AMENDED

INITIAL ENVIRONMENTAL EXAMINATION

PROGRAM /ACTIVITY DATA:

Program/Activity Number: 685-011
Country/Region: Senegal, West Africa
Program/Activity Title: Increased Economic Growth through Trade and Natural Resource Management
Sub-activities : Global Food Security Response Program, Development Grant Program, Water and Sanitation and the development and promotion of Integrated Management of mango Pests in Senegal

Funding Begin: FY09 **Funding End:** FY14 **LOP Amount:** $139,750,000

Sub-Activity Amount: GFSR: **$ 115,000,000**; Water, hygiene and sanitation: **$ 21,000,000**
GDP water program**: $ 2, 500,000;** GDP Gender**: $600,000;** GDP Civil Society**: $250,000;**
Fruit Fly: **$ 400,000**

IEE Amendment Prepared by: Peter Trenchard, USAID/Senegal

Current date: June 19, 2009

IEE Amendment (Y/N): __Y__ If "yes", **Date of the original IEE**: June 28, 2006

Related Documents:

- Original IEE for this program, June 28, 2006
- Programmatic Environmental assessment for the Development Grant Program (ODP, march 2009)
- Programmatic Environmental Assessment for Insecticide -Treated Materials in USAID activities in Sub-Saharan Africa (Africa Bureau, 2002)

Environmental Actions recommended: (Place X where applicable)

Categorical Exclusion: __X__ Negative Determination: __X

Positive Determination: __X__ Deferral:__X____

ADDITIONAL ELEMENTS: (place X where applicable)

EMEMP: _____ CONDITIONS: __X__

Environmental Media and/or Human Health Potentially Impacted:

Air ____ water _X_ land _X_ biodiversity ____ human health _X_ other ____ none__

Environmental actions recommended under this amendment

_X_ 1. *Categorical Exclusions*

_X_ 2. Initial Environmental Examination:

_X_ *Negative Determination*: no significant adverse effects expected regarding the proposed activities, which are well defined over life of the Economic Growth IEE prepared:

___ without conditions (no special mitigation measures needed; normal good practices and engineering will be used);

_X_ with conditions (special mitigation measures specified to prevent unintended adverse impact)

____ *Negative Determination*: no significant adverse effects expected, but multiple sites and sub-activities are involved which are not yet fully defined or designed. "Umbrella" IEE prepared.

___ Conditions agreed to regarding an appropriate process of environmental capacity building and screening, mitigation and monitoring.

____ *Positive Determination*: IEE confirms potential for significant adverse effect of one or more activities. Appropriate environmental review needed/conducted.

____ EA to be / being / has been (circle which) conducted.

___X_ *Deferral*: one or more elements not yet defined, will not be implemented until amended IEE is approved.

__X__ Pesticides used; 22 CFR 216.3 (b) (1) applies; Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP) attached.

SUMMARY OF FINDINGS

The original Initial Environmental Examination (IEE) was approved in June 2006; this amendment addresses the following USAID/Senegal's new proposed activities: (1) Global Food Response Program within the context of the food crisis in Senegal (GFSR), (2) Water, Hygiene and Sanitation (WASH), (3) The Development Grants Program (DGP) including water an gender activities and (4) the development and promotion of Integrated Management of mango Pests in Senegal. This latest activity will include use of pesticides and a Pesticide Evaluation report and Safer use Action Plan (PERSUAP) has been added to this amendment.

All others projects activities remain essentially the same.

Pursuant to the U.S. Agency for International Development's (USAID's) environmental regulations found in 22CFR 216, this IEE amendment was prepared in accordance with guidance contained in the original EGO IEE, the Programmatic Initial Environmental Examination (PIEE) for the Development Grant Program (ODP, march 2009) and also the Programmatic Environmental Assessment for Insecticide-Treated Materials in USAID activities in Sub-Saharan Africa (Africa Bureau, 2002) for the PERSUAP. To the extent possible relevant analysis in these PEAS are cited herein rather than repeated. This amended document that is specific to the activities in questions and risk mitigations that can be taken within these activities.

This summary addresses the findings of the Initial Environment Examination amendment of new activities foreseen under:

- the GFSR initiative,
- the water, hygiene and Sanitation,
- the development Grant Program including water, gender activities and civil society capacity building
- and the development and promotion of Integrated Management of mango Pests in Senegal.

Following is a summary of the recommended threshold determination for the new activities under this IEE amendment:

GFSR initiative

A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving education, technical assistance, or training programs except to the extent such programs include activities directly affecting the environment (for example, for training in the application of Integrated Pest Management ; per 22 CFR 216.2(c)(2)(ii) for activities involving controlled experimentation exclusively for the purpose of research and field evaluation which are confined to small areas and carefully monitored (except as these may involve genetically modified organisms- GMOs); per 22 CFR

216.2(c)(2)(xiv) for studies, projects or programs intended to support the development of GOS capabilities for contingency planning related to an enhanced market orientation for agricultural production and trade in staples food security.

A **positive determination** is recommended per 22 CFR 216.2(d)(2), and an Environmental Assessment will be prepared, per 22 CFR 216.6 for activities involving irrigation and supporting increased efficiency in existing irrigated areas; support to improved rainfed agricultural practices (small-scale irrigation); for activities involving the multiplication and distribution of seeds of staple food crop; for activities supporting the increased use of organic and inorganic fertilizer; improving farm to market roads, construction of food storage warehouses and cold storage facilities at critical trading centers in various locations around the country; activities supporting the development of entrepreneurial capabilities and/or small to medium-scale enterprise developments for the private sector and farmer associations. Ongoing activities in this area must follow best practice requirements detailed in Section 4.1 of this document.

A deferral of a threshold determination, per 22 CFR216.3(a) (7) iii, is recommended because of the requirements of ADS 211 which mandates carrying out a Biosafety review for any activities involving the field testing or open release of genetically modified organisms (GMOs) prior the environmental examination. USAID/Senegal does plan to support the development of regulations for safe, effective technological advances, including biotechnology. There is, however, some possibility that field testing of GMOs may be supported with resources from other sources working in the country and as part of Agency support for the program.

Water and sanitation Activities

A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, or training programs; per 22 CFR 216.2(c)(2)(ii) for activities involving (i) strengthen participatory governance; (ii) increase demand for sustainable water, sanitation and hygiene services and products; (iii) strengthen the capacity of the small-scale service providers, the private sector and water users associations; per 22 CFR 216.2(c)(2)(xiv) for studies, projects or programs intended to support building capacity of targeted actors including (but are not limited to): latrine manufactures; user associations; village level soap producers; pump producers, water infrastructure engineers; and maintenance providers.

A Negative Determination with Conditions is recommended per 22CFR 216.3(a)(2)(iii), for the Water, Hygiene and Sanitation activities including small scale irrigation, the construction activities consisting of community wells, and latrines. Because these structures are small in size, made mainly with local materials and using local knowledge, supervised by a licensed professional and conducted in collaboration with the community, the potential negative physical impact on the environment is minimal. For the small scale irrigation and the construction of these facilities that include, latrines, and wells, the Mission SO team will ensure that the Guidelines attached to this amended IEE (Attachment 1) are properly followed and that the Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA) are used throughout the construction phase. If construction exceeding 10,000 ft2 is warranted a more detailed environmental assessment would be conducted.

GDP Program--Water

A Negative Determination with Conditions is recommended per 22CFR 216.3(a)(2)(iii) for construction/rehabilitation activities which entail physical interventions and for sanitation activities including the construction activities consisting of community wells, and latrines. Because these structures are small in size, made mainly with local materials and using local knowledge, supervised by a licensed professional and conducted in collaboration with the community, the potential negative physical impact on the environment is minimal. For the small scale irrigation and the construction of these facilities that include, latrines, and wells, the Mission SO team will ensure that the Guidelines attached to this amended IEE (Attachment 1 and 2) are properly followed and that the Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA) are used throughout the construction phase. If construction exceeding 10,000 ft2 is warranted a more detailed environmental assessment would be conducted.

Water and Sanitation conditions:
Both water supply and sanitation activities should be conducted in a manner consistent with the good design and implementation practices described in *EGSSAA Chapter 16: Water Supply and Sanitation*.

Water quality testing is essential for determining that the water from a constructed water source is safe to drink and to determine a baseline so that any future degradation can be detected.

More specifically, the mission shall ensure that the implementing partner develops and implements a Water Quality Assurance Plan that addresses how the partner will ensure the provision of safe drinking water to communities served under the subject activity. This Plan should be approved by the MEO and should assure that drinking water sources meet local and WHO water quality standards.

Initial water quality testing is the responsibility of the program to assure, but when feasible, the program should also set in place capacities and responsibilities to provide reasonable assurance that ongoing water quality monitoring occurs. The standards for initial and ongoing testing -- types of contaminants for which testing should be conducted, testing methods, testing frequency, and issues such as public access to results should follow any applicable USAID guidance, as well as local laws, regulations and policies. Furthermore, a response protocol should be established in the event that water quality testing detects contamination.

Among the water quality tests which must be performed are tests for the presence of arsenic. Any USAID-supported activity engaged in the provision of potable water must adhere to Guidance Cable State 98 108651, which requires arsenic testing. The USAID managing team must assure that the standards and testing procedures described in the following document are met:"Guidelines for Determining the Arsenic Content of Ground Water in USAID-Sponsored Well Programs in Sub-Saharan Africa."

GDP Program—Gender / Civil society capacity building

A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, support to capacity building or training programs

The development and promotion of Integrated Management of mango Pests in Senegal

A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, training programs to producers, building capacity of research and extension personnel; per 22 CFR 216.2(c)(2)(ii) for activities involving controlled experimentation exclusively for the purpose of research and field; per 22 CFR 216.2(c)(2)(xiv) for studies, projects or programs intended to support the development of GOS capabilities.

A Negative determination with conditions is recommended for the development and promotion of Integrated Management of Mango Pests activity. This activity will involve use of 4 (four) fruit fly pheromones, of 2 (two) insecticides used with pheromones for trapping, of one fruit fly bait spray containing an insecticide approved for organic production. The condition, therefore, is that a PERSUAP addressing USAID's Pesticide Procedures pursuant to 22 CFR 216.3 (b) (1) (a-1) be prepared and approved before this activity is initiated.

The conditions to be met for this activity are listed in the final section of the PERSUAP. The condition is as follows:

> USAID/Senegal EGO SO team and the implementing partner will implement the risk reduction actions outlined in the (PERSUAP) and summarized in the section entitled Required Mitigation Measures: The Safer Use Action Plan *(**see Attachment 3).***

This amended IEE describes a specific set of steps that will be taken to ensure adequate environmental review and mitigation. With implementation of the recommended mitigation and monitoring measures, these activities are not expected to have significant adverse effects on the environment.

A deferral of a threshold determination, per 22 CFR216.3(a) (7) iii, is recommended for the loan guarantees under the Development Credit Authority per 22 CFR 216.3(a)(2)(iii) related to credit being made available for productive activities, because the activities have not yet been sufficiently defined to permit a threshold determination at this time. This activity may not proceed until the appropriate environmental review has occurred, at which point this IEE will be amended to remove the deferral or a separate IEE will be prepared.

Monitoring:

As required by ADS 204.5.4, the SO11 Team and activity implementing partners will "actively monitor and evaluate whether the conditions associated with these activities are being implemented effectively and whether there are new or unforeseen consequences arising during implementation that were not identified and reviewed in accordance with sound environmental management. USAID/Senegal commits itself to incorporating sound environmental review principles and screening, capacity building, monitoring, evaluations, and mitigation procedures specified in this amended IEE.

As part of its initial Work Plan, and all Annual Work Plans thereafter, the Implementing Partner, in collaboration with the USAID Cognizant Technical Officer and Regional Environmental Officer or Bureau Environmental Officer, as appropriate, shall review all ongoing and planned activities under the award to determine if they are within the scope of the approved Regulation 216 environmental documentation. If the recipient plans any new activities outside the scope of the approved Regulation 216 environmental documentation, it shall prepare an amendment to the documentation for USAID review and approval. No such new activities shall be undertaken prior to receiving written USAID approval of environmental documentation amendments. Any ongoing activities found to be outside the scope of the approved Regulation 216 environmental documentation shall be halted until an amendment to the documentation is submitted and written approval is received from USAID.

