&ai=14944>
- ¹¹⁵ ‘Sherry Ayittey urges farmers to ensure proper use of pesticides’, Ghana News Agency, 8 October 2009, www.ghanaweb.com
- ¹¹⁶ ‘Ghana: Twelve die after poisonous food’, 4 December 2010, www.afriquejet.com
- ¹¹⁷ ‘Establish more laboratories for pesticide control analysis – EPA’, Ghana News Agency, 16 August 2010, <http://ghananewsagency.org/details/Science/Establish-more-laboratories-for-pesticide-control-analysis-EPA/?ci=8&ai=19347>
- ¹¹⁸ ‘Sherry Ayittey urges farmers to ensure proper use of pesticides’, Ghana News Agency, 8 October 2009, www.ghanaweb.com
- ¹¹⁹ ‘Sherry Ayittey urges farmers to ensure proper use of pesticides’, Ghana News Agency, 8 October 2009, www.ghanaweb.com
- ¹²⁰ ‘Agric extension officers upgrade skills on pesticides’, Ghana News Agency, 9 August 2010, <http://ghananewsagency.org/details/Science/Agric-extension-officers-upgrade-skills-on-pesticides/?ci=8&ai=19144>
- ¹²¹ ‘Pesticides inspectors attend five-day training workshop’, Ghana News Agency, 19 May 2008, www.ghanaweb.com; ‘Input dealers and agric extension officers upgrade skills on pesticides’, 10 August 2010, www.ghanabusinessnews.com
- ¹²² <http://ghana.cleanfarms.net/>
- ¹²³ CropLife Africa Middle East, ‘Study tour to observe obsolete pesticide safeguarding activities in Ghana’, CropLife Africa Middle East Newsletter Number 71, October 2011, p4, http://www.croplifeafrica.org/uploads/File/forms/communication/newsletter/2011/newsletter_october_2011.pdf
- ¹²⁴ ‘EPA to get tough with illegal dealers’, Ghana News Agency, 25 September 2007

-
- ¹²⁵ ‘Use of unapproved agro-chemicals said to be major health danger’, 17 December 2009, www.ghanabusinessnews.com
- ¹²⁶ Interview with Ernest Osei-Assibey, PPRSD, in Accra, November 2010
- ¹²⁷ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ¹²⁸ Interview with John Pwamang, Pesticides Registrar in Accra, November 2010
- ¹²⁹ Government budget at <http://www.mofep.gov.gh/documents/appendices2010.pdf>, Appendix 8a
- ¹³⁰ Interview with John Pwamang, Pesticides Registrar in Accra, November 2010
- ¹³¹ Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ¹³² Interview with Vesper Suglo, Director of PPRSD, in Accra, November 2010
- ¹³³ Interview with Abdulkari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ¹³⁴ Interview with Salifu Wahabu, EPA, in Tamale, November 2010
- ¹³⁵ Interview with Maxwell Atanga, EPA, in Bolgatanga, November 2010
- ¹³⁶ Interview with Dr Quest, MOFA Director for Navrongo district, Upper East, in Sandema, November 2010
- ¹³⁷ Ruth Meinzen-Dick, ‘Engendering Agricultural Research’, March 2010, <http://gcardblog.files.wordpress.com/2010/03/engendering-agricultural-research.pdf>, p.23
- ¹³⁸ Interview with Ben My-Issah, MOFA, in Bolgatanga, November 2010
- ¹³⁹ Interviews with Vesper Suglo, Director of PPRSD and Ernest Osei-Assibey, PPRSD, in Accra, November 2010
- ¹⁴⁰ In a recent study of European countries to assess the relative contribution of various components of agricultural intensification on species diversity of wild plants, carabids and birds, the use of insecticides and fungicides was found to have persistent negative effects. In particular, the authors show that while sustainable farming practices did increase the diversity of wild plant and carabid species, the diversity of birds was not restored, concluding that despite decades of European policy to ban harmful pesticides, the negative effects on wild plants and animals persist overtime. F.Geiger et al, ‘Persistent negative effects of pesticides on biodiversity and biological control potential on European farmland’, *Basic and Applied Ecology 11*, 2010, pp.97–105
- ¹⁴¹ PAN Europe, ‘Environmental effects of pesticides. An impression of recent scientific literature’, August 2010, p.4
- ¹⁴² PAN Europe, ‘Environmental effects of pesticides. An impression of recent scientific literature’, August 2010, p.4
- ¹⁴³ PAN, ‘Position on Synthetic Pesticide Elimination’, June 2007, p.2
- ¹⁴⁴ IIED, ProForest and Rabobank International, *Better Management Practices and Agribusiness Commodities Phase Two, Report: Commodity Guides*, 2004, p.19
- ¹⁴⁵ PAN Germany, *Phasing in Alternatives to Endosulfan: Reasons, experiences and links*, October 2008, p.6
- ¹⁴⁶ PAN Germany, *Phasing in Alternatives to Endosulfan: Reasons, experiences and links*, October 2008, p.4
