



Bureau for Food Security Initial Environmental Examination (IEE)

Activity/Project Title: Feed the Future Partnering for Innovation (FTF-P4I)	
Contract/Award Number (if known): AID-OAA-A-12-0051/Sub-award PI-SMOG—Zambia Sub-award Title: Amatheon Agri Zambia (AAZ)	
Geographic Location: Zambia	
Is this is an Amendment to an existing IEE? No Date & title of Original document: N/A ECD link:	
Funding: \$930,000	
Implementation Start/End: October 1, 2016-July 31, 2018	
Prepared By: Karen Menczer (Fintrac-P4I) BFS Office: Markets, Partnerships and Innovations	Date Prepared: 8 October 2016
Expiration Date (if any): 10 October 2018	EMMP Reporting dates: July 15, 2017 and 2018
Recommended Threshold Determination: <input checked="" type="checkbox"/> Negative Determination <input checked="" type="checkbox"/> with conditions <input type="checkbox"/> Categorical Exclusion [include rationale per 216.2(c)]	<input type="checkbox"/> Deferral [include rationale per 216.3(a)(1)(iii)] <input type="checkbox"/> Exemption [include rationale per 216.2(b)] <input type="checkbox"/> Positive Determination [see 216.3(2)(iii)]
Environmental Mitigation and Monitoring Plan (EMMP): As required by this IEE, an EMMP will be developed by the Implementing Partner (IP) per the conditions described in this IEE. The EMMP will be completed before activities start. A periodic EMMP Report shall be prepared by the IP to describe how well the monitoring and mitigation measures are working, and if any modifications are necessary. Guidance on BFS EMMP development is available at the BFS Environmental Compliance Tracking site. (EMMP is attached to this IEE.)	
Gender Equality and Women's Empowerment Per USAID policy, this IEE will consider the proposed activity in the full light of gender equity and women's empowerment related to environmental impact, not as a separate component, but as a core activity element.	
Global Climate Change Per USAID and Presidential directives, this IEE will consider proposed activity impact on global climate change, and in as much as possible, promote climate-smart agriculture, planning, and related activities. As applicable, project implementation will be cognizant of adaptation, integration, mitigation, clean energy and sustainable landscapes.	
This Document: The purpose of the Initial Environmental Examination, in accordance with Title 22, Code of Federal Regulations, Part 216 (22CFR216), is to provide a preliminary review of the reasonably foreseeable effects on the environment of the described activity, and to recommend determinations and, as appropriate, conditions, for these activities. Upon final approval of this IEE, these recommended determinations are affirmed as 22 CFR 216 Threshold Decisions and Categorical Exclusions, and conditions become mandatory elements of implementation. This IEE is a critical element of a mandatory environmental review and compliance process meant to achieve environmentally sound activity design and implementation.	

IEE SUMMARY:

1. Project Context

In Chibombo District, located in the Central Province, smallholder farmers have limited access to inputs and markets, and therefore, they are unable to move beyond subsistence agriculture and grow high value crops for market. Markets for farm products are far, and this imposes transaction costs that reduce incomes. The purpose of this sub-award is to expand AAZ's current outgrower model to Chibombo District. AAZ will provide access to high value markets, enhance productivity, increase incomes, and improve food security for smallholder farmers in the Chibombo District.

2. Activity Description, Location, & Conditions

The specific activities to be supported by this sub-award are described in Section 2.1 of the IEE and are listed below in the Table in Section 5.

3. Potential Environmental Impacts

Potential environmental impacts of this activity are agricultural conversion, health and environmental impacts from pesticide use, and environmental impacts from improper use of chemical fertilizers.

4. Mitigation Conditions

The following mitigation measures are required as part of this sub-award:

Activity 1. Mitigation Measures

1) If AAZ intends to use contact pesticides to protect stored commodities from pests, AAZ shall first develop a Safe Use Action Plan (SUAP) based on the USAID/Zambia Pesticide Evaluation Report-Safer Use Action Plan (PERSUAP). See Annex A for the list of pesticides approved for use in USAID/Zambia activities and pesticides rejected. This SUAP must be submitted through P4I to USAID and approval obtained prior to using pesticides. If AAZ intends to use aluminum phosphide for stored commodities, they shall follow the protocol of the recently updated DCHA Fumigation Programmatic Environmental Assessment (PEA).

Activity 2. Mitigation Measures

2) If AAZ will sell pesticides at the depots, they shall first develop a SUAP based on the USAID/Zambia PERSUAP (see mitigation measure 2 for additional information). Neonicotinoid pesticides shall not be sold for field treatments.

3) If AAZ will sell fertilizers at the depots, they shall ensure that fertilizer best practices (see example in Annex B) are promoted in conjunction with the sale of fertilizers.

Activity 3. Mitigation Measures

4) AAZ shall develop and implement a reuse-recycle-disposal plan for the depots that have post-harvest equipment to ensure waste products do not pollute the environment.

Activity 4. Mitigation Measures

5) If AAZ intends to use pesticides to protect stored seeds from pests, AAZ shall first develop a SUAP based on the USAID/Zambia PERSUAP (see mitigation measure 2 for additional information).

Activity 6. Mitigation Measures

6) AAZ shall ensure that if they facilitate purchases of pesticides, that they develop a SUAP to ensure safe use of pesticides and that only approved pesticides listed in Annex A are purchased (see mitigation measure 2 for additional information). Neonicotinoid pesticides shall not be purchased for field treatments.

7) AAZ shall ensure that if they facilitate purchases of fertilizers, that fertilizer best use practices are promoted in conjunction with this assistance.

8) AAZ shall not facilitate the purchase of equipment that could result in land conversion and clearance.

Activity 8. Mitigation Measures

9) AAZ shall include the following topics in training on conservation farming:

- Safe pesticide use training using the safe use practices in the USAID/Zambia PERSUAP, including use of integrated pest management (IPM) and use of pesticides as a last resort pest management measure; use of appropriate personal protection equipment (PPE); information on neonicotinoid pesticides and their effects on bee populations; other measures in the PERSUAP to protect human health and the environment; recommending only those pesticides (active ingredients) approved for use in the PERSUAP and listed in Annex A. Use of pesticides rejected by the PERSUAP, also listed in Annex A, shall be discouraged; and
- Measures to discourage conversion and clearance of natural ecosystems to agriculture.

Activity 9. Mitigation Measures

10) AAZ shall ensure that to establish demo plots, no natural ecosystems are cleared or converted to agriculture.

11) Prior to using and demonstrating pesticides at demo plots, AAZ shall develop a SUAP that includes only approved pesticides in Annex A, and that is based on the USAID/Zambia PERSUAP safe use measures (see mitigation measure 2 for additional information). Neonicotinoid pesticides shall not be sold for field treatments.

12) At demo sites, AAZ shall ensure that when using and demonstrating fertilizer, best use practices are implemented and promoted (See Annex B for an example).