A provision for sub-grants shall be included under the award; therefore, the Implementing Partner should include in the SOW the requirement to include an Environmental Review Form (ERF) or Environmental Review (ER) checklist using impact assessment tools to screen grant proposals to ensure the funded proposals will result in no adverse environmental impact, to develop mitigation measures, as necessary, and to specify monitoring and reporting.

Use of the ERF or ER checklist is called for when the nature of the grant proposals to be funded is not well enough known to make an informed decision about their potential environmental impacts, yet due to the type and extent of activities to be funded any adverse impacts are expected to be easily mitigated. Implementation of sub-grant activities cannot go forward until the ERF or ER checklist is completed and approved by USAID. The recipient will be responsible for ensuring that mitigation measures specified by the ERF or ER checklist process are implemented.

The SO Team shall also monitor the need for additional environmental review based on the amended IEE recommendations. SO11, in collaboration with implementing partners, shall ensure that provisions of this amended IEE, including the conditions and monitoring set forth herein, are incorporated into all contracts, cooperative agreements, grants and sub-grants, as appropriate. Determinations and conditions associated with this amended IEE meet environmental standards established by the Government of Senegal.

APPROVAL OF THE AMENDED IEE :
Increased Economic Growth through Trade and Natural Resource Management

CLEARANCE:

Director, USAID/Senegal _____ Date 7/15/2009
Kevin J. Mullally

CONCURRENCE:

Bureau Environmental Officer _____ Date 4/29/10
Brian Hirsch

Approved X

Disapproved _____

File No.

ADDITIONAL CLEARANCES:

Mission Environmental Officer _____ Date 07/01/09
Aminata Badiane

EG Office Director _____ Date 07/1/09
Peter Trenchard

OPTIONAL CLEARANCE:

Regional Legal Advisor: _____ Date 7/15/09
Cruz –Hubbard Haven

Regional Environmental Advisor: ____/signed_____ Date __7/6/09___
Ruybal Ronald

DCHA Bureau Environnemental officer _____ Date_____
Erika Clesceri

APPROVAL OF THE AMENDED IEE:
Increased Economic Growth through Trade and Natural Resource Management

CLEARANCE:

Director, USAID/Senegal_____ _____ Date _____
Kevin J. Mullally

CONCURRENCE:

Bureau Environmental Officer _____ _____ Date_ _____
Brian Hirsch

Approved _____

Disapproved _____

File No.

ADDITIONAL CLEARANCES:

Mission Environmental Officer_____ _____ Date_____

Aminata Badiane

EG Office Director_____ _____ Date_____
Peter Trenchard

OPTIONAL CLEARANCE:

Regional Legal Advisor: _____ _____Date _____
Cruz –Hubbard Haven

Regional Environmental Advisor: ____/signed_____ Date __7/6/09___
Ruybal Ronald

DCHA Bureau Environnemental officer _____Date_____
Erika Clesceri

AMENDED INITIAL ENVIRONMENTAL EXAMINATION

Program/Activity Number: 685-011

Country/Region: Senegal, West Africa

Program Title: Increased Economic Growth through Trade and Natural Resource Management

Activities: Global food Security Response Program (GFSR), Water, Hygiene and Sanitation, The Development Grants Program (DGP) including water an gender activities and the Development and Promotion of Integrated Management of mango Pests in Senegal

1.0 Purpose and Scope of the amended IEE

The original IEE was approved in June 2006; this IEE will be amended to include the following USAID/Senegal's new activities: (1) Global Food Response program within the context of the food crisis in Senegal, (GFSR), (2) Water, Hygiene and Sanitation (WASH), (3) The Development Grants Program (DGP) including water an gender activities and (4) the development and promotion of Integrated Management of mango Pests in Senegal in the entire SO11 for Increased Economic Growth through Trade and Natural Resource Management in Senegal (EG) to determine the foreseeable effects of the proposed actions on the environment. The fourth activity will include use of pesticides and a PERSUAP has been added to this amendment.

1.1 Background and projects descriptions

This section will address the background and programs descriptions of the following new activities: (1) the GFSR initiative, (2) the Water, Hygiene and Sanitation, (3) the Development Grant Program including water and gender activities and (4) the development and promotion of Integrated Management of Mango Pests in Senegal included in this amended IEE.

1.1.1 Global Food Security Response Program (GFSR)-

A- Background

On May 1, 2008, President Bush announced his request to Congress for additional supplemental resources to help address the impact of high global food prices on developing countries. On June 30, 2008, the President signed Public Law 110-252 (the Act) providing for FY 2008 supplemental appropriations, and an FY 2009 bridge supplemental appropriation, which appropriated emergency Title II food assistance funding, International Disaster Assistance (IDA) funding, and Development Assistance (DA) funding to address the international food crisis. The strategy targets increasing food productivity in sub-Saharan Africa, focusing on those where significant expansion of production is feasible, and then reducing barriers to the movement and procurement of food throughout sub-Saharan Africa.

The integrated framework for the response to the global food crisis includes three components: an emergency humanitarian response, urgent measures to address high food prices through agriculture and trade programs, and a global policy agenda to address the systemic causes of high food prices.

The three inter-related pillars target the immediate consequences and underlying causes of this emerging food crisis. Taken as a whole, the framework presents a road map out of food insecurity for developing countries willing to make the policy and public investment decisions necessary to promote sustainable growth. The emergency humanitarian response will be funded through P.L. 480 Title II and IDA resources.

The DA funds will be used, largely, to support urgent agricultural and trade measures, as proposed under pillar two of the framework, above. These include actions to increase agricultural productivity; alleviate transportation, distribution, and post harvest supply-chain bottlenecks; and promote sound market-based principles. USAID/Senegal has received $23 million of these DA funds to implement the Global Food Security Response in Senegal.

The amended IEE includes the two major contracts implemented: the Agriculture and Natural Resource Management Program (known locally as Wula Nafaa) and the Program to Support Accelerated Growth and Increased Competitiveness (SAGIC) that are already amended to include the Global food security response program. The prime contractor for both of these projects is the International Resources Group (IRG). In addition to SAGIC and Wula Nafaa future instruments will include the following:

***ICRISAT**:* The Economic Growth office (EGO) will buy into the West African Seed Alliance that has been established through a cooperative agreement between USAID/WA and ICRISAT to improve seed development and distribution.

***Fertilizer Alliance**:* EGO will buy into an eventual regional fertilizer alliance aimed at working with the private sector to improve fertilizer distribution and use and to decrease costs.

***West African Value Chain Alliance**:* Funds will be set aside to buy into an APS to solicit private sector input into developing targeted value chains in Senegal. The APS will be solicited by AFR/SD.

***Famine Early Warning System (FEWS) and Contingency Planning**:* Support the reestablishment of a FEWS office in Senegal and to procure services to provide real time data collection on food security and agriculture markets as well as develop contingency planning for future food shocks caused by drought, prices or pest infestations.

***Development Credit Authority**:* Provide loan guarantees to banks and microfinance institutions to provoke increased investments in the agriculture sector.

***Education Alliance**:* EGO will use funds over five years to develop educational alliances to increase access to high education in agriculture and related field. EGO will explore the possibility of partnering with the Ministry of Education and UCAD as well as the private sector to expand educational opportunities.

***USDA Partnership**:* EGO will use USDA expertise in the Global Food Security Response including support from APHIS in improving phyto-sanitary capacity building of DPV. Funds will be set aside for buy-ins into existing inter-agency agreements with USDA.

***Agriculture Productivity, Irrigation and NRM RFA**:* EGO will solicit NGO involvement in improving agriculture productivity, irrigation schemes and natural resource management.

***Peace Corps*: EGO** will enter into a partnership with the United States Peace Corps in Senegal to help achieve the goals of the United States Government's (USG) Global Food Security Response. Funding will be made available to Peace Corps through a Participating Agency Program Agreement (PAPA) to support agriculture activities and enterprise development.

Agricultural Development Program (ADP)s: EGO will solicit new cooperative agreements to achieve the goals of the GFSR to high food prices. Activities under the new procurements will facilitate the development of community capacity at the grass-roots level to strategically respond to food price increases. Activities will involve local community leaders in health, business, agriculture, natural resource management, water and sanitation and education in a strategic planning process to address short and long-term food security needs

National Parks and Wildlife Project: EGO will initiate a new biodiversity program in southeastern Senegal to gain a better understanding of existing wildlife populations and threats towards their continued survival. Additional technical assistance and capital support will be provided to the Niokolo Koba National Park based on a continued commitment of the government to develop a public-private partnership for its management.

B- Description of GFSR Activities

In April of 2008, President Wade launched an initiative to address Senegal's food insecurity and greatly increase the country's future agricultural production. USAID intends to obligate $23 million of FY09 bridge supplemental Development Assistance (DA) funds for agricultural and trade activities in Senegal. Funds will support the GOS' initiative and will be part of President Bush's Global Food Security Response.

The activities will help address the impact of high global food prices, increase food productivity in Senegal and reduce barriers to the movement and procurement of food throughout Senegal and to neighboring countries. Activities will work within a framework that includes three inter-related components: increasing agriculture productivity, increasing regional trade in food staples, and promoting sound market based principles for agricultural growth. Activities to address the impact of high global food prices will focus on: trade and transport corridors; value chain development; finance; technology deployment; irrigation and natural resource management; agricultural processing; and sound market principles. An explicit focus of this effort will be the modernization of staple food production systems combined with strengthening of key trade and transport corridors in Africa. USAID will coordinate and harmonize these activities with other donors, USG agencies such as USDA and APHIS, and Senegal's own initiative responding to food shortages.

The Global Food Security Response has three components along with a provision for administrative/program support costs. The following is a description of each component with key results expected and illustrative activities.

(1) Increasing agricultural productivity and production ($ 48 million)

USAID will increase agricultural productivity in Senegal with activities that include: technology deployment ($18 million); irrigation and natural resource management ($15 million); agricultural processing ($5 million); and developing educational alliances ($10 million). Expected results will include the doubling of production of selected staple food commodities (e.g., maize, rice, sorghum, and millet) by 2013 and a 12 percent increase in production for the 2009/10 season for the targeted commodities; and an alliance for higher education that increases human resource capacity.

Illustrative actions include:

- *Deploying technology* by: strengthening Senegal's Agricultural Institute's seed development program; improving soil fertility through the increased use of organic and inorganic fertilizer; implementing an integrated pest management program and supporting private sector and producer organizations in seed multiplication and distribution.

- *Enhancing irrigation and natural resource management* by: increasing the efficiency of irrigation use in existing irrigated areas; scaling up the availability and adoption of small scale irrigation technologies; and improving local resource management and governance to increase productivity and land access.

- *Developing agricultural processing capacity* by: strengthening the capacity of the Food Technology Institute to assist local firms in food processing; developing market linkages between producers and private sector for distribution, processing and storage; and improving the grading and packaging of products for regional trade.

(2) Alleviating transportation distribution, and supply-chain bottlenecks ($47 million)

National and regional trade in food staples will be increased by improving: trade and transport corridors ($12 million); value chain development ($25 million); and finance services ($10 million). Expected results will include the doubling of regional trade of food staples in trade and transport corridors by 2011, a 25 percent reduction in transport costs along selected corridors by 2011 and reducing food prices by 10 percent for targeted staple foods. For transport corridors the program will focus on the Dakar, Senegal to Bamako, Mali corridor but will also explore possibilities to link with an eventual MCC program that is improving road networks within the country.

Illustrative actions include:

- Developing *trade and transport corridors* by: expanding rural roads that increase access to main production sites and key trade and transport corridors; developing warehouses and cold storage distribution systems; and alleviating port and borders bottlenecks.