- ¹⁴⁷ H.Zemp-Tapang, ‘Organic agriculture in Northern Ghana’, *I.L.E.I.A. Newsletter*, 12(3), 1996, pp.30-31
- ¹⁴⁸ O. AdeOluwa, ‘Organic Agriculture and Fair Trade in West Africa’, in Ching et al. (eds.), *Climate Change and Food Systems Resilience in Sub-Saharan Africa*, FAO, 2011, p. 329, <http://www.fao.org/docrep/014/i2230e/i2230e11.pdf>
- ¹⁴⁹ O. AdeOluwa, ‘Organic Agriculture and Fair Trade in West Africa’, in Ching et al. (eds.), *Climate Change and Food Systems Resilience in Sub-Saharan Africa*, FAO, 2011, p. 331, <http://www.fao.org/docrep/014/i2230e/i2230e11.pdf>
- ¹⁵⁰ V.Owusu and M.Owusu, ‘Measuring Market Potential for Fresh Organic Fruit and Vegetable in Ghana’, Paper presented at the Joint 3rd African Association of Agricultural Economists ,Cape Town, South Africa, September 19-23, 2010, p.10-14; Y. Osei-Asare, ‘Status of Organic Agriculture in Ghana: A Survey of Consumers, Producers, and Marketers’, 2009, p.30
- ¹⁵¹ O. AdeOluwa, ‘Organic Agriculture and Fair Trade in West Africa’, in Ching et al. (eds.), *Climate Change and Food Systems Resilience in Sub-Saharan Africa*, FAO, 2011, p. 331, <http://www.fao.org/docrep/014/i2230e/i2230e11.pdf>
- ¹⁵² Interview with Gustav Mahunu, University of Development Studies, in Nyankpala, November 2010
- ¹⁵³ Interview with Dr Mumuni Abdoulai, Savannah Agricultural Research Institute, in Tamale, November 2010
- ¹⁵⁴ Interview with Abdulkari Ziblim, MOFA, Extension Officer for Tamale Metropolitan area, in Tamale, November 2010
- ¹⁵⁵ Jules Pretty, ‘Agroecological Approaches to Agricultural Development’, Background Paper for the World Development Report 2008, 2008, p.3

-
- ¹⁵⁶ Catherine Badgely et al, Organic Agriculture and the Global Food Supply', *Renewable Agriculture and Food Systems*, 22(2), 2007
- ¹⁵⁷ UNEP-UNCTAD Capacity-building Task Force on Trade, Environment and Development, *Organic Agriculture and Food Security in Africa*. UN, 2008 p.1
- ¹⁵⁸ UNEP-UNCTAD Capacity-building Task Force on Trade, Environment and Development, *Organic Agriculture and Food Security in Africa*. UN, 2008 p.x
- ¹⁵⁹ The Farmer Field School (FFS) is an early innovative model for community based farmer education based on non-formal, adult educational or 'discovery learning' methods, developed some 20 years ago in response to the weaknesses of more top-down extension models of the time. The pioneering work on the FFS model was initiated by FAO in Southeast Asia in the late 1980s. Over the past two decades the approach has been adopted by technical agencies outside of FAO and spread to nearly 90 countries worldwide (<http://www.farmerfieldschool.info/>).
- ¹⁶⁰ FAO, *The West African Regional Integrated Production and Pest Management (IPPM) Programme, a case study*, 2011, p.13-15, http://www.fao.org/fileadmin/templates/agphome/documents/IPM/WA_IPPM_2011.pdf
- ¹⁶¹ FAO, *The West African Regional Integrated Production and Pest Management (IPPM) Programme, a case study*, 2011, p.8, http://www.fao.org/fileadmin/templates/agphome/documents/IPM/WA_IPPM_2011.pdf
- ¹⁶² E.Styger et al., 'The system of rice intensification as a sustainable agricultural innovation: Introducing, adapting and scaling up a system of rice intensification practices in the Timbuktu region of Mali', *International Journal of Agricultural Sustainability*, 9(1) 2011, pp. 67-75
- ¹⁶³ 'Rice farmers ask Government to adopt SRI', November 2011, <http://www.ghananewsagency.org/details/Economics/Rice-farmers-ask-Government-to-adopt-SRI/?ci=3&ai=35133>
- ¹⁶⁴ Z. Khan et al., '#Push-pull technology: a conservation agriculture approach for integrated management of insect pests, weeds and soil health in Africa', *International Journal of Agricultural Sustainability*, 9(1) 2011, pp.162-170
- ¹⁶⁵ Interview in Golog, November 2010
- ¹⁶⁶ Interview in Chuchuliga, November 2010
- ¹⁶⁷ Interview with Evans Addo Gyau, Vansadoo Enterprises, in Tamale, November 2010
- ¹⁶⁸ 'Vegetable farmers schooled in organic farming practices', GNA, 5 September 2009
- ¹⁶⁹ Shashidhara Kolavilli et al, 'Institutional and Public Expenditure Review of Ghana's Ministry of Food and Agriculture', *IFPRI Discussion Paper*, August 2010, p.7
- ¹⁷⁰ SEND-West Africa, *Investing in Smallholder Agriculture for Optimal Result: The ultimate policy choice for Ghana*, 2010, p.38
- ¹⁷¹ Interviews with Vesper Suglo, Director of PPRSD and Ernest Osei-Assibey, PPRSD, in Accra, November 2010