5. Threshold Determinations

Activity	Recommended Determination
1. AAZ will operate 20 rural Chibombo aggregation depots, where the 10,000 outgrower farmers can sell produce directly to AAZ.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
2. AAZ will stock inputs at eight of the aggregation depots.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
3. AAZ will equip several depots with post-harvest equipment, such as shellers for soybeans and groundnuts.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
4. AAZ will establish a rural seed bank for groundnuts, soybeans, sunflower, and cowpeas to ensure sustainable supply of these crops for smallholders.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
5. AAZ will provide market access for smallholders' crops.	Negative Determination in accordance with 22 CFR 216.3(a)(2)(iii)
6. AAZ will facilitate access to financial services.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
7. AAZ will also encourage 2,000 smallholder farmers to save money through Village Savings and Loan Associations (VSLAs).	Negative Determination in accordance with 22 CFR 216.3(a)(2)(iii)
8. AAZ will build the capacity of farmers in better agricultural and business management practices, and nutrition.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
9. AAZ will establish demo plots where farmers can learn new techniques and gain hands-on experience.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
10. AAZ will track communicate and track progress of outgrowers though a comprehensive, cloud-based mobile monitoring and evaluation platform.	Negative Determination in accordance with 22 CFR 216.3(a)(2)(iii)

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

CLEARANCE:

Acting BFS/MPI Office Director:


Kelley Cormier

Date: 11-2-16

Agreement Officer Representative:


Aviva Kutnick

Date: 11-2-2016

CONCURRENCE:

BFS Bureau Environmental Officer:


William Thomas

Date: 11-3-2016

cc: USAID/Zambia Mission Environmental Officer

Filename/location: P:\BFS.MPI\FTF Partnering for Innovation\Component 2- Mission Buy-
Ins\Zambia\Amatheon Agri

BFS Tracking #: BFS-16-11-001

BFS Initial Environmental Examination (IEE)

1. Project Context

In Chibombo District, located in the Central Province, smallholder farmers have limited access to inputs and markets, and therefore, they are unable to move beyond subsistence agriculture and grow high value crops for market. Markets for farm products are far, and this imposes transaction costs that reduce incomes.

AAZ combines its large-scale farming operations in Mumbwa District with engagement of smallholder farmers through its outgrower program. The outgrower program provides free training in conservation farming and business skills, access to inputs and markets, and facilitates linkages between emerging farmers and financial services. By providing a market for smallholder farmers, AAZ is able to significantly increase its volume of trade in high quality commodities.

2. Activity Description, Location, & Baseline

2.1. Activity Description

The purpose of this sub-award is to expand AAZ's current outgrower model to the Chibombo District. AAZ will provide access to high value markets, enhance productivity, increase incomes, and improve food security for smallholder farmers in the Chibombo District. AAZ will impact 10,000 smallholder farmers by establishing 20 rural aggregation and input depots; establishing one seed bank; providing agriculture and business management trainings; and facilitating access to financial services and savings groups. AAZ will focus on oilseeds (soybeans and sunflower); legumes (groundnuts and cowpeas); and maize (white variety) value chains. Specifically, this sub-award will support the following activities:

1. AAZ will operate 20 rural Chibombo aggregation depots. Ten of the depots will be 20-foot shipping containers and the remainder will be existing buildings that AAZ will rent. No construction will be involved. At these depots, the 10,000 outgrower farmers can sell produce directly to AAZ.
2. AAZ will stock and sell inputs at eight of the aggregation depots.
3. AAZ will equip several depots with post-harvest equipment, such as shellers for soybeans and groundnuts.
4. AAZ will establish a rural seed bank for groundnuts, soybeans, sunflower, and cow peas to ensure sustainable supply of these crops for smallholders. The seeds will be stored either at the AAZ farm or in one of the existing storage facilities. From there, all seeds will be distributed to farmers for multiplication in Chibombo district.
5. AAZ will provide market access for smallholders' crops.

6. AAZ will facilitate access to financial services. Through a strategic partnership with Zanaco Bank, AAZ is able to facilitate credit for buying inputs. AAZ will target 500 farmers in Chibombo to receive input credit. The farmers put 50% down and then receive the remainder of the loan in credit, which is paid back from their sales to AAZ at the end of the season.

7. AAZ will also encourage 2,000 smallholder farmers to save money through Village Savings and Loan Associations (VSLAs). The farmers will be formed into groups of 20 to 25 and they will be trained in group facilitation and management, financial management, and business best practices.

8. AAZ will build the capacity of farmers on better agricultural and business management practices. Using a Train the Trainer model, AAZ will train 200 Farmer Coordinators in conservation farming, business and financial best practices, and nutrition. In turn the Farmer Coordinators will each train two farmer groups of roughly 25 farmers each. Conservation farming topics will focus on measures to increase productivity in an environmentally sound way, and will include land preparation, liming and fertilizer application, planting, crop management, and post-harvest handling.

9. AAZ will establish demo plots where farmers can learn new techniques and gain hands-on experience.

10. AAZ will track communicate and track progress of outgrowers through a comprehensive, cloud-based mobile monitoring and evaluation platform.

2.2. Location

Figure 1 shows Zambia's location in south-central Africa. According to <http://www.nationsonline.org/oneworld/zambia.htm>, Zambia's land area is 285,994 sq miles (740,724 sq km) and the total area of the country is 290,586 sq miles. The 2014 population was approximately 14,638,505. The annual population growth rate is 2.88%.

The capital city is Lusaka in the south-central part of Zambia. Zambia's population is concentrated mainly around Lusaka and in the Copperbelt Province to the northwest, the core economic hubs of the country.

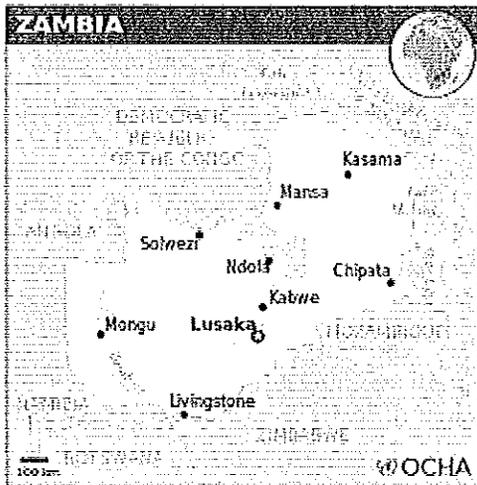


Figure 1. Map of Zambia From: <https://en.wikipedia.org/wiki/Zambia>

The following is from <https://en.wikipedia.org/wiki/Zambia>. Zambia is drained by two major river basins: the Zambezi/Kafue basin in the center, west, and south covering about three-quarters of the country; and the Congo basin in the north covering about one-quarter of the country. A very small area in the northeast forms part of the internal drainage basin of Lake Rukwa in Tanzania.

In the Zambezi basin, there are a number of major rivers flowing wholly or partially through Zambia: the Kabompo, Lungwebungu, Kafue, Luangwa, and the Zambezi, which flows through the country in the west and then forms its southern border with Namibia, Botswana, and Zimbabwe. Two of the Zambezi's longest and largest tributaries, the Kafue and the Luangwa, flow mainly in Zambia. The Zambezi falls about 100 meters (328 ft) over the 1.6 km (0.99 mi) wide Victoria Falls, located in the southwest corner of the country, subsequently flowing into Lake Kariba.

In Eastern Zambia the plateau which extends between the Zambezi and Lake Tanganyika valleys is tilted upwards to the north, and rises from about 900 m (2,953 ft) in the south to 1,200 m (3,937 ft) in the center, reaching 1,800 m (5,906 ft) in the north near Mbala.