- Supporting *agricultural value chain development* by: expanding value chain analysis to major staple foods such as rice, maize, millet, cowpeas; sesame, sorghum, livestock and other local food products; expanding new multi-partner value chain alliances; and increasing business capacity of agricultural firms.

- Increasing access to *finance services* by: increasing access to capital for agricultural producer organizations and SMEs; establishing a warehouse receipt system; and increasing private funding to agriculture.

(3) Promoting Sound Market-based Principles ($15 million)

USAID will reduce distortions, promote competition and promote sound market-based principles in Senegal by: assisting Senegalese and regional organizations; implementing sound agriculture and food strategies; and developing contingency plans. Targeted assistance will be provided to Senegalese and regional organizations to analyze food price increases and react with sound market-based principles. Expected results will include reducing the amount of agricultural tariffs for regional trade of selected staple food commodities by at least 25 percent, the establishment of a Senegal CAADP compact and a contingency plan for future threats to food security.

Illustrative actions include:

- *Assisting Senegalese and regional organizations* by: assisting in establishing CAADP Compacts (integrated investment, policy frameworks, and partnership agreements focused on doubling production of key staple foods) and expediting full implementation; mobilizing public-private partnership to scale up and coordinate investments; supporting Senegal's effort as a member of ECOWAS to address food prices through regional policies that reduce taxes, tariffs, and corruption; and building capacity of producer organizations in business management and access to markets.

- *Implementing sound agriculture and food policies* by: supporting regulations to ensure that safe, effective technologies, including biotechnology, are developed and can be used by farmers; and harmonizing agricultural standards and regulatory procedures.

- *Developing contingency planning* by: developing rapid-response capacity and plans to improve response to market shocks; and developing food and seed banks.

1.1.2. Water, Hygiene and sanitation program ($21,000,000)

A- Purpose

USAID/Senegal's assistance to the water/sanitation/hygiene sector in the past includes several hygiene related activities and a program that trained local craftsmen in the Casamance to build manual pumps and tube wells for improved access to potable water. With USAID-financed technical training, local craftsmen constructed and sold 90 pumps and 100 tube wells, benefiting over 7,000

people. With their acquired know-how, local manufacturers can continue to help deliver potable water supply in rural areas.

The "Senator Paul Simon Water for the Poor Act, Report to Congress" identified Senegal as a priority country for Fiscal Year 2008 U.S. Water and Sanitation Activities. Current priority areas for USAID/Senegal include rural areas in targeted regions. USAID funded water activities coordinate with the Government of Senegal, PEPAM, other donors, and other United States Government funded activities.

The United States Agency for International Development in Senegal (USAID/Senegal) is going o implement the USAID/ Water and Sanitation Program, a 5-year cooperative agreement with a ceiling of $21 million. This activity will improve sustainable access to water supply and sanitation, and promote better hygiene in targeted rural, small towns and peri-urban areas of Senegal. The program will focus on sustainable basic services and infrastructure provision in the rural water supply/sanitation sector to enhance quality of life and to assist Senegal in achieving the Millennium Development Goals (MDG) for water and sanitation.

To achieve this purpose, the USAID/Senegal Water and Sanitation Program has four components:

- Strengthen participatory governance;
- Increase demand for sustainable water, sanitation and hygiene services and products;
- Strengthen the capacity of small-scale service providers, the private sector and water users associations; and
- Install and rehabilitate improved drinking water and sanitation infrastructure, using a service delivery framework.

The program includes a pilot phase in the region of Casamance in year one with the intention to scale up activities starting in year two to areas outside of the Casamance, depending on availability of funding. The program will use an integrated and holistic approach in water supply and sanitation to address the interrelated social, governance, economic, ecological, sustainability, health and capacity challenges in the sector. In addition, activities in the Casamance shall also incorporate a conflict sensitive approach that contributes to the community peace building process.

As the sector is cross-cutting, USAID funds water and sanitation activities with FY08 resources across several offices: Economic Growth, Health, and Education and Casamance offices. This amended IEE includes other mechanisms and planned water and sanitation activities besides that being solicited under the RFA and also the USAID/Agriculture and Natural Resource Management Program (Wula Nafaa) which is building capacity for water and sanitation governance. ($700,000)

B- Background

Senegal is making progress in achieving the MDGs for water supply, with lesser prospects for sanitation. In 2004, Senegal's water supply coverage was 75 percent (64 percent rural, 90 percent urban), compared with 33 percent sanitation coverage (17 percent rural and 57 percent urban). Reaching the MDGs will require substantially increasing the numbers of people gaining access to water per year, and even more so for sanitation.

The Government of Senegal (GOS) has developed the National Programme d'Eau Potable et d'Assainissement du Millénaire (PEPAM) to coordinate different sector actors' efforts under a unified platform to achieve the MDGs for water supply and sanitation. Senegal has identified safe water supply and sanitation services as a priority. MDG and PEPAM objectives for Access to Potable Water and Sanitation in Rural Areas in Senegal are as follows:

Year	***2004***	***2005***	***2006***	***2007***	***2010***	***2015***
Achieved	64%	66%	69%	72.4%		

Targeted			67%	71%	73%	82%

and MDG and PEPAM Objectives for Sanitation in Rural Areas in Senegal are

Year	***2004***	***2005***	***2006***	***2007***	***2010***	***2015***
Achieved	17%	17%	17.05%	17.06%		
Targeted			20%	20%	33%	59%

C- Description of the water and sanitation activities

The overall objective of this program is to improve sustainable access to water supply and sanitation, and promote better hygiene. It includes 4 "Activity Components."

- Strengthen participatory governance;
- Increase demand for sustainable water, sanitation and hygiene services and products;
- Strengthen the capacity of small-scale service providers, the private sector and water users associations; and
- Install and rehabilitate improved drinking water and sanitation infrastructure, using a service delivery framework.

Decades of development experience has shown that merely building infrastructure is not sufficient either to deliver an adequate and integrated service package to citizens in sectors like water and sanitation or to ensure that such services are sustainable over time. Among the best practices/principles that should be incorporated in the water and sanitation program include having: an optimal balance between 'software' (such as management and governance systems) and 'hardware' (infrastructure such as boreholes, wells and latrines); a participatory process for infrastructure design and decision making; local ownership and decentralized management of infrastructure and service delivery; involvement of multiple actors from the public and private sectors; use of appropriate and affordable technologies; and attention to cost recovery to ensure long-term operations and maintenance.

Component 1 - Strengthen participatory governance

Governance in the water and sanitation sector in Senegal is fragmented, and does not always involve stakeholders fairly and democratically in making decisions about how much water or sanitation services goes where, to whom, and for what purpose. The program will emphasize improving governance and building capacity to support long-term improvements in participatory governance. The program will focus on building trust and facilitating dialogue, strengthening decentralized institutions, empowering women to take leadership roles in community life, improving the information foundation for management decision making, and strengthening institutional and organizational capacity to effectively engage in cooperative management of water resources and sanitation services. Building transparent, accountable, effective and equitable governance systems will help balance tradeoffs in the allocation and use of water, ensuring that human, economic and environmental needs will be met in the most optimal manner possible.

Component 2 - Increase demand for sustainable water, sanitation and hygiene services and products

Sustainable water and sanitation governance and service provision hinges on long-term, demand-side management. Demand for improved potable water and, to a greater extent, sanitation is low in rural communities in Senegal. The program should increase demand for sustainable potable water, sanitation and hygiene services and products through linkages with social marketing and private sector distribution networks. Social Marketing is an approach that uses the typically commercial private sector approach to "market" products and messages to promote targeted behaviors. Social Marketing also utilizes the private sector distribution and sales channels to make products and services broadly available to target populations.

Successful activities to increase demand could include mass media communication campaign, marketing and educative entertainment.

Component 3 - Strengthen the capacity of the small-scale service providers, the private sector and water users associations

Multiple actors from both the public and private sector are involved in increasing sustainable access to improved water supply and sanitation. USAID/Senegal will built the capacity of these actors which include service providers, private sector and users associations in developing systems and increasing knowledge, skills and abilities that will facilitate a functioning business or organization. Some attributes of successful business models that could be developed with targeted organizations include: clear roles and responsibilities, accountability, the concept of "the bottom line", employee incentives, good channels of communication, and customer service. A value chain approach can be used to identify where investments would have optimal impacts. Human performance improvement may be used in building capacity and targeted actors could include (but are not limited to): latrine manufactures; user associations; village level soap producers; pump producers, water infrastructure engineers; and maintenance providers.

Component 4 - Install and rehabilitate improved drinking water and sanitation infrastructure, using a service delivery framework

The program objective to improve sustainable access to water supply and sanitation will require installation and rehabilitation of infrastructure. Ideally, the program will facilitate local communities' and government's procurement of these services from the private sector.

Access to water supply services is defined as the availability of at least 20 liters per person per day from an improved source within one kilometer of the user's dwelling. An "improved" source is one that is likely to provide "safe" water, such as a household connection to a networked system, a borehole, a public standpipe, a protected dug well, a protected spring, rainwater collection, etc. Any water infrastructure built with USAID financing should furthermore be "protected," i.e., remove vulnerabilities to contamination such as uncapped/unlined wells, holes where surface water can drain into well water, lack of a tight seal where the pump lines enter into the casing, etc. Improved sanitation facilities are those more likely to ensure privacy and hygienic use, i.e., connection to a public sewer, connection to a septic system, pour-flush latrine, simple pit latrine, and ventilated improved pit (VIP) latrine.

1.1.3 Development Grants Program (DGP) ($3,350,000)

A- Background

As stated in theDGP Programmatic Initial Environmental Examination (PIEE) for the Office of the Development Partners (March, 2009) , the purpose of the DGP is a direct response to an earmark contained in Section 674 of the State, Foreign Assistance Appropriations Act of 2008 (H.R. 2764). The legislation establishes within USAID the development grants program to provide small grants to U.S. and indigenous nongovernmental organizations for specified purposes under the Foreign Assistance Act of 1961. The DGP Award provides small grants to U.S. and indigenous nongovernmental organizations in order to support new grant-making activity involving both U.S. PVOs and indigenous NGOs who have, to date, had limited opportunities to work with USAID in supporting development activities

USAID/Senegal will provide grants to US private voluntary organization(s) and local Non Governmental Organization(s) to use integrated approaches for water and sanitation activities ($2,500,000), for genders activities ($ 600,000) and for civil society capacity building activities ($250,000).

B- Activities descriptions

The DGP includes 5 activities related to water, 2 activities related to Gender issues and 2 activities for civil society capacity building

Water:

- Program to expand access to potable water and sanitation facilities and to renovate aging water systems in the regions of Fatick and Ziguinchor.
- Program to provide potable water, hygiene and sanitation systems to six rural communities in the Tambacounda Region.
- Program to provide drinking water and purification systems to marginalized areas of the Kedougou and Tambacounda Regions
- Project to support the realization of the Millennium Development Goals related to water and sanitation in rural communities of the Fatick Region.
- Provision of improved roofing and latrines in isolated villages in the Delta du Saloum region

Gender:

- Professionalization of Women's Groups in the Production, Transformation and Commercialization of Fruits and Vegetables, Fish Resources and Cereals
- An academic study to look at gender and property rights in Senegal and a sensitization campaign to inform the public and key stakeholders about existing land rights laws and gender inequalities vis-à-vis land rights

Civil Society capacity building

- $150,000 to RADI (Réseau Africain pour le Développement Intégré) for a 2 year civil society capacity building activity which will promote greater participation in the democratic process. It will fall under Area 2.4 Civil Society and Element 2.4.1 Civic Participation.
- $100,000 for SYAFD (Synergie d'Action pour la Formation et le Développement) for a 2 year capacity building activity among civil society groups in the Sedhiou Region. It will also fall under Area 2.4 Civil Society and Element 2.4.1 Civic Participation.

1.1.4 Development and Promotion of Integrated Management of Mango Pests program in Senegal

A- Background

Senegal produces 60,000 to 90,000 tons of mangos annually yet less than 7,000 tons were exported in 2006. The exports of mangos has decreased over the years and it is recorded that 50% to 60% of mangos are going waste as pre and post harvest losses due primarily to the fruit fly problem. In some areas, the losses recorded in 2006 are more than 80% (Casamance area). The most common type of fruit fly present in Senegal and in other West African countries is also the most destructive, known as "Bactrocera invadens," and is of South Asian origin.