According to the USAID/Zambia IEE for the Economic Development (EDEV) Portfolio (July 2015), data on deforestation rates are poor. The current annual deforestation rate is 250,000 to 300,000 ha/year (UN-REDD Programme Zambia, 2010). This is lower than previous estimates of 445,000 ha/year (Campbell et al., 2007) or 850,000 ha/year (FAO, 2005). Previous estimates had placed Zambia in fourth place globally, behind Brazil, Indonesia, and Sudan, for percentage rate of area deforested. Rapid population growth and rural-urban migration, combined with limited job opportunities, lead to over-exploitation of forest reserves and illegal off-take of wildlife and fish. In addition, most Zambians depend on either wood fuel or charcoal for their domestic energy supply. These trends explain why Zambia is threatened with a deforestation rate among the highest in Africa.

The USAID/Zambia Environmental Threats and Opportunities Assessment (March, 2011) states that there are 625 nationally recognized protected areas (PAs) in Zambia, covering approximately

309,052 sq km or about 41% of the country's territorial area. Included in this number are 480 forest reserves covering a total land area of about 7.2 million hectares.

The ETOA identified the following key threats to Zambia's environment:

- Unsustainable Agricultural Practices
- Climate Change
- Charcoal Production
- Illegal Off-takes
- Mining Operations and Expansion
- Poor Governance

The ETOA recommended the following to address the threats:

- Conservation Agriculture
- Public-Private Conservation Partnerships
- Integrated Land Use Planning
- High Efficiency Cook Stoves
- Monitoring, Reporting and Verification
- Urban Health and Environment Improvements

2.3. Project Baseline

AAZ will work with farmers in Chibombo District, located in the Central Province (see Figure 2).

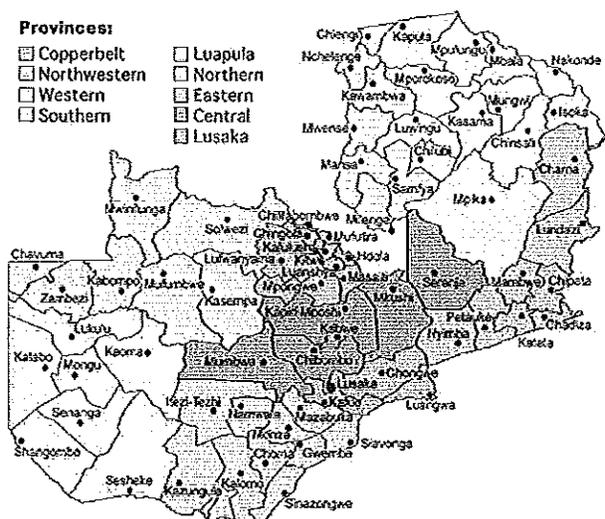


Figure 2. Zambia's Provinces

The following national parks and other key natural resources are located in Central Province:

- Kafue National park, the country's largest, shared with Southern and Northwestern Provinces
- Blue Lagoon National Park
- The northern part of the Kafue Flats
- Kasanka National Park and the margins of the Bangweulu wetlands
- The eastern end of the province reaches South Luangwa National Park
- Lunsemfwa and Lukasashi River valleys
- Lukanga Swamp and the Lunga-Luswishi Game Management Area

According to https://en.wikipedia.org/wiki/Chibombo_District, as of the 2010 Zambian Census, the district had a population of 293,765 people. It lies between the Lukanga Swamp in the west and the end of the Luangwa Valley in the east, and contains good commercial farmland north of Lusaka.

According to the USAID/Zambia IEE, Economic Development (EDEV) Portfolio (July 2015) IEE, approximately two-thirds of Zambians live in rural areas and are dependent on agriculture for their livelihoods. Traditional small-scale agricultural practices are not productive, and yields for key staples are one-half or less than the world average. Continuous use of synthetic fertilizers without the use of lime or use of legumes may also lead to lower soil fertility and high pH levels. Low soil quality leads to farmers abandoning existing holdings to migrate to land that is more fertile. The cycle is then repeated. by providing access to lime, fertilizer, and other high quality inputs, this sub-award addresses poor soil quality, which in part addresses shifting agriculture.

3. Potential Environmental Impacts

The following are the potential environmental impacts of proposed activities under this sub-award to AAZ:

Activity 1. AAZ will operate 20 rural Chibombo aggregation depots. Ten of the depots will be 20-foot shipping containers and the remainder will be existing buildings that AAZ will rent. No construction will be involved. At these depots, the 10,000 outgrower farmers can sell produce directly to AAZ.

The area disturbed to place 20-foot shipping containers at ten different locations is extremely minimal and no adverse environmental impacts will result. Rental of existing buildings has no effect on the environment. Operating the 20 rural aggregation depots as trading hubs, where AAZ will buy produce from farmers could have environmental impacts if AAZ will use pesticides to protect stored commodities.

Activity 2. AAZ will stock and sell inputs at eight of the aggregation depots.

Depending on the inputs to be sold, use of them could indirectly affect the environment. Sale of pesticides at the aggregation depots could have environmental and human health effects if farmers fail to implement safe use practices. If fertilizers are used without implementation of best practices, waters and wetlands could be contaminated. Other inputs to be sold at the depots are unlikely to cause environmental impacts.

Activity 3. AAZ will equip several depots with post-harvest equipment, such as shellers for soybeans and groundnuts.

Use of post-harvest equipment creates waste, which if not reused, recycled, or disposed of in an environmentally sound manner, could contaminate soil and water.

Activity 4. AAZ will establish a rural seed bank for groundnuts, soybeans, sunflower, and cowpeas to ensure sustainable supply of these crops for smallholders. The seeds will be stored either at the AAZ farm or in one of the existing storage facilities. From there, all seeds will be distributed to farmers for multiplication in Chibombo district.

If AAZ intends to use pesticides to protect the seeds stored at the seed bank, health and environmental impacts could result. Of particular concern is the fumigation process if aluminum phosphide is going to be used to protect stored seed. Impacts to human health from incorrect fumigation can be severe. If contact pesticides will be used, human health and environmental impacts typical of pesticide use could result.

Activity 5. AAZ will provide market access for smallholders' crops.

Linking smallholders to markets will have no direct or indirect adverse environmental impacts.

Activity 6. AAZ will facilitate access to financial services.

By facilitating access to financial services so that farmers can purchase inputs, AAZ's support could indirectly affect the environment. If AAZ facilitates purchase of pesticides, fertilizers, or equipment that could clear land to convert to agriculture, adverse impacts could result.

Activity 7. AAZ will also encourage 2,000 smallholder farmers to save money through VSLAs.

Promoting savings through VSLAs will have no direct or indirect adverse environmental impacts.

Activity 8. AAZ will build the capacity of farmers in better agricultural and business management practices, and nutrition.

Training in business management practices and nutrition has no direct or indirect adverse environmental impacts. However, training in agricultural practices, including conservation farming, could indirectly have adverse effects. Although the intention is to train farmers to increase productivity using environmentally sound practices, farmers may clear land to expand crop production. Training on pesticide and fertilizer use could indirectly impact human health and the environment.

Activity 9. AAZ will establish demo plots where farmers can learn new techniques and gain hands-on experience.

Establishing demo plots could have environmental impacts if land will be cleared/converted to create the plots. If pesticides and fertilizers are used and demonstrated on the plots, human health and environmental impacts could result.

Activity 10. AAZ will track communicate and track progress of outgrowers through a comprehensive, cloud-based mobile monitoring and evaluation platform.