Mangos represent about 60% of the total fruit production of Senegal. The "Bactrocera invadens" fruit fly is a serious problem not only for mangos, but it is reported that other fruits are also destroyed by this pest. The population depending solely on the mango sector for income is reported to be more than 100,000 people in Senegal, which is excluding the population making a living from other types of fruits produced in the country.

The fruit fly has become a major agronomic, socio-economic, and biodiversity threat. Failure to take immediate, preventive measures may result in negative, damaging impacts which will seriously impede the development of the mango sub sector in Senegal. This will negatively affect the country's accelerated growth strategy. It is therefore urgent to raise awareness among all the actors implied in the mango sub sector, namely the public authorities, the producers, and the exporters about this biodiversity threat.

USAID/Senegal is taking the lead in addressing this calamity which was first highlighted through the mango sub sector value analysis conducted by the Economic Growth program. On August 10, 2006, the Economic Growth program set up a Fruit Fly Control Committee and initiated field trips in the three zones of intensive production to raise awareness among local farmers and collect information to be used for advocacy. Some of the activities included the following support programs:

a. Mobilization of Stakeholders

b. Training and Raising Awareness

c. Support to Disseminate Information on the Fight against Fruit Flies

As a result of the efforts of the USAID Economic Growth program (together with its partners), some of the large and medium scale actors have begun and are continuing to implement different techniques for fruit fly control to a certain extent. However, the majority of small and medium scale farmers do not have the resources and adequate knowledge to organize and implement the required control techniques.

The amended IEE includes the major leader with Associate Cooperative Agreement already implemented by Virginia Polytechnic Institute and State University ($400,000)

C- Activity description

The primary objective of this program is to assist the GOS and the private sector to develop the capacity to effectively fight and control fruit flies. The proposed activities will be organized into four main areas of action:

1) Promoting current best practices;
2) Improving best practices;
3) Capacity building and outreach;
4) Environmental compliance and stewardship

Activity 1: Promotion of current best practices

Best practices use the most effective, economical, and safest means of preventing economically significant damage. It is the project's intent to identify, improve, and verify best practices for small and medium growers and to promote their adoption such that it becomes common practice. In taking an integrated pest management approach, we will seek alternative methods to direct spraying of mango trees with broad-spectrum insecticides. Except for large growers, pesticides are rarely used by mango growers in Senegal. However the emergence of Bactrocera invadens and the resulting emergency faced by growers will no doubt force some growers to make uninformed choices to spray insecticides and to do so in a manner that is neither safe compliant with regulations in Senegal and importing countries.

Ideally, best practices will prevent a situation where direct spraying of mango trees is necessary. The project will work primarily with cultural control, sex pheromones, and feeding attractants. The latter two will be tested using traps combining the attractant with a pesticide such that: 1) no pesticide is applied to trees or ripening fruit; 3) only small quantities of EPA approved pesticide are used; and 3) pesticides are presented such that poses little risk to humans, livestock, or wildlife.

The following four actions will be carried out:

1- Baseline survey of current orchard mango practices on large, small, and medium orchards, focusing on fruit fly management and damage control.

2- Technical training for small and medium-size producers who export (focusing on Ziguinchor, Niayes, Kolda)

3. Collaborate with USAID/Economic growth program in training for large growers (follow-on to SAGIC's training.)

4. Establish an orchard monitoring system to measure success of control measures.

Activity 2: Improving Best Practices

Best practices will be tested and adapted into IPM packages appropriate for small orchards and village growers. This effort includes economic evaluation.

1. Establish an area-wide monitoring program for a minimum of eight production zones. The network of sampling stations will be used to monitor fruit fly infestation dynamics and seasonal dispersion with respect to time of year, seasonal variables (e.g. onset of rains, temperature, prevailing winds), mango variety, alternative hosts and refuges, and existing management strategies.

2. Improve timing of management tactics based on the orchard monitoring system and the regional monitoring plan. The information from orchard monitoring and regional monitoring will be used to develop better criteria for treatment decisions.

3. Determine a means for commercial retail pheromone
For sex pheromones to become practical for small farmers, they must be affordable and available. If pheromone trials show the method superior, the project will design a private sector distribution model for importing, wholesaling, and retailing pheromones to the village level. If feeding attractants such as moisturizing cream are found equally effective, such an effort will not be required because these products are already available throughout the country.

4. Improved Quality Assurance
Shipment rejection at the port of entry increases the risk of a specific shipper or an entire country being blocked from further imports. Fruit flies are a particularly serious phytosanitary constraint. Whereas some exporters in Senegal are also growers and thus have control over production, other exporters in Senegal buy mangoes from small growers and consolidate them for export. This later case poses a higher risk of fly-infested mangoes being exported. A pre-inspection program would reduce this risk. In a pre-inspection program mangoes would be inspected by competent authorities before departure for export. The IPM CRSP has helped host-countries set up such systems for high-value vegetables.

Quality assurance also requires compliance with the regulations of importing countries with respect to pesticides used and pesticide residues.

Activity 3: Capacity Building and Outreach

I. Strengthen grower associations

By helping grower associations provide accurate technical advice to members. Through this activity, the program will strengthen relationships between growers, grower associations, and relevant government institutions (e.g. ANCAR, DRDR, DPV) by demonstrating the value of these institutions as sources of technical advice on fruit fly management. A video documentary will be produced explaining the mango fruit fly problem in Senegal, new successful management techniques and innovative activities across USAID/Senegal interventions. Extension booklets will be developed in local languages in collaboration with SAGIC in light of fruit fly management techniques tested in the project

2. Support several Senegalese students at for advanced degrees at ENSA (National Superior School of Agriculture) working on fruit fly management.

ENSA will be the focal point for building institutional capacity for carrying out applied research related to mango orchard management and providing effective technology transfer. The research of these students will be an important means of making advances in techniques. Thesis committee members from U.S. universities will be supported in order to engage students in the international scientific community and ensure access to current resources and thinking. Support for short-term student training in the U.S. may be planned if required and could be combined with intensive ESL courses for a semester to provide a reasonable competency in English.

Activity 4. Environmental Compliance and Stewardship

This program will involve the use of 4 (four) fruit fly pheromones, of 2 (two) insecticides used with pheromones for trapping, of one fruit fly bait spray containing an insecticide approved for organic production. A Pesticide Evaluation and Safe Use Action Plan (PERSUAP) will be completed and approved by AID/W for the proposed EPA approved pesticides to be use in this program (see attachment 3).

2.0 COUNTRY AND ENVIRONMENTAL INFORMATION (BASELINE INFORMATION)

2.1 Locations Affected

These four new programs will work throughout the whole territory of Senegal. The GFSR program will focuses along the Senegal River zone where irrigation is possible and the central and northern part of the so-called Basin groundnut including the regions of Kaolack and Fatick for the main staples food growing areas. However, in order to enable the program to take advantage of targets of opportunity that may arise in different parts of the country, the program will retain the flexibility to work outside these areas.

Considering the Water and Sanitation program, it will focus on the Casamance region during the first year. This will include the regions of Ziguinchor, Sediou and Kolda which rural communities have some of the lowest rates of access to potable water in Senegal. The program will include a pilot phase in year one with the intention to scale up activities starting in year two to areas outside of the Casamance, depending on available funding. The DGP program will focus in the central and the southern part of the country including the regions of Fatick, Kaolack, Tambacounda, and Kédougou. And Ziguinchor

Senegal comprises an area of 196,722 km2, which is mostly flat without any pronounced relief. A quarter of its territory is arid. As in much of West Africa, environmental degradation has placed intense strains on Senegal's agriculture and natural resources and threatens economic livelihoods. Once expansive forests are in danger of disappearing, which negatively affects rural incomes, biodiversity and stability. The following provides a brief description of the biophysical and socio-economic aspects of Senegal.

Climate: Senegal has a harsh climate with generally high temperatures, and low to moderate rainfall. The rainy season is limited to a seasonal monsoon, wetter in the south than in the north. The average rainfall varies between 200 – 400 mm from July to September in the north, 400 – 700 mm in the center, and 700 – 1000 mm from May to October in the south. Variations in amounts and timing of annual rainfall cause fluctuations in productivity of the agricultural, livestock and forestry sectors and make food security an issue for most rural dwellers.

Water Resources: The availability of water to a great extent governs land use and conditions of health or existence among most rural populations living at the subsistence level, and also affects the condition of the Senegalese economy. Water supply in the country is erratic, dependent largely on rainfall that varies greatly in amount, distribution and frequency from year to year. Groundwater reserves are still relatively abundant.

Socio-economic context: The population of Senegal is growing at a relatively high rate of 2.6 percent per year, having increased from approximately 3.2 million at independence in 1960 to about 11 million currently. As a result of this rate of increase, nearly 45 percent of the population is under the age of 15. Gross domestic investment rates (23% of GDP in 2003) are too low to raise the real growth rate to the 7.5 percent range essential to generate increased income and employment needed to accelerate the pace of poverty reduction. While Senegal's 4.3% average economic growth rate over the past decade is laudable, stronger economic growth is needed to meet the Millennium Development Goal of halving poverty by 2015.

Food security is dependent on rain-fed staple crop production, much affected by increasingly erratic rainfall patterns and doughtiness (a pronounced shifting of the rainfall isohyets towards the South), as

well as incipient desertification in many areas that were once viable farming communities. Because of the changing rainfall patterns, modern farming systems must address the need for resilience in the face of potential increasingly arid conditions. This underscores the need for including more effective soil and water conservation best practices in the context of sustainable natural resources management, both on-farm and beyond.

Over 60% of Senegal's population relies on agriculture for their livelihoods (17% are in fisheries) and another 20% depend on income from agricultural secondary markets. Agriculture and fisheries contribute only 12% of GDP but represent about 57% of exports, indicating that there is room for increased growth. The actual amount of suitable agricultural land is low (19%) so population density figures can be misleading. Actual population density in productive lands can reach over 300 people / hectare. Most of this suitable land is rain-fed agriculture, with only 1.5% under irrigation. Rain-fed agriculture remains a low investment, low yield activity and won't be able to contribute more significantly to GDP until private sector investments are increased, agriculture is further diversified, and new technologies adopted.

Although there is some potential for continuing expansion of the irrigation sector in both countries, the areas intrinsically suited and developed for irrigated agriculture are along the major river (the Senegal River) where wetland based biodiversity assets could be threatened. The forests of Senegal, most of which are open savannah forest formations, are highly affected by the growing and incessant demand for woodfuels to satisfy domestic energy needs, primarily for cooking. In Senegal, the conflict over the demand for charcoal in the north has added to the civil unrest in the Casamance Region to the south. In Senegal, localized effects of deforestation can have a negative influence on the agricultural micro-climate and exacerbate the problems associated with climate change and desertification

Smallholder, mixed farming systems have been the backbone of the agriculture sector in Senegal, particularly as concerns staple food crops (millet, rice, maize, sorghum and cowpea) and food security. The higher rainfall regimes, more rolling topography and the continuing use of shifting cultivation (slash and burn) also underscore the need for soil conservation and soil fertility enhancement to increase and maintain farm productivity and production. High population growth rates and inherently higher population densities are threatening to push the agricultural frontier onto more marginal lands or into protected forested areas.

Agricultural modernization must include increasing availability of farm credit, inputs, agrochemicals and technical advice and extension services for smallholders while at the same time promoting sustainable natural resources management over the longer-term. Extensification of farming systems must be replaced with more intensive and productive farm practices, matching land-use to land capability which is the most basic premise of sustainable natural resources management. Although there is some scope for increasing the area under irrigation, Senegal typically share water resources with neighboring countries and thus care must be taken to avoid transboundary water conflicts.

2.2 The Regional Framework associated with Agriculture and the Environment

For the GFSRI program USAID/Senegal is closely working with the GOS, other donors, international finance institutions and international organizations to "shape integrated investment plans that address urgent needs and lay the foundation for longer term sustained growth", in particular under the aegis of the Comprehensive African Agricultural Development Program (CAADP). The CAADP, a program of the African Union (AU) and the New Partnership for Africa's Development (NEPAD) is a continent wide "framework endorsed by all heads of state and government across Africa as their common vision and agenda to reform and revitalize African agriculture". Since the GFSRI will support achieving the CAADP objectives, an effort to ensure that learning about environmental oversight and management for sustainable agricultural development, a USAID/Senegal objective, will help to multiply and spread GFSRI achievements.

For example, the CILSS (*Comité Permanent Inter Etats De Lutte Contre La Secheresse Au Sahel*) is one of the premier regional cooperation organizations in Sub-Saharan Africa, involving eight (8) States and has consistently promoted program integration related to agricultural policy and research. Under the umbrella of the CILSS, a Common Regulation for Pesticide Registration in the CILSS Member States was established and Senegal is part of this regional pesticide harmonization system, and provisional or permanent registration.These regulations provide for the registration of all pesticides

entering the Sahel region to be performed by a central committee of experts, called the Sahelian Pesticide Committee.

3.0 EVALUATION OF ISSUES WITH RESPECT TO ENVIRONMENTAL IMPACT POTENTIAL

This section evaluates potential environmental impact of the proposed activities under the EGO program.

3.1 The GFSR program

There are three major components that have been designed into the program to achieve the goal of increasing the production and marketing of food staples. They include: increasing agricultural production and productivity; increasing regional trade in food staples; and promoting sound market-based principles.

(1) Increasing agricultural productivity and production

USAID/Senegal will support a program for *limited applied research* related to staple food crop production by strengthening the Agricultural Institute's seed development program. It will strengthen also the capacity of the Food Technology Institute to assist local firms in food processing; develop market linkages between producers and private sector for distribution, processing and storage; and improving the grading and packaging of products for regional trade. Theses activities are not expected to have any impact on the environment.

USAID/ Senegal will support the development of entrepreneurial capabilities and/or small to medium-scale enterprise developments for the private sector and farmer associations to enable them to become more effectively engaged in input supplies and commodity trading. These activities will support the development of private sector and entrepreneurial capabilities for producing and trading in staple food commodities.

USAID/Senegal Programs will directly target activities specifically aimed at multiplying and distributing improved seeds. This activity will have a positive impact by making available of quality seed, well adapted to local conditions and could enhanced food productivity. We shall emphasize that negative impact may occur when improved seeds affects plant diversity at local level.

USAID/Senegal also will support the increased use of organic and inorganic fertilizer and implement an integrated pest management (IPM). This activity can have a negative impact on the environment if inappropriate fertilizer and pesticide use are done in the field that can lead to water contamination. USAID Senegal will adhere to the procedures listed in the Africa Bureau Fertilizer Fact Sheet.

USAID/Senegal will enhance irrigation and natural resource management by: increasing the efficiency of irrigation use in existing irrigated areas; scaling up the availability and adoption of small scale irrigation technologies; and improving local resource management and governance to increase productivity and land access. The use of improved irrigation technology and management is expected to reduce the demand for water resources, maintain the productivity of the soil and lead to an overall increase in productivity. This activity is expected to have a negative impact on the environment that includes salt intrusion, soil erosion, and spread of water – borne diseases or provoke social conflict over water usage rights.

Support for the use of small-scale irrigation systems that may be implemented through manuals, demonstration sites, and other forms of technical assistance and training shall include irrigation best practices. In addition, close monitoring shall be undertaken to ensure farmers are using the best

practice guidance on irrigation. The Program and its partners will refer to www.encapa.africa Africa Bureau Environmental Guidelines for Small Scale Activities (Agriculture: Soil and Water Resources, including Irrigation).
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(2) Alleviating transportation distribution, and supply-chain bottlenecks

Developing trade and transport corridors: USAID/Senegal will support improving farm to market *roads* as part of their activities. In Senegal, there are existing roads that link farming areas with trading centers. Improved roads will facilitate the supply of agriculture inputs and the trade in staple food commodities, typically lowering the costs involved for all concerned, with direct positive impacts therefore on food security. For transport corridors the program will focus on the Dakar, Senegal to Bamako, Mali corridor but will also explore possibilities to link with an eventual MCC program that is improving road networks within the country. Improved road might have a negative impact on the environment if it does involve opening access to sensitive ecosystems) forest or wetlands).

USAID/Senegal will provide technical assistance to support the construction of food storage warehouses and cold storage facilities at critical trading centers in various locations around the country. Improved warehousing facilities and programs will help to overcome the significant post harvest losses which undermine the availability of food staples in Senegal. A Negative Determination with Conditions as per 22 CFR 216.3 (a) (2) (iii) is recommended for these construction/rehabilitation activities which entail physical interventions. Where necessary, construction engineers will recommend a monitoring and evaluation plan plus mitigation measures be taken for any potential negative effects from the construction and rehabilitation before construction begins. USAID Senegal will adhere to the guidelines in the ENCAP Guide for Small Scale Construction activities.

USAID /Senegal, will provide specific support to *agricultural value chain development* by: expanding value chain analysis to major staple foods such as rice, maize, millet, cowpeas, sesame, sorghum, livestock and other local food products expanding new multi-partner value chain alliances; and increasing business capacity of agricultural firms and enhance capacity for a market based response to food security needs. Theses activities are not expected to have any impact on the environment

USAID/Senegal will help increasing access to *finance services* for agricultural producer organizations and SMEs; establishing a warehouse receipt system; and increasing private funding to agriculture. USAID/Senegal is committed too to assisting income-generating activities in a manner that promotes efficient resource conservation practices. USAID will provide technical assistance, training and a loan guarantee program to promote trade in targeted staples food sectors. This activity is not expected to have an overall negative effect on the environment because it is accompanied by efforts to improve local management of the resources.

(3) Promoting Sound Market-based Principles

USAID will reduce distortions, promote competition and promote sound market-based principles in Senegal by: assisting Senegalese and regional organizations; implementing sound agriculture and food strategies; and developing contingency plans. Targeted assistance will be provided to Senegalese and regional organizations to analyze food price increases and react with sound market-based principles.

USAID/ Senegal will provide specific support to *capacity building, training*, and an enhanced institutional framework for agricultural enterprise *education* for both the private sector (farmers and tradesmen) and government personnel in better farming practices, post harvest practices and basic business and marketing skills. USAID/ Senegal will be providing *technical assistance* in support of national policy analysis, dialogue and innovations for greater food security and will assist in establishing CAADP Compacts (integrated investment, policy frameworks, and partnership agreements focused on doubling production of key staple foods) and promoting public – private partnerships to increase trade, liberalize commodity markets, establish value chains for major staple food crops ; supporting Senegal's effort as a member of ECOWAS to address food prices through regional policies that reduce taxes, tariffs, and corruption; and building capacity of producer

organizations in business management and access to markets. USAID Senegal will be supporting the development of the GOS capabilities for contingency planning related to an enhanced market orientation for agricultural production and trade in food security staples. Technical assistance will be provided to: develop rapid-response capacity and plans to improve response to market shocks; and developing food and seed banks. All theses activities are not expected to have any negative impact on the environment and are categorical exclusions.

In order to Implement sound agriculture and food policies, USAID/Senegal is planning to support the development of regulations for safe, effective technological advances, including biotechnology being developed and be used by farmers; and harmonizing agricultural standards and regulatory procedures. The use of biotechnology may have a negative impact on the environment.

There is, however, some possibility that field testing of GMOs may be supported with resources from other sources working in the subject countries and as part of Agency support for the program. Therefore, A Deferral [216.3a(7)(iii)] is recommended because of the requirements of ADS 211 which mandates carrying out a biosafety review for any activities involving the field testing or open release of genetically modified organisms (GMOs) prior to the environmental examination

3.2 Water, Hygiene and Sanitation program (WASH)

The WASH program includes 4 components:

- strengthen participatory governance;
- increase demand for sustainable water, sanitation and hygiene services and products;
- strengthen the capacity of small-scale service providers, the private sector and water users associations;
- and install and rehabilitate improved drinking water and sanitation infrastructure, using a service delivery framework.

The overall objective of this program is to improve sustainable access to water supply and sanitation, and promote better hygiene

USAID does not expect adverse impacts on the environment for activities planned under the following three following component: (i) strengthen participatory governance; (ii) increase demand for sustainable water, sanitation and hygiene services and products; (iii) strengthen the capacity of the small-scale service providers, the private sector and water users associations. The activities to be undertaken to achieve these results are exclusively provision of technical assistance by building capacity to support long-term improvements in participatory governance and also to built the capacity of these actors which include service providers, private sector and users associations in developing systems and increasing knowledge, skills and abilities that will facilitate a functioning business or organization. The program will focus on building trust and facilitating dialogue, strengthening decentralized institutions, empowering women to take leadership roles in community life, improving the information foundation for management decision making, and strengthening institutional and organizational capacity to effectively engage in cooperative management of water resources and sanitation services. The program will increase demand for sustainable potable water, sanitation and hygiene services and products through linkages with social marketing and private sector distribution networks. Technical assistance will be provide in building capacity of targeted actors including (but are not limited to): latrine manufactures; user associations; village level soap producers; pump producers, water infrastructure engineers; and maintenance providers. No additional environmental reviews are required for all theses activities as they do not affect the environment in any way. The all meet the categorical exclusion under 22CFR 216.2 (c) (1) (i) and 22CFR 216.2 (c) (1) (i), (iii), (v), (viii), and (xiv)

Activities working toward the objective of the fourth component **"**Install and rehabilitate improved drinking water and sanitation infrastructure, using a service delivery framework" will require installation and rehabilitation of infrastructure. Ideally, the program will facilitate local communities' and government's procurement of these services from the private sector. Construction and rehabilitation might include any or all of the following; a household connection to a networked system, a borehole, a public standpipe, a protected dug well, a protected spring, rainwater collection, etc. Any water

infrastructure built with USAID financing should furthermore be "protected," i.e., remove vulnerabilities to contamination such as uncapped/unlined wells, holes where surface water can drain into well water, lack of a tight seal where the pump lines enter into the casing, etc. Improved sanitation facilities are those more likely to ensure privacy and hygienic use, i.e., connection to a public sewer, connection to a septic system, pour-flush latrine, simple pit latrine, and ventilated improved pit (VIP) latrine. Because these structures are small in size, made mainly with local materials using local construction knowledge, the labor is supervised by a licensed professional, and it is done in collaboration with the community, the potential negative physical impact on the environment is minimal. The construction and rehabilitation of any individual structure will not exceed more than 10 000 sq. ft. A Negative Determination with Conditions as per 22 CFR 216.3 (a) (2) (iii) is recommended for these construction/rehabilitation activities which entail physical interventions. Where necessary, construction engineers will recommend a monitoring and evaluation plan plus mitigation measures be taken for any potential negative effects from the construction and rehabilitation before construction begins.

3.3 Development Grant Partners (DGP) Program

1. Water

The DGP involving water has five activities (i) expand access to potable water and sanitation facilities and to renovate aging water systems in the regions of Fatick and Ziguinchor; (2) provide potable water, hygiene and sanitation systems to six rural communities in the Tambacounda Region; (3) provision of drinking water and purification systems to marginalized areas of the Kedougou and Tambacounda Regions; (4) support the realization of the Millennium Development Goals related to water and sanitation in rural communities of the Fatick Region; (5) provision of improved roofing and latrines in isolated villages in the Delta du Saloum region. The implementation of these construction/rehabilitation activities which entail physical interventions will be undertaken by NGOs and PVOs. All these activities have potential impact in water, sanitation and hygiene promotion if not properly mitigated. A negative determination with conditions per 22 CFR 216.3 (a) (2) (iii) is recommended for these construction/rehabilitation activities which entail physical interventions (**see attachment 2**).