Supporting this cloud-based mobile system will have no direct or indirect adverse environmental impacts.

This sub-award addresses climate change adaptation by encouraging farmers to diversify their crops and by training farmers in conservation agriculture methods.

4. Mitigation Conditions

AAZ shall implement the following mitigation measures. With implementation of these measures, these activities will not have a significant effect on the environment.

Activity 1. AAZ will operate 20 rural Chibombo aggregation depots, where outgrower farmers will sell produce directly to AAZ.

Mitigation Measures

1) If AAZ intends to use pesticides to protect stored commodities from pests, AAZ shall first develop a Safe Use Action Plan (SUAP) based on the USAID/Zambia Pesticide Evaluation Report-Safer Use Action Plan (PERSUAP). See Annex B for the list of pesticides approved for use in USAID/Zambia activities and pesticides rejected. This SUAP must be submitted through P4I to USAID and approval obtained prior to using pesticides. If AAZ intends to use aluminum phosphide for stored commodities, they shall follow the protocol of the recently updated DCHA Fumigation Programmatic Environmental Assessment (PEA).

Activity 2. AAZ will stock inputs at eight of the aggregation depots.

Mitigation Measures

2) If AAZ will sell pesticides at the depots, they shall first develop a SUAP based on the USAID/Zambia PERSUAP (see mitigation measure 2 for additional information). Neonicotinoid pesticides shall not be sold for field treatments.

3) If AAZ will sell fertilizers at the depots, they shall ensure that fertilizer best practices (see example in Annex C) are promoted in conjunction with the sale of fertilizers.

Activity 3. AAZ will equip several depots with post-harvest equipment, such as shellers for soybeans and groundnuts.

Mitigation Measures

4) AAZ shall develop and implement a reuse-recycle-disposal plan for the depots that have post-harvest equipment to ensure waste products do not pollute the environment.

Activity 5. AAZ will establish a rural seed bank for groundnuts, soybeans, sunflower, and cowpeas to ensure sustainable supply of these crops for smallholders.

Mitigation Measures

5) If AAZ intends to use contact pesticides to protect stored seeds from pests, AAZ shall first develop a SUAP based on the USAID/Zambia PERSUAP (see mitigation measure 2 for additional information). If AAZ intends to use aluminum phosphide for stored commodities, they shall follow the protocol of the recently updated DCHA Fumigation PEA.

Activity 6. AAZ will facilitate access to financial services.

Mitigation Measures

6) AAZ shall ensure that if they facilitate purchases of pesticides, that they develop a SUAP to ensure safe use of pesticides and that only approved pesticides listed in Annex B are purchased (see mitigation measure 2 for additional information). Neonicotinoid pesticides shall not be purchased for field treatments.

7) AAZ shall ensure that if they facilitate purchases of fertilizers, that fertilizer best use practices are promoted in conjunction with this assistance.

8) AAZ shall not facilitate the purchase of equipment that could result in land conversion and clearance.

Activity 8. AAZ will build the capacity of farmers in better agricultural and business management practices, and nutrition.

Mitigation Measures

9) AAZ shall include the following topics in training on conservation farming:

- Safe pesticide use training using the safe use practices in the USAID/Zambia PERSUAP, including use of integrated pest management (IPM) and use of pesticides as a last resort pest management measure; use of appropriate personal protection equipment (PPE); information on neonicotinoid pesticides and their effects on bee populations; other measures in the PERSUAP to protect human health and the environment; recommending only those pesticides (active ingredients) approved for use in the PERSUAP and listed in Annex B. Use of pesticides rejected by the PERSUAP, also listed in Annex B, shall be discouraged; and
- Measures to discourage conversion and clearance of natural ecosystems to agriculture.

Activity 9. AAZ will establish demo plots where farmers can learn new techniques and gain hands-on experience.

Mitigation Measures

10) AAZ shall ensure that to establish demo plots, no natural ecosystems are cleared or converted to agriculture.

11) Prior to using and demonstrating pesticides at demo plots, AAZ shall develop a SUAP that includes only approved pesticides in Annex B, and that is based on the USAID/Zambia PERSUAP safe use measures (see mitigation measure 2 for additional information). Neonicotinoid pesticides shall not be sold for field treatments.

12) At demo sites, AAZ shall ensure that when using and demonstrating fertilizer, best use practices are implemented and promoted (See Annex C for an example).

5. Threshold Determinations

Recommended Threshold Determinations

In accordance with this analysis, the following determinations are recommended for this activity:

Activity	Recommended Determination
1. AAZ will operate 20 rural Chibombo aggregation depots, where the 10,000 outgrower farmers can sell produce directly to AAZ.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
2. AAZ will stock inputs at eight of the aggregation depots.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
3. AAZ will equip several depots with post-harvest equipment, such as shellers for soybeans and groundnuts.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
4. AAZ will establish a rural seed bank for groundnuts, soybeans, sunflower, and cowpeas to ensure sustainable supply of these crops for smallholders.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
5. AAZ will provide market access for smallholders' crops.	Negative Determination in accordance with 22 CFR 216.3(a)(2)(iii)
6. AAZ will facilitate access to financial services.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
7. AAZ will also encourage 2,000 smallholder farmers to save money through Village Savings and Loan Associations (VSLAs).	Negative Determination in accordance with 22 CFR 216.3(a)(2)(iii)

8. AAZ will build the capacity of farmers in better agricultural and business management practices, and nutrition.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
9. AAZ will establish demo plots where farmers can learn new techniques and gain hands-on experience.	Negative Determination with conditions in accordance with 22 CFR 216.3(a)(2)(iii)
10. AAZ will track communicate and track progress of outgrowers through a comprehensive, cloud-based mobile monitoring and evaluation platform.	Negative Determination in accordance with 22 CFR 216.3(a)(2)(iii)

General Project Implementation and Monitoring Requirements

1. Integration and implementation of EMMP. Amatheon Agri Zambia shall integrate the below EMMP into their project work plan, implement the EMMP, and report on its implementation as an element of their quarterly reporting.
2. Compliance with Host Country Requirements. Nothing in this IEE substitutes for or supersedes AAZ's responsibility for compliance with all applicable Zambian laws and regulations. AAZ must comply with Zambia's environmental regulations unless otherwise directed in writing by P4I.

6. Environmental Mitigation & Monitoring Plan

Amatheon Agri Zambia's Project Manager is responsible for oversight of this EMMP. The Project Manager will collect monitoring data and will report to P4I quarterly, who will report to USAID in their quarterly reports. The quarterly report shall discuss status of mitigation measures, successes, and need for remedial action or other environmental compliance actions.