2. Gender

1- This first activity will be run by a women NGO (AFAO/WAWA) and this is the activity whereby women's food processing cooperative is trying to improve their business by learning more about food processing, trying to process new products and improve the processing of their existing products, improve their packaging and marketing. Technical assistance will be provided.

2- GESTES is an activity that will be run by the University of Gaston Berger -it is an academic study of the connection between land rights and gender inequality in Senegal and has a strong advocacy component related to raising awareness about women's legal rights to land ownership and advocating for a greater application of the existing laws.

For these two gender activities, a Categorical exclusion is recommended because no environmental impacts are expected under 22CFR 216.2 (c) (1) (i) and 22CFR 216.2 (c) (1) (i), (iii), (v), (viii), and (xiv).

3. Civil society capacity building

1- This first activity will be run by a local NGO called RADI (Réseau Africain pour le Développement Intégré) for a 2 year civil society capacity building activity which will promote greater participation in the democratic process.

2- this second for SYAFD (Synergie d'Action pour la Formation et le Développement) for a 2 year capacity building activity among civil society groups in the Sedhiou Region.

For these two civil society activities, a Categorical exclusion is recommended because no environmental impacts are expected under 22CFR 216.2 (c) (1) (i) and 22CFR 216.2 (c) (1) (i), (iii), (v), (viii), and (xiv).

3.4 Development and Promotion of Integrated Management of Mango Pests program in Senegal

USAID/Senegal will support the Government of Senegal and the private sector to develop their capacities to help growers effectively manage economically important fruit flies. The program will focus on fruit flies and mangoes. It will (i) expands technology transfer of practical, economical, and least toxic fruit fly control technology to small growers in important mango production areas of Senegal; (ii) tests and improve a variety of management techniques appropriate for individuals and groups of contiguous growers; (iii) develops predictive environmental indicators for fruit fly population upsurges in order to optimize timing of control efforts and understand the potential for area-wide management and; (iv) builds capacity of research and extension personnel to effectively serve the needs of the mango sector.

Activities related to build capacity of research and extension personnel are not expected to have any adverse impact on the environment.

All remaining activities such as promoting current best practices and improving best practices involving use of 4 (four) fruit fly pheromones, of 2 (two) insecticides used with pheromones for trapping, of one fruit fly bait spray containing an insecticide approved for organic production, will have a negative impact in the environment under the 22 CFR 216.3 (b) (1) (a-1). A PERSUAP addressing theses issues have been developed and attached to this amended IEE (**see attachment 3**).

4.0 RECOMMENDED MITIGATION ACTIONS (INCLUDING MONITORING AND EVALUATION)

Based on environmental review procedures, the following environmental determination are recommended under this IEE amendment:

4.1. GFSR program

Threshold Decisions :

A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, or training programs except to the extent such programs include activities directly affecting the environment (for example, for training in the application of Integrated Pest Management ; per 22 CFR 216.2(c)(2)(ii) for activities involving controlled experimentation exclusively for the purpose of research and field evaluation which are confined to small areas and carefully monitored (except as these may involve genetically modified organisms- GMOs); per 22 CFR 216.2(c)(2)(xiv) for studies, projects or programs intended to support the development of GOS capabilities for contingency planning related to an enhanced market orientation for agricultural production and trade in staples food security.

A deferral of a threshold determination, per 22 CFR216.3(a) (7) iii, is recommended for the loan guarantees under the Development Credit Authority per 22 CFR 216.3(a)(2)(iii) related to credit being made available for productive activities, because the activities have not yet been sufficiently defined to permit a threshold determination at this time. This activity may not proceed until the appropriate environmental review has occurred, at which point this IEE will be amended to remove the deferral or a separate IEE will be prepared.

A **positive determination** is recommended per 22 CFR 216.2(d)(2), and an Environmental Assessment will be prepared, per 22 CFR 216.6 for activities involving irrigation and supporting increased efficiency in existing irrigated areas; support to improved rainfed agricultural practices (small-scale irrigation); for activities involving the multiplication and distribution of seeds of staple food crop; for activities supporting the increased use of organic and inorganic fertilizer; improving farm to market roads, construction of food storage warehouses and cold storage facilities at critical trading centers in various locations around the country; activities supporting the development of entrepreneurial

capabilities and/or small to medium-scale enterprise developments for the private sector and farmer associations.

A deferral of a threshold determination, per 22 CFR216.3(a) (7) iii, is recommended because of the requirements of ADS 211 which mandates carrying out a Biosafety review for any activities involving the field testing or open release of genetically modified organisms (GMOs) prior the environmental examination. USAID/Senegal does plan to support the development of regulations for safe, effective technological advances, including biotechnology. There is, however, some possibility that field testing of GMOs may be supported with resources from other sources working in the country and as part of Agency support for the program.

Conditions:

- Although expansion within the boundaries of the existing irrigated schemes is allowable, no expansion on to new sites and in particular, on undeveloped wetlands can be undertaken as this would change the determination to a positive one (22CFR216.2(d)(ii) and would therefore require carrying out an environmental assessment (EA).

- This determination specifically excludes seeds resulting from the genetic modification of living organisms (GMOs).

- Promoting and/or procuring fertilizers will be done in conjunction with the guidance available in the Africa Bureau Fertilizer Information Sheet (www.usaid.gov/our_work/environment/compliance/ane/tool_shed/fertilizer_info.doc).

- No funds may be expended on pesticide procurement or use, until after an amendment to this IEE is approved that addresses the pesticide procedures outlined under 22 CFR 216.3(b) and a Pesticide Evaluation and Safe Use Action Plan (PERSUAP) is completed and approved by the MEO and the Africa Bureau Environmental Officer (BEO).

- Construction activities will be conducted following environmentally sound practices presented in USAID's *Environmental Guidelines for Small-Scale Activities in Africa*, (Chapters 3 and 16). Prior to constructing any facilities in which the total disturbed surface area exceeds 10,000 square feet, the program will conduct a supplemental environmental review according to guidelines in the *Africa Bureau Environmental Procedures Training Manual* (Annex G). Construction may not begin until such a review is completed and approved by the REO.
This determination does not cover the implied need for crop storage protection against rodents, insects and fungi which must be the subject of a separate analysis related to agrochemical use.

- Other conditions that would also apply include: Program proponents should ensure that copies of the *Environmental Guidelines for Small Scale Activities in Africa* are printed up and made available to partners in the field and that they are being used, in particular the *Chapter 1- Agriculture: Soil and Water Resources, including irrigation* of the *Environmental Guidelines for Small Scale Activities in Africa* is also highly recommended because introducing improved seeds should be part of an overall effort to modernize agriculture.

4.2 Water, Hygiene and Sanitation Activities

Threshold Decisions : A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, or training programs; per 22 CFR 216.2(c)(2)(ii) for activities involving (i) strengthen participatory governance; (ii) increase demand for sustainable water, sanitation and hygiene services and products; (iii) strengthen the capacity of the small-scale service providers, the private sector and water users associations; per 22 CFR 216.2(c)(2)(xiv) for studies, projects or programs intended to support building capacity of targeted actors including (but are not limited to): latrine manufactures; user

associations; village level soap producers; pump producers, water infrastructure engineers; and maintenance providers.

Threshold Decisions: A Negative Determination with Conditions is recommended per 22CFR 216.3(a)(2)(iii), for the Water, Hygiene and Sanitation activities including small scale irrigation, the construction activities consisting of community wells, and latrines. Because these structures are small in size, made mainly with local materials and using local knowledge, supervised by a licensed professional and conducted in collaboration with the community, the potential negative physical impact on the environment is minimal. For the small scale irrigation and the construction of these facilities that include, latrines, and wells, the Mission SO team will ensure that the Guidelines attached to this amended IEE (Attachment 1) are properly followed and that the Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA) are used throughout the construction phase. If construction exceeding 10,000 ft2 is warranted a more detailed environmental assessment would be conducted.

Water supply and sanitation activities should be conducted in a manner consistent with the good design and implementation practices described in *EGSSAA Chapter 16: Water Supply and Sanitation*. Another useful reference to consult for good water and sanitation design and implementation principles is the document, "Guidelines for the Development of Small Scale Rural Water Supply and Sanitation Projects in Ethiopia," by Catholic Relief Services and USAID, July 31, 2003. For a compendium of humanitarian assistance expertise in 1) Hygiene Promotion, 2) Water Supply, 3) Excreta Disposal, 4) Vector Control, 5) Solid Waste Management and 6) Drainage, consult the Sphere Handbook (2004): Humanitarian Charter and Minimum Standards in Disaster Response, Chapter 2: Minimum Standards in Water Supply, Sanitation and Hygiene Promotion.

More specifically, the mission shall ensure that the implementing partner develops and implements a Water Quality Assurance Plan that addresses how the partner will ensure the provision of safe drinking water to communities served under the subject activity. This Plan should be approved by the MEO and should assure that drinking water sources meet local and WHO water quality standards.

Initial water quality testing is the responsibility of the program to assure, but when feasible, the program should also set in place capacities and responsibilities to provide reasonable assurance that ongoing water quality monitoring occurs. The standards for initial and ongoing testing -- types of contaminants for which testing should be conducted, testing methods, testing frequency, and issues such as public access to results should follow any applicable USAID guidance, as well as local laws, regulations and policies. Furthermore, a response protocol should be established in the event that water quality testing detects contamination.

Among the water quality tests which must be performed are tests for the presence of arsenic. Any USAID-supported activity engaged in the provision of potable water must adhere to Guidance Cable State 98 108651, which requires arsenic testing. The USAID managing team must assure that the standards and testing procedures described in the following document are met:"Guidelines for Determining the Arsenic Content of Ground Water in USAID-Sponsored Well Programs in Sub-Saharan Africa."

4.3 GDP Program— Water / Gender / Civil society capacity building

1- GDP water

Threshold Decisions: A Negative Determination with Conditions is recommended per 22CFR 216.3(a)(2)(iii) for construction/rehabilitation activities which entail physical interventions and for sanitation activities including the construction activities consisting of community wells, and latrines. Because these structures are small in size, made mainly with local materials and using local knowledge, supervised by a licensed professional and conducted

in collaboration with the community, the potential negative physical impact on the environment is minimal. For the small scale irrigation and the construction of these facilities that include, latrines, and wells, the Mission SO team will ensure that the Guidelines attached to this amended IEE (Attachment 1 and 2) are properly followed and that the Environmental Guidelines for Small-Scale Activities in Africa (EGSSAA) are used throughout the construction phase. If construction exceeding 10,000 ft2 is warranted a more detailed environmental assessment would be conducted.

Water and Sanitation conditions:

Both water supply and sanitation activities should be conducted in a manner consistent with the good design and implementation practices described in *EGSSAA Chapter 16: Water Supply and Sanitation*. The SO Team and implementing partners should closely examine this chapter, as it provides a thorough discussion of program design and implementation issues that can help avoid numerous preventable problems. Another useful reference to consult for good water and sanitation design and implementation principles is the document, "*Guidelines for the Development of Small Scale Rural Water Supply and Sanitation Projects in Ethiopia," by Catholic Relief Services and USAID, July 31, 2003*.

Water quality testing is essential for determining that the water from a constructed water source is safe to drink and to determine a baseline so that any future degradation can be detected.

Among the water quality tests which must be performed are tests for the presence of arsenic. Any USAID-supported activity engaged in the provision of potable water must adhere to Guidance Cable State 98 108651, which requires arsenic testing. That 1998 cable also anticipates "practical guidelines on sampling and testing for arsenic" that were then under development. The EGAT Bureau completed these guidelines, and the Africa Bureau has packaged them in a document titled, "Guidelines for Determining the Arsenic Content of Ground Water in USAID-Sponsored Well Programs in Sub-Saharan Africa." The SO team must assure that the standards and testing procedures described in this guideline document are followed for potable water supply activities under this program.

Microbiological contamination of improved wells can often be prevented by aquifer protection measures and proper well design and maintenance. For example, wells for human consumption are readily contaminated when additionally used for livestock watering. Water management committee must ensure that separate wells are used for human and animal consumption. Simple and cost-effective sample kits for *E. coli* and fecal coliforms are available through a variety of manufacturers (e.g., Idex Colilert or Coliscan Easygel).

2- GDP Program – gender:

Threshold Decisions: A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, support to capacity building or training programs

3. Civil society capacity building

Threshold Decisions: A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, support to capacity building or training programs

4.4 Development and Promotion of Integrated Management of Mango Pests program in Senegal

Threshold Decisions: A Categorical Exclusion is recommended per 22 CFR 216.2(c)(2)(i) for activities involving Education, technical assistance, training programs to producers, building capacity of research and extension personnel; per 22 CFR 216.2(c)(2)(ii) for activities involving controlled experimentation exclusively for the purpose of research and field; per 22 CFR

216.2(c)(2)(xiv) for studies, projects or programs intended to support the development of GOS capabilities

Threshold Decisions: A Negative Determination with Conditions: is recommended for the development and promotion of Integrated Management of mango Pests activity. This activity will involve use of 4 (four) fruit fly pheromones, of 2 (two) insecticides used with pheromones for trapping, of one fruit fly bait spray containing an insecticide approved for organic production. The condition, therefore, is that a PERSUAP addressing USAID's Pesticide Procedures pursuant to 22 CFR 216.3 (b) (1) (a-1) be prepared and approved before this activity is initiated.

The conditions to be met for this activity are listed in the final section of the PERSUAP.

The condition is as follows:
- USAID/Senegal EGO SO team and the implementing partner will implement the risk reduction actions outlined in the Pesticide Evaluation report and Safer use Action Plan (PERSUAP) and summarized in the section entitled Required Mitigation Measures : The Safer Use Action Plan ***(see Attachment 3).***

This amended IEE describes a specific set of steps that will be taken to ensure adequate environmental review and mitigation. With implementation of the recommended mitigation and monitoring measures, these activities are not expected to have significant adverse effects on the environment.

Monitoring:

As required by ADS 204.5.4, the SO11 Team and activity implementing partners will "actively monitor and evaluate whether the conditions associated with these activities are being implemented effectively and whether there are new or unforeseen consequences arising during implementation that were not identified and reviewed in accordance with sound environmental management. USAID/Senegal commits itself to incorporating sound environmental review principles and screening, capacity building, monitoring, evaluations, and mitigation procedures specified in this amended IEE.

As part of its initial Work Plan, and all Annual Work Plans thereafter, the Implementing Partner, in collaboration with the USAID Cognizant Technical Officer and Regional Environmental Officer or Bureau Environmental Officer, as appropriate, shall review all ongoing and planned activities under the award to determine if they are within the scope of the approved Regulation 216 environmental documentation. If the recipient plans any new activities outside the scope of the approved Regulation 216 environmental documentation, it shall prepare an amendment to the documentation for USAID review and approval. No such new activities shall be undertaken prior to receiving written USAID approval of environmental documentation amendments. Any ongoing activities found to be outside the scope of the approved Regulation 216 environmental documentation shall be halted until an amendment to the documentation is submitted and written approval is received from USAID.

A provision for sub-grants shall be included under the award; therefore, the Implementing Partner should include in the SOW the requirement to include an Environmental Review Form (ERF) or Environmental Review (ER) checklist using impact assessment tools to screen grant proposals to ensure the funded proposals will result in no adverse environmental impact, to develop mitigation measures, as necessary, and to specify monitoring and reporting.

Use of the ERF or ER checklist is called for when the nature of the grant proposals to be funded is not well enough known to make an informed decision about their potential environmental impacts, yet due to the type and extent of activities to be funded any adverse impacts are expected to be easily mitigated. Implementation of sub-grant activities cannot go forward until the ERF or ER checklist is completed and approved by USAID. The recipient will be responsible for ensuring that mitigation measures specified by the ERF or ER checklist process are implemented.

The SO Team shall also monitor the need for additional environmental review based on the amended IEE recommendations. SO11, in collaboration with implementing partners, shall ensure that provisions of this amended IEE, including the conditions and monitoring set forth herein, are incorporated into all contracts, cooperative agreements, grants and sub-grants, as appropriate.

Determinations and conditions associated with this amended IEE meet environmental standards established by the Government of Senegal.

Attachment 1

Guidelines for Small-Scale Development Activities

I. Types of Construction

A. Latrines

Community sanitation programs will be established at each rural community's site where latrines are installed and, where feasible, in surrounding areas, to promote family latrine use. Local officials will be trained as trainers to conduct training and other educational activities to stress the importance of hygiene and proper sanitation to good health.

The EGO and its grantees will, for the purpose of this activity, be familiar with established technical standards and specifications for the construction and sitting of improved pit latrines, as formulated under low cost sanitation programs in other countries in Africa and specified in Attachment 2.

The EGO grantees will have overall responsibility for the sitting and construction of the latrines. Communities will actively participate in the construction of the latrines as well by providing labor and local building materials.

B. Rehabilitation and Construction of Water Points

The project will rehabilitate existing wells and establish new hand-dug wells where they are technically feasible and lack of water makes good hygiene difficult or impossible. It is assumed that each water point will be equipped with drainage system and a dry well.

In the course of activity implementation, EGO grantee(s) will work with established technical standards and specifications for the construction of hand-dug wells and those for operation and maintenance.

Final water point site selection will be made in conjunction with the community leaders and school personnel. Communities will actively participate in all stages of well construction/rehabilitation.

The EGO grantee(s) will train peri-urban and village community members for the proper use and treatment of water (including the transport and storage of water), and the general relationship of water to health.

II. Impacts and Mitigation

The following environmental issues will be addressed by the EGO during implementation of the EG activities:

A. Water Point Rehabilitation and Construction

The extraction of groundwater from wells can cause well and aquifer pollution unless correct sitting, construction, and usage procedures are adhered to. Consequently:

a. All well sitting will be the ultimate responsibility of the EG grantee(s). All wells will meet the sitting requirements in terms of acceptable distance from latrine installations, proper drainage of excess water and other sources of possible groundwater contamination.

b. All wells shall be constructed and/or rehabilitated based on established technical standards and specifications for sitting, construction and usage. This will include proper sampling and analysis of water to assure safety of water supply (i.e., levels of boron, nitrate, conductivity, chloride, pH, etc.) and a determination of the maximum number of wells that a given aquifer can sustain based upon yield estimates if several wells are nearby. Where the rehabilitation process may require abandonment of the existing wells, abandonment shall be done in a manner that ensures non-pollution of the aquifer.

c. All wells will be lined with concrete well rings to prevent possible contamination by parasites and disease-causing bacteria.

d. All wells will be raised adequately above ground level to prevent contamination entering into the well shaft. The means of extraction will be devised to avoid contamination. A concrete apron will be constructed to ensure correct drainage of wastewater away from the well head and into a dry well to avoid standing water.

e. All wells will be thoroughly disinfected after construction. Disinfection of wells shall be done in a manner that ensures no increase in pollutant concentration following the disinfection process.

f. All well intervention will be accompanied by a community participation water and health education program through the rural community.

B. Latrine Construction

Unless correctly sited, latrines can be responsible for well and aquifer pollution. Consequently:

a. All latrine sitting and construction will be the ultimate responsibility of the EG grantee(s).

b. All improved latrine construction shall be done according to established standards and specification for construction and sitting of improved latrines.

c. In unstable ground, the latrine will be lined.

d. Where existing latrines are close to a source of water such as a river or in areas of high water table, the latrine shall be moved to higher ground.

e. All latrine intervention will be accompanied by a community participation personal hygiene and health education program through the rural community.

III. Monitoring

A. Water Point Rehabilitation and Construction

The EGO Staff, with input from local government organizations for rural water will have overall responsibility for monitoring ongoing water point rehabilitation and well construction progress. Samples of water from water points will be tested for water quality monitoring. Selected and trained community members and school staff will have the continued responsibility to monitor water quality and general well conditions after project completion.

B. Latrine Construction

The EGO Staff has the responsibility for ongoing monitoring of the latrine construction phase. Selected and trained community members and school staff will have the continued responsibility to monitor the latrine status and maintenance after project completion.

IV. Evaluation Program

During the implementation of this program each well and latrine will be subject to local community and government staff approval and evaluation.

During the life of the activity, and as long thereafter as USAID continues to fund activities conducted by EGO, USAID field staff will review any data collected by the concerned government departments, and assess it for possible changes in the characteristics of the water supply and sanitation interventions.

Environmental issues will be one of the key items addressed during any monitoring and evaluation. Also, USAID will closely monitor implementation and will utilize the recently published Africa Bureau **"Environmental Guidelines for Small Scale Activities in Africa"**.

Attachment 2

Technical Specifications

(*Note:* additional specifications for housing, clinics, wells, and other small infrastructure will be provided by grantees and approved by Activity Engineer(s) – TP, Genie Rural or consultant – before construction begins)

Constructions layout:

The bloc layout shall take into account the optimum sunlight, winds direction and other weather constraints. It shall also have a good fit into the existing buildings setting with regard to their location, the location of existing trees and sanitation requirements.

Technical specifications:

The latrine

1) Description:

- **Construction** will be supervised by qualified in-house sanitation manager.
- **Host-country public health service** should be involved to ensure proper sanitation measures are taken as per the national water and sanitation regulations.
- **Latrines will be constructed** no less than 5 meters from the house and no less that 10 meters from water sources.
- **Training to avoid** water accumulation and disease vectors should accompany every project.
- Each sanitation system should consider the **grey water** management methods.
- **Latrines are encouraged to be individual and constructed at household** levels, group latrines tend to not be as efficiently and sustainably managed.
- **Training in use and maintenance** of latrines should be developed for all families participants in these activities.

Attachment 3:

Pesticide Evaluation Review and Safe Use Action Plan (PERSUAP) for Development and Promotion of Integrated Management of Mango Pests in Senegal

I. Pesticide Evaluation Review

Activity title: Development and Promotion of Integrated Management of Mango Pests in Senegal
Country: Senegal
Award amount: $400,000 total for two years and 22 days. (10 July 2008 to 31 July 2010)
Authorizations requested: four fruit fly pheromones, two insecticides used with pheromones for trapping, one fruit fly bait spray containing an insecticide approved for organic production. Several food grade materials are described for use as fruit fly bait or bait adjuvants. These materials are included for informational purposes.

A. Introduction

Project Background

The Integrated Pest Management Collaborative Research Support Program (IPM CRSP) is an initiative of USAID's Bureau of Economic Growth, Agriculture, and Trade (USAID/EGAT). The overall purpose of the IPM CRSP is to develop and implement a replicable approach to IPM that will help reduce agricultural losses due to pests, reduce damage to natural ecosystems including loss of biodiversity, and reduce pollution and contamination of food and water supplies. The goals of the IPM CRSP as proposed in Virginia Tech's 2004 competitive application are to combine strong regional IPM programs with focused efforts on critical global cross-cutting themes to measurably reduce crop and animal losses due to pests, increase farmer income, reduce pesticide use, reduce residues on export crops, improve IPM research and education program capabilities, improve ability to monitor pests, and increase the ability of women in IPM decision making and program design.

The outcomes of the IPM CRSP program as proposed in 2004 were designed to contribute to the Strategic Objective of the Land Resources Management Team (LRMT) of EGAT/NRM to increase the capacity of USAID and its partners to advance land resource management practices that provide long term social, economic, and environmental benefits. In 2007, the IPM CRSP was moved to EGAT's Agriculture Technology Generation Outreach Team (EGAT/ATGO). The IPM CRSP complements ATGO objectives of providing assistance on the improvement of yields in crops and livestock systems for reducing production costs, increasing profits, improving nutritional quality or other consumer benefits, and reducing variability in output such as those due to weather and pest attacks.