Amatheon Agri Zambia EMMP

<i>Activity</i>	<i>Potential impact</i>	<i>Mitigation measures</i>	<i>Monitoring indicators</i>	<i>Monitoring methods & frequency</i>
(1) AAZ will operate 20 rural Chibombo aggregation depots, where outgrower farmers will sell produce directly to AAZ.	Operating the 20 rural aggregation depots as trading hubs, where AAZ will buy produce from farmers could have environmental impacts if AAZ will use pesticides to protect stored commodities.	1) If AAZ intends to use pesticides to protect stored commodities from pests, AAZ shall first develop a SUAP based on the USAID/Zambia PERSUAP. See Annex B for the list of pesticides approved for use in USAID/Zambia activities and pesticides rejected. This SUAP must be submitted through P4I to USAID and approval obtained prior to using pesticides. If AAZ intends to use aluminum phosphide for stored commodities, they shall follow the protocol of the recently updated	SUAP developed, submitted and/or DCHA PEA protocol followed before aluminum phosphide is used	Monitor that SUAP approval is obtained when submitted and/or monitor that required Fumigation PEA documentation is completed and approved

		DCHA Fumigation PEA.		
(2) AAZ will stock inputs at eight of the aggregation depots.	Depending on the inputs to be sold, they could indirectly affect the environment. Sale of pesticides at the aggregation depots could have environmental and human health effects if farmers fail to implement safe use practices.	2) If AAZ will sell pesticides at the depots, they shall first develop a SUAP based on the USAID/Zambia PERSUAP (see mitigation measure 1 for additional information). Neonicotinoid pesticides shall not be sold for field treatments.	SUAP developed, submitted	Monitor that SUAP approval is obtained when submitted
	If fertilizers are used without implementation of best practices, waters and wetlands could be contaminated.	3) If AAZ will sell fertilizers at the depots, they shall ensure that fertilizer best practices (see example in Annex C) are promoted in conjunction with the sale of fertilizers.	Brochures, labels, etc. include best practices and are distributed	Review AAZ documentation annually
(3) AAZ will equip several depots with post-harvest equipment, such as shellers for soybeans and groundnuts.	Use of post-harvest equipment creates waste, which if not reused, recycled, or disposed of in an environmentally sound manner, could contaminate soil and water.	4) AAZ shall develop and implement a reuse-recycle-disposal plan for the depots that have post-harvest equipment to ensure waste products do not pollute the environment.	Plan developed, implemented	Review plan when prepared; site visits to select depots annually
(4) AAZ will establish a rural seed bank for groundnuts, soybeans, sunflower, and cowpeas to ensure sustainable supply of these crops for smallholders.	Operating the seeds banks could have environmental impacts if AAZ will use pesticides to protect stored commodities.	5) If AAZ intends to use contact pesticides to protect stored seeds from pests and diseases, they shall first develop a SUAP based on the USAID/Zambia PERSUAP (see mitigation measure 1 for additional information). If AAZ intends to use aluminum phosphide to protect stored seeds, they shall follow the protocol of the recently updated DCHA Fumigation PEA.	SUAP developed, submitted and/or DCHA PEA protocol followed before aluminum phosphide is used	Monitor that SUAP approval is obtained when submitted and/or monitor that required Fumigation PEA documentation is completed and approved
(6) AAZ will facilitate access to financial services.	By facilitating access to financial services so that farmers can purchase inputs, AAZ's support could indirectly affect the environment. If AAZ facilitates purchase of pesticides, fertilizers, or equipment that could clear land to convert to agriculture, adverse impacts could result.	6) AAZ shall ensure that if they facilitate purchases of pesticides, that they develop a SUAP to ensure safe use of pesticides and that only approved pesticides listed in Annex B are purchased (see mitigation measure 1 for additional information). Neonicotinoid pesticides shall not be purchased for field treatments.	SUAP developed, submitted	Monitor that SUAP approval is obtained when submitted
		7) AAZ shall ensure that if they facilitate purchases of fertilizers, that fertilizer best use practices are promoted in conjunction with this assistance.	Fertilizer best use practices provided with all loan documents	Review AAZ's documentation annually

		8) AAZ shall not facilitate the purchase of equipment that could result in land conversion and clearance.	No such equipment purchased with AAZ assistance	Monitor AAZ's documentation
(8) AAZ will build the capacity of farmers in better agricultural and business management practices, and nutrition.	Training in agricultural practices, including conservation farming, could indirectly have adverse effects. Although the intention is to train farmers to increase productivity using environmentally sound practices, farmers may clear land to expand crop production. Training on pesticide and fertilizer use could indirectly impact human health and the environment.	9) AAZ shall include the following topics in training on conservation farming: <ul style="list-style-type: none"> • Safe pesticide use training using the safe use practices in the USAID/Zambia PERSUAP, including use of integrated pest management (IPM) and use of pesticides as a last resort pest management measure; use of appropriate personal protection equipment (PPE); information on neonicotinoid pesticides and their effects on bee populations; other measures in the PERSUAP to protect human health and the environment; recommending only those pesticides (active ingredients) approved for use in the PERSUAP and listed in Annex B. Use of pesticides rejected by the PERSUAP, also listed in Annex B, shall be discouraged; and • Measures to discourage conversion and clearance of natural ecosystems to agriculture. 	Curricula includes these topics	Review training curricula when developed
(9) AAZ will establish demo plots where farmers can learn new techniques and gain hands-on experience.	Establishing demo plots could have environmental impacts if land will be cleared/converted to create the plots. If pesticides and fertilizers are used and demonstrated on the plots, human health and environmental impacts could result.	10) AAZ shall ensure that to establish demo plots, no natural ecosystems are cleared or converted to agriculture.	Demo plots do not require clearing, draining, filling, or other conversion	Conduct site visit or obtain photo documentation of each plot prior to establishment
		11) Prior to using and demonstrating pesticides at demo plots, AAZ shall develop a SUAP that includes only approved pesticides in Annex B, and that is based on the USAID/Zambia PERSUAP safe use measures (see mitigation measure 1 for additional information). Neonicotinoid pesticides shall not be sold for field treatments.	SUAP developed, submitted	Monitor that SUAP approval is obtained when submitted

		12) At demo sites, AAZ shall ensure that when using and demonstrating fertilizer, best use practices are implemented and promoted (See Annex C for an example).	Fertilized best use practices used, demonstrated, disseminated	Review AAZ documentation annually of the use of best practices
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Annex A. Pesticides Approved in the USAID/Zambia DO2 PERSUAP (PERSUAP expires 30 September 2018)

The following pesticides have been approved for use in USAID/Zambia DO 2 programs with the condition that mitigation measures described in the PERSUAP are implemented. Prior to providing support (including using pesticides on fields and for post-harvest storage, selling pesticides at depots, providing assistance to access credit to purchase pesticides), AAZ must submit a Safer Use Action Plan (SUAP) to the AOR (if pesticides are approved for use in the list below). If AAZ intends to use pesticides other than those listed below, P4I, in consultation with AAZ, will submit an amended PERSUAP prior to providing such support.

Only the below-listed pesticides (active ingredients) are permitted for use/support and can only be used/supported with the mitigation measures described in the PERSUAP, including the development of a SUAP specific to this sub-award. For reference, AIs evaluated in the PERSUAP, but not approved, are also listed.

Allowed Fumigant AIs (with strict conditions)	
<ul style="list-style-type: none"> aluminum phosphide for stored grains (for use only by trained and certified applicators, not farmers; see Fumigation PEA) metam sodium for soil pests, diseases and weed seeds (for use only by trained and certified applicators, not farmers; see Fumigation PEA) 	
Allowed Miticide AIs registered by ZEMA	Miticide AIs registered by ZEMA and considered but Rejected for "Use" by USAID Projects
<ul style="list-style-type: none"> abamectin/avermectin (use only formulations below 1.9%) amitraz 	<ul style="list-style-type: none"> tetradifon (not EPA registered)
Allowed Insecticide AIs registered by ZEMA	Insecticide AIs registered by ZEMA and considered but Rejected for "Use" by USAID Projects
<ul style="list-style-type: none"> abamectin/avermectin (use only formulations below 1.9%) acetamiprid (but only when plants are in vegetative state, not when flowering due to risk to pollinators and honeybee colony collapse disorder) dichlorvos/DDVP (use only acute toxicity Class II and III products; not Class I) chlorpyrifos-ethyl (for uses except spraying for household pests, favor the use of granular formulations for soil pests) cyfluthrin (use only acute toxicity 	<ul style="list-style-type: none"> acrinathrin (not EPA registered) alpha-cypermethrin (not EPA registered) benthiocarb (not EPA registered) carbofuran (RUP, Class I) cartap hydrochloride (not EPA registered) chlorfenvinphos (not EPA registered) endosulfan (being phased out as banned under POPs Treaty) fenamiphos (not EPA registered) methamidophos (not EPA registered) monocrotophos (not EPA registered) profenofos (RUP)

<ul style="list-style-type: none"> • Class III products; not Class II) • cypermethrin (registered USA for medical, veterinary and household use) • deltamethrin • dimethoate • ethofenprox • fenitrothion • imidacloprid (but only when plants are in vegetative state, not when flowering due to risk to pollinators and honeybee colony collapse disorder) • lambda cyhalothrin (use only formulations 10% and below) • methomyl (use only acute toxicity Class II and III products; not Class I) • permethrin • pyrimiphos-methyl • propoxur 	<ul style="list-style-type: none"> • terbufos (RUP, Class I) • triflumeron (not EPA registered)
<p>Allowed (when registered) Insecticide AIs proposed for registration by ZEMA</p>	
<ul style="list-style-type: none"> • <i>Bacillus thuringiensis</i>-BT • <i>Beauveria bassiana</i> • cyromazine (for use only in areas without high water table and sandy soil) • fipronil (registered in USA for use against termites, ticks, mites, fleas, ants, roaches and mole crickets) • lufenuron • malathion/mercaptotion • pyrethrins (Marigold extract) • spinosad • thiamethoxam (but only when plants are in vegetative state, not when flowering due to risk to pollinators and honeybee colony collapse disorder) 	
<p>Allowed Fungicide AIs registered by ZEMA</p>	<p>Fungicide AIs registered by ZEMA and considered but Rejected for "Use" by USAID Projects</p>
<ul style="list-style-type: none"> • boscalid (nicobifen) • carbendazim • chlorothalonil • copper ammonium complex (acetate, carbonate) 	<ul style="list-style-type: none"> • benomyl/benlate (not EPA registered) • iprovalicarb (not EPA registered) • propineb (not EPA registered)

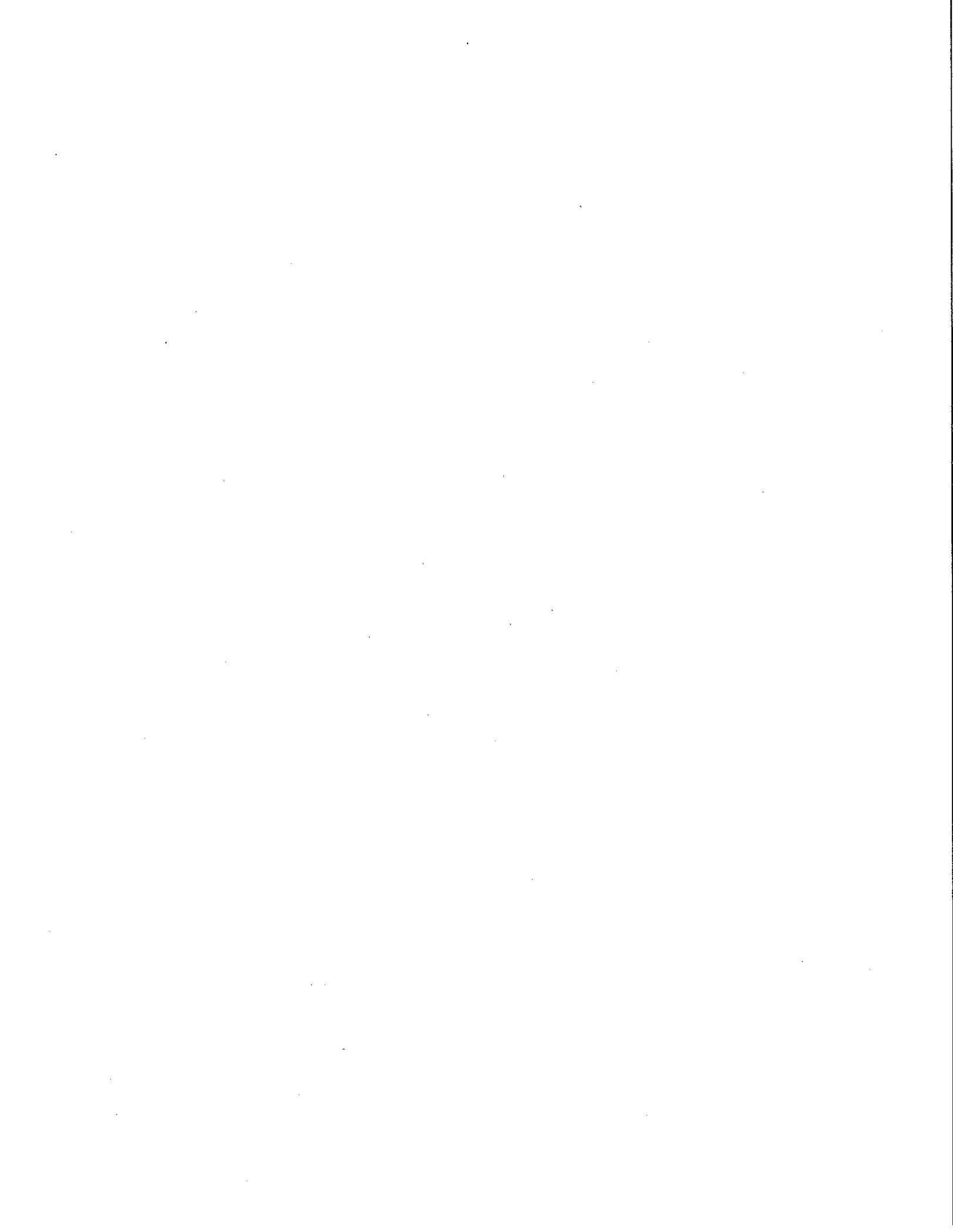
<ul style="list-style-type: none"> • copper (cuprous) oxide • copper oxychloride • copper sulfate • difenoconazole • fenamidone • folpet • fosetyl aluminum • kresoxim-methyl • mancozeb/maneb-zinc • phosphorous acid • propamocarb HCl • propiconazole • sodium metabisulfite • tebuconazole • thiram • triadimefon 	
<p>Allowed (when registered) Fungicide AIs proposed for registration by ZEMA</p>	<p>Fungicide AIs proposed for registration by ZEMA, but Rejected for “Use” by USAID Projects</p>
<ul style="list-style-type: none"> • copper hydroxide • cymoxanil • famoxadone • metalaxyl • triadimenol • <i>Trichoderma species</i> • pyraclostrobin 	<ul style="list-style-type: none"> • alkyldimethylbenzyl ammonium chloride (not EPA registered) • dichlorophen (not EPA registered) • epoxiconazole (not EPA registered) • flusilazole (not EPA registered) • flutriafol (not EPA registered) • penconazole (not EPA registered)
<p>Allowed Herbicide AIs registered by ZEMA</p>	<p>Herbicide AIs registered by ZEMA and considered but Rejected for “Use” by USAID Projects</p>
<ul style="list-style-type: none"> • 2 4 DB acid • 2 4 D isooctyl ester • ametryne • bentazon • bromoxynil • clethodim • clomazone • dacthal/DCPA (for use only in areas without high water table and sandy soil) • diuron (for use only in areas without high water table and sandy soil) • fluazifop-p-butyl • fomesafen (use only acute toxicity Class II and III products; not Class I) 	<ul style="list-style-type: none"> • acetochlor (RUP) • atrazine (RUP) • chlorimuron (ethyl) (not EPA registered) • paraquat (RUP) • propaquizafop (not EPA registered) • sulcotrione (not EPA registered)

<ul style="list-style-type: none"> • glyphosate • hydramethylnon • imazethapyr • mepiquat chloride • metolachlor/S-metolochlor (for use only in areas without high water table and sandy soil) • metribuzin • metsulfuron-methyl • nicosulfuron • pendimethalin • pyrothiobac-sodium • terbutylazine 	
<p>Allowed (when registered) Herbicide AIs proposed for registration by ZEMA</p>	<p>Herbicide AIs proposed for registration by ZEMA, but Rejected for “Use” by USAID Projects</p>
<ul style="list-style-type: none"> • bentazon • diuron (use only in areas without high water table and sandy soil) • fluometuron • halosulfuron (methyl) • linuron • mesotrione • MCPA • nicosulfuron (methyl) • oxyfluorfen • prometryn • propachlor (continued use without PPE could increase cancer risk) • propanil • quizalofop-p-tefuryl • thiobencarb(e)/benthiocarb • trifluralin 	<ul style="list-style-type: none"> • cyanazine (not EPA registered)
<p>Allowed Rodenticide AIs registered by ZEMA</p>	<p>Rodenticide AIs registered by ZEMA and considered but Rejected for “Use” by USAID Projects</p>
<ul style="list-style-type: none"> • bromadiolone • difethialone 	<ul style="list-style-type: none"> • coumatetralyl (not EPA registered)
<p>Allowed (when registered) Rodenticide AI proposed for registration by ZEMA</p>	
<ul style="list-style-type: none"> • zinc phosphide (only in concentrations of 2% and lower, which are EPA acute toxicity Class III) 	

Allowed Nematicide AIs registered by ZEMA	Nematicide AIs registered by ZEMA and considered but Rejected for "Use" by USAID Projects
NONE	<ul style="list-style-type: none"> • fenamiphos (not EPA registered) • oxamyl (RUP, Class I) • terbufos (RUP, Class I)
Allowed (when registered) Nematicide AI proposed for registration by ZEMA	
<ul style="list-style-type: none"> • <i>Paecilomyces lilacinus</i> Strain 251 (attacks nematode eggs) 	
Allowed Molluscicide AIs registered by ZEMA	Molluscicide AIs registered by ZEMA and considered but Rejected for "Use" by USAID Projects
NONE	NONE
Allowed Microbicide AI registered by ZEMA	Microbicide AI registered by ZEMA and considered but Rejected for "Use" by USAID Projects
<ul style="list-style-type: none"> • copper ammonium complex 	<ul style="list-style-type: none"> • alkyldimethylbenzyl ammonium chloride (not EPA registered)
Allowed Bird Repellant AI registered by ZEMA	
<ul style="list-style-type: none"> • methyl-anthranilate 	
Allowed (when registered) Nitrogen-Fixing Organism AIs proposed for registration by ZEMA	
<ul style="list-style-type: none"> • <i>Rhizobium leguminosarum</i> • <i>Bradyrhizobium japonica</i> 	
Allowed Wood Preservative Pesticide AIs registered by ZEMA	Wood Preservative Pesticide AIs registered by ZEMA and considered but Rejected for "Use" by USAID Projects
NONE	<ul style="list-style-type: none"> • chlorpyrifos-ethyl (no longer registered for this use by EPA)
Allowed (when registered) Wood Preservative Pesticide AI proposed for registration by ZEMA	Wood Preservative Pesticide AIs proposed for registration by ZEMA, but Rejected for "Use" by USAID Projects

• fipronil		• creosote (RUP)
Seed Treatment Products Product Trade Name <i>Active Ingredient</i>		
• Medal SD <i>Imidacloprid</i> 70% WDG		•

Annex B. USAID/AFR Bureau Fertilizer Fact Sheet





USAID
FROM THE AMERICAN PEOPLE

Version: June 2004

Download this factsheet at:

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AFRICA BUREAU FERTILIZER FACTSHEET

Prepared by: Rob Clausen, Regional Environmental Advisor (REA), USAID West Africa Regional Program (WARP), Accra, Ghana & Walter Knausenberger, REA, USAID Regional Economic Development Services Office (REDSO), Nairobi, Kenya.

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are fundamental for sustainable agricultural and economic development.

2. FERTILIZERS AND USAID ENVIRONMENTAL PROCEDURES

Fertilizers are frequently lumped together with pesticides under the generic heading of “agro- or agrichemicals.” From an environmental compliance perspective (22 CFR 216), as well as from a field-level implementation point of view, this is inappropriate, because it implies that fertilizers require the same level of scrutiny reserved for pesticides. Whereas pesticides are subject to clearly defined environmental review procedures [22 CFR 216.3(b)(1)], and an approval process to promote safer use and integrated pest management, such procedures do not apply to fertilizers (procurement procedures do apply to quantity bulk purchase).

As with any technology, however, it is recommended that fertilizers be thoughtfully employed according to best practice, promoting integrated soil fertility management, within the context of the prevailing biophysical and socio-economic conditions, as well as the desired outcomes. This fact sheet was developed to assist in that regard.

1. BACKGROUND

Low soil fertility is a problem throughout most of Sub-Saharan Africa (SSA). Moreover, the drastic reduction in fallow periods and the almost continuous cropping without soil fertility restoration has depleted the nutrient base of most soils. By the mid-late 1990s, all SSA countries were demonstrating a negative annual nutrient balance¹. Countries that have the highest nutrient loss rates are the ones where fertilizer use is low and soil erosion is high. These areas include the East African highlands and a number of countries in West Africa.

Low soil fertility is also a driving force behind the conversion of natural areas for agricultural extension. It is generally accepted that agricultural intensification is the only viable means to conserve key natural areas while increasing food security for the continents growing population and generating economic growth through improved agricultural productivity. Land degradation undermines the ability of countries to move in this direction, and the loss of soil nutrients is the most important contributing factor to the land degradation process. The use of inorganic fertilizers is a critical part of the strategy to stop land degradation, restore soil fertility and better manage the soil resources that

3. IMPORTANCE OF WATER MANAGEMENT TO NUTRIENT UPTAKE

Proper water management is important for maximizing crop use of nutrients. About 97% of crop nutrient uptake is from soil solution (water-soluble nutrients), which makes water by far the most important nutrient or fertilizer delivery medium. This also means that, for the most part, nutrient mobility is directly linked to water movement. In sandy soils, nutrients move more quickly through the root zone and soil profile than in other soil types, and excessive water application (or heavy rainfall) can lead to nutrient loss through leaching. Run-off is most serious on loamy-sands or sandy loams that often have a strong surface crust formation. In heavier soils (clays), if nutrients are not adequately incorporated into the soil, the chances for surface runoff in the event of heavy rains or over-irrigation are increased. Sound water management is especially important in rainfed conditions (common throughout SSA). Overall, good water management leads to a more efficient

use of fertilizers and increased nutrient uptake and vice versa.

4. GENERAL SOIL FERTILITY TRENDS IN AFRICA

- Farmers who have taken measures to conserve moisture or increase soil organic matter are more likely to use inorganic fertilizer. When farmers in some areas have capital, they often invest first in increasing moisture retention and/or increasing soil organic matter and secondly in inorganic fertilizer.
- Farmers increase their use of fertilizer when investing more money in fertilizer is seen to be the best available option.

This increase may result from changes in any of the following: fertilizer price, crop price, fertilizer availability, water availability, seed availability, knowledge about fertilizer use, or cropping pattern.

- In West Africa, integrated soil fertility management is progressively adopted. It concerns the combined use of soil amendments and inorganic fertilizer, leading in time to improved soil fertility and increased fertilizer use efficiency and profitability. The nutrient losses to the environment are decreasing.
- Given past and current use rates, USAID's fertilizer-related activities in Africa are unlikely to cause environmental problems.

5. FERTILIZER APPLICATION GUIDELINES

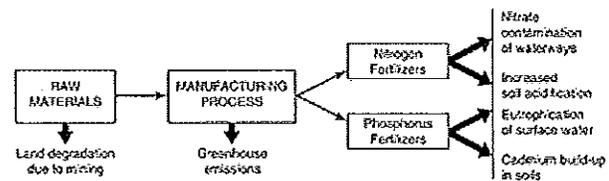
- Before applying fertilizers, obtain an assessment of soil conditions (fertility).
- Indiscriminate use of chemical fertilizers should be avoided.
- Different kinds of fertilizers are required in order to maintain a given level of soil fertility. This depends on site-specific factors, including the soil type, the nutrient requirement of the crop and the various sources of available nutrients. Nitrogen and Phosphorous are the most important nutrients lacking in SSA soils.
- Fertilizer application has to be considered in the context of the overall farming system. This includes the use of organic manure and residues, soil cultivation and crop rotation and water harvesting. Collectively, these factors influence the efficiency of nutrient use.
- When fertilizers are used, it is very important to apply the correct amount for the given situation. The challenge to the farmer is to match as closely as possible the input of nutrients to the nutrient uptake of the crop, thereby minimizing losses. Over fertilization is both costly (wasteful) and potentially harmful to the

environment. To apply the correct amount, the farmer has to define his production goal.

6. POTENTIAL NEGATIVE ENVIRONMENTAL EFFECTS OF FERTILIZERS

Excessive application of nutrients over time can cause pollution. Such losses may occur when nutrients run off the land caused by heavy rainfall, are leached through the soil, beyond the root zone, eventually reaching the groundwater, or escape into the atmosphere as volatile gases.

Aspects of environmental impact can be illustrated as follows:



(Taken from Incitec Fertilizers)

NITROGEN FERTILIZERS

Inorganic nitrogen fertilizers are readily converted by soil organisms to nitrate in the soil. The nitrogen in soil organic matter and organic fertilizers becomes available more slowly. Nitrates may be readily leached if not used by crops or other vegetation. Leaching is particularly likely in sandy soils following heavy rainfall. Leached nitrates may contaminate underground water. This is of concern if the water is to be used for human or livestock consumption, as high concentrations of nitrate may affect health.

Nitrogen fertilizers can also accelerate the natural process of soil acidification. Some fertilizers (e.g. anhydrous ammonia and urea) may initially raise the soil pH at the site of application but in the long term acidify the soils. This occurs when ammonium is converted to nitrate. Acid produced in the nitrification process is used if the nitrate is taken up by plants or soil organisms, but if the nitrate is leached beyond the root zone, acidification occurs. Soil acidification reduces the availability of the trace element molybdenum, fosters the development of aluminum, iron and manganese toxicity and increases nodulation failure in legumes. Lime may be required where acidity is a problem (obtained from naturally occurring calcium carbonate) or the use of acid tolerant plant species can be considered. An illustrative list of crops with acid tolerant varieties include: rice, cassava, mango, cashew, citrus, pineapple and cowpeas.

PHOSPHORUS FERTILIZERS

Excess amounts of phosphorus have been associated with algal blooms and the eutrophication of lakes and waterways. In most waters, phosphorous functions as a growth-limiting factor because it is usually present in very low concentrations. Algae only require small amounts of phosphorous to live. Excessive phosphorus over-stimulates the growth of algae, which could deplete the water of the

dissolved oxygen that is vital to other aquatic life. Phosphorus is relatively immobile in the soil, so conservation and cultural practices which reduce soil erosion can significantly reduce phosphorus inputs into water bodies and the water table.

Phosphorus fertilizers contain various impurities from the phosphate rock and acid used in manufacturing the fertilizer. Cadmium increases is the greatest concern as its compounds are toxic to human beings. Cadmium increases are most noticeable in certain crops e.g. potatoes and leafy vegetables (lettuce and spinach) and in the organs (kidneys and liver) of animals. Almost all phosphate fertilizers contain traces of cadmium, and the concentration of cadmium varies considerably from source to source. At this time, there are efforts underway in West Africa to develop viable processes to remove cadmium from phosphate rock. Exports of rock phosphate represent a vital source of revenue for a number of developing countries in Africa.

FERTILIZER EFFECTS ON SOIL BIOLOGY

Good soil consists of 93% mineral and 7% bio-organic substances. The bio-organic parts are humus (85%), roots (10%) and soil organisms (5%). Most of the soil organisms are decomposers (bacteria and fungi), which are responsible for nutrient retention in soil. In order for nutrients to become available they must be mineralized by the interaction of decomposers and organisms that feed on the decomposers (protozoa, nematodes, micorarthropods and earthworms). Plant growth is dependent on microbial nutrient immobilization. When the number of decomposers declines in soils, more nutrients are lost into the ground and surface water. Heavy treatments of chemical fertilizers can kill decomposers and other soil organisms, which will lead to a reduction in nutrient retention and possible surface and ground water contamination.

7. A SUMMARY OF BEST MANAGEMENT PRACTICES FOR SOIL FERTILITY AND HEALTH

- Practice Integrated Soil Fertility Management (ISFM) – the use of both organic and inorganic sources of nutrients rather than either alone;
- Use of legume cover crops (plus phosphorous) and green manures by fallow rotation or intercropping;
- Promote agroforestry practices – in addition to soil conservation and production benefits, agroforestry transfers/cycles nutrients from within the soil profile (deeper levels to surface);
- Use conservation tillage rather than deep plowing (although conservation tillage can be harmful for production systems in certain regions?);
- Use farm site manures and household wastes, with or without composting;

- Choose crops and associated plants that have high nutrient use efficiency.

6. ADDITIONAL READING

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ACKNOWLEDGMENT

This fact sheet was strengthened by a thoughtful technical review by Dr. Henk Bremen, Director of Africa Division, International Center for Soil Fertility and Agricultural Development (IFDC), Lome, Togo.