The IPM CRSP has four program objectives:

1. Advance IPM science, and develop IPM technologies, information, and systems for sound land resource management;
2. Improve IPM communication and education, and the ability of beneficial practitioners to manage knowledge, resulting in widespread adaptation, adoption, and impact of ecologically-based IPM technologies, practices and systems;
3. Provide information and capacity building to reform and strengthen policies and local/national institutions that influence pest management; and

4. Develop and integrate sustainable resource-based local enterprises into national regional and global markets.

Consistent with U.S. government regulation, USAID determined a “categorical exclusion” on May 5, 2004 covering EGAT activities related to Strategic Objective 9 “Strengthen Agriculture’s Contribution to Broad-based Economic Growth, Better Health, and Effective Natural Resources Management”. The activities of the IPM CRSP fall under SO9 as long as plant protection products are not used. Pursuant to the SO9 PERSUAP, research plans that involve the use of pesticides (defined broadly) are submitted to the USAID Environment Officer in the form of an Initial Environmental Examination (IEE).

In the cooperative agreement for the core IPM CRSP program funded by USAID/EGAT and awarded competitively to Virginia Tech in 2004 is a provision allowing non-competitive associate awards within the domain of IPM to be funded by missions and bureaus of USAID. The mango IPM project for which this PERSUAP applies is an associate award funded by the USAID/Senegal Mission. Reporting is made to the Mission. Therefore, the authorization for use of phytosanitary products during implementation of this project lies with USAID/Senegal.

IPM Background

Integrated Pest Management is an approach to pest management in which economically rational treatment decisions are made from among environmentally sound options. Pesticides are used only when necessary, in as small a quantity as possible, and in a manner that poses the least risk to humans and the environment. IPM also considers, as much as is practical, the relationship of a pest with other crops and the relationship of a farmer’s different crops to an overall pest management strategy, not a single pest on a single crop. Identifying economic alternatives to pesticides is a fundamental activity of each regional program.

Finding effective, economical, and safer alternatives to currently used pesticides is done through collaborative research with host country institutions. In countries where the IPM CRSP works, pesticides in common use are often of an older, more toxic chemistry than newer products, which are not as widely known. Most of the IPM CRSP activities do not use pesticides. Activities that do use pesticides often involve testing fewer applications or lower doses of commonly used products or comparing them with newer, safer pesticides. IPM CRSP experiments may also involve comparing biological control products such as microbial biopesticides. Comparing fewer applications or reduced dose to standard farmer practice is frequently carried out in the fields of cooperating farmers. If equivalent or superior levels of control can be obtained at a reduced cost, then safety, environmental, and economic objectives of the project are advanced. Replacement or combination of commonly used pesticides with less toxic chemicals or non-chemical methods of pest management are even better. Once improved IPM packages are developed by the IPM CRSP, the project promotes technology transfer activities to promote farmer adoption. In the case of recommendations that reduce dose or reducing the number of applications of commonly used products, these recommendations are not a recommendation for the pesticide itself. On the other hand, when new products or techniques are part of a recommended IPM package, the safety and economics relative to current practice are factored into the decision to make new recommendations.

For on-farm research in the core IPM CRSP project, pesticides are rarely purchased. When farmer practice using common pesticides is being compared with different application scenarios, farmers use their own supply of pesticides. When new products are being tested, they may be supplied by the IPM CRSP. The majority of pesticide research, experiments are conducted with small quantities of products (<5L on a maximum of 10 ha). However, for the mango IPM associate award, the IPM CRSP intends to purchase pheromones, food attractants, and insecticides sufficient to establish a long-term fruit fly population monitoring program as well as conduct research on appropriate management techniques.

B. Program Description

The goal of this associate award is to reverse the national trend of increased economic damage, primarily that caused by tephritid fruit flies in fruit production – principally mango – by promoting practical techniques for small and medium orchard owners to manage the principal constraints to preserving quality and yield. Techniques will be developed through an adaptive research program over the course of several seasons of on-farm testing and monitoring. Research and extension work is being carried out with cooperation of other national and regional projects and programs having an interest in fruit fly management. This cooperation includes the USAID-funded SAGIC economic growth project. Phytosanitary product authorizations made under this PERSUAP should also cover activities in SAGIC's workplans that are undertaken in cooperation with this associate award.

Senegal is home to about thirteen species of tephritid fruit flies. The family Tephritidae is the most economically important group because they lay eggs in fresh fruit. *Bactrocera invadens* and *Bactrocera cucurbitae* are the most damaging of the introduced fruit flies in Senegal. *B. invadens* is the most serious pest of mangoes in Senegal. *B. cucurbitae*, known as the melon fly, is less attracted to mangoes, but causes substantial losses in vegetables in Senegal and around the world. The native *Ceratitis cosyra* was, until the arrival of *B. invadens* in 2004, the most serious fruit fly pests of Senegalese mangoes. The Mediterranean fruit fly, *Ceratitis capitata*, is a native fruit fly that is of great phytosanitary importance around the world. It may be found on mango, but is not a serious pest compared to other species.

Program Components/Technical Objectives

The mango IPM associate award is a means for USAID/Senegal support to help the Government of Senegal and the private sector to develop their capacities to help growers effectively manage economically important fruit flies.

Focusing on fruit flies and mangoes, the project:

- expands technology transfer of practical, economical, and least toxic fruit fly control technology to small growers in important mango production areas of Senegal;
- tests and improve a variety of management techniques appropriate for individuals and groups of contiguous growers;
- develops predictive environmental indicators for fruit fly population upsurges in order to optimize timing of control efforts and understand the potential for area-wide management and;
- builds capacity of research and extension personnel to effectively serve the needs of the mango sector.

Eleven activities are organized around four components:

1. developing national research capacity to optimize control efforts
2. improving best practices
3. building capacity and outreach to promote best practices; and
4. ensuring environmental compliance and stewardship

Component I. Research and Building Research Capacity

1.1 Conduct a baseline survey of current mango orchard practices focusing on fruit fly management and damage control

A baseline study will be carried out at the eight intervention sites in order to characterize current pest management practices among fruit growers.

1.2 Generate experimental data to support registration of pesticides on mango to promote new, less toxic insecticides
The project will test candidates for economical, effective, least toxic chemical options for when insecticide use is necessary.

1.3 Establish an area-wide monitoring program for a minimum of eight production zones
A network of long-term monitoring stations is being established to monitor fruit fly infestation dynamics and seasonal dispersion with respect to time of year, seasonal variables, mango variety, alternative hosts and refuges, and management strategies.

II. Best Practices
2.1 Establish an orchard monitoring system to measure success of control measures
The project will evaluate and adapt biorational, cultural, and chemical control to arrive at economically robust treatment recommendation and decision criteria at the orchard level.

2.2 Improving timing and choice of management tactics
The information from the two years of orchard monitoring and regional monitoring will be used to develop better criteria for treatment decisions.

2.3 Improving quality assurance
The project will provide technical assistance and leadership to develop a model pre-inspection program for mangoes. The objective of the model system is to avoid export shipment rejection at ports of entry, thereby increasing confidence of the importer and reducing the economic risk of exporters.

III. Outreach
3.1 Technical training for growers
The project will develop a curriculum for training producers in fruit fly management and conduct training of trainers for public service agents. Training materials will contain recommendations for treatment that may include insecticides.

3.2 Strengthen grower associations
As the results of the project research lead to IPM recommendations, the project will transfer these recommendations to grower groups.

IV. Environmental Compliance and Stewardship
4.1 Obtaining USAID pesticide authorizations
Prior authorization for use or recommendation of pesticides is required for all USAID projects in accordance with Title 22 Part 216 of the Federal Code of Regulations (22 CFR 216). Obtaining this authorization is part of Virginia Tech's environmental compliance obligation.

4.2 Facilitate submission of registration dossiers
The project will make research on efficacy available to private sector entities that do have the right to submit registration dossiers for products they manufacture, formulate, or distribute.

4.3 Seeking emergency and research exemptions
In order to use for research pesticides not yet registered for use on mangoes, DPV must make authorizations. DPV is national coordinating institution for the project and may conduct research using such products with the Director's approval. Exemptions for emergency use may be issued by Ministry of Agriculture the Senegalese government. The project will supply supporting information if requested by the ministry.

C. Program Activities Requiring Pesticide Use

Phytosanitary products needed to implement the project.

The project is requesting authorization to use the phytosanitary materials necessary to validate and promote IPM packages for fruit fly control on mango that are appropriate for small, medium, and large growers. The principal insecticidal components of these IPM packages will be fruit fly traps and sprayed protein baits. The types of materials used in other fruit fly management programs around the world are:

1. Conventional synthetic chemical insecticides can be used in blanket sprays or as the killing agent in traps that lure flies with sexual attractants or feeding attractants

2. Adjuvants synergize the active ingredient without themselves being toxic or are added to pesticide formulations to provide other desirable characteristics.

3. Sexual attractants. Pheromones and parapheromones (synthetically produced analogues of naturally occurring attractants) are chemicals – frequently found naturally in plants – that attract male fruit flies of one or a narrow range of species. They do not attract female fruit flies.

4. Feeding attractants. Substances like hydrolyzed protein have odors that attract tephritid fruit flies. Because these substances are not pesticides, they do not require authorization by USAID. Traps baited with feeding attractants attract female fruit flies.

5. Botanical extracts. Insecticides such as azadiractin and rotenone are plant extracts. Being a plant extract often confers the ability to use such a substance for organic production, but such substances are not necessarily less toxic than synthetic chemical alternatives. For example, concentrated rotenone is more toxic than concentrated malathion. Their permitted use for certified organic production or an exemption from maximum residue levels on commodities may favor the selection of botanicals irrespective of toxicity.

6. Microbial biopesticides made from insect pathogenic fungi or bacteria could be used applied to soil under mango trees to kill larvae as they move into the soil to pupate. These microbes are usually very host-specific and would have essentially no harmful effects on non-target organisms. The mango associate award has no activities on biopesticides for fruit fly control.

7. Parasites and predators. Native and non-native wasps lay eggs on fruit fly larvae. Weaver ants reduce oviposition either by harassing females trying to lay eggs, by repelling flies with their chemical cues, or by consuming larvae or adults.

The use of plant protection products within this project fall into activity three categories:

1. Long-term population monitoring

Population monitoring is done by regular monitoring of fly traps using an attractant and, in most cases, a toxicant to kill flies before they escape. The project is primarily concerned with the two major fruit fly pests of mango in Senegal, the recently arrived invasive species *Bactrocera invadens* and the native species *Ceratitis cosyra*. Less important mango pests are the melon fruit fly *Bactrocera cucurbitae* (also introduced) and the Mediterranean fruit fly *Ceratitis capitata* (probably native). Males of each of these species are attracted to a different sexual attractant that mimics natural pheromones or functions as a pheromone analog (parapheromone). *B. invadens* is attracted to methyl eugenol. *C. cosyra* is attracted to terpinyl acetate. *B. cucurbitae* is attracted to cuelure, and *C. capitata* is attracted to

trimedlure. The use of these attractants is key to understanding population dynamics and designing effective control techniques.

2. Research to test management techniques

The efficacy of chemical, cultural, or biological control techniques needs to be evaluated by including traps to measure populations. Chemicals may be used as spray treatments.

3. Extension recommendations to promote adoption of effective management techniques

It is expected that our recommendations will comprise a combination of techniques including rational, minimal use of insecticides. Recommendations to growers to use phytosanitary products may include chemical application or fly trapping. In consideration of commonly used techniques in other parts of the world and the research that has been planned in the course of this project, recommendations will likely include use of insect traps containing either a combination of nontoxic sexual attractants combined with an insecticide or a combination of nontoxic feeding attractant without an insecticide. Bait spraying will also be practiced. There is a single product registered in Senegal for use against fruit flies on mangoes, (Success Appat or GF-120).

A core component of an IPM approach to pest management is monitoring populations so that treatments are done only when necessary. Therefore, placing traps for detecting the presence of fruit flies will undoubtedly be part of extension recommendations to growers.

Techniques for fruit fly control:

1. Conventional spraying.

Blanket spraying of mango trees with insecticides is not widely practiced in Senegal. The increased threat to growers by *Bactrocera invadens* may increase pressure on small growers to spray trees, but few of them currently have access to sprayers that can reach well into the canopy of mango trees. Furthermore, outside of the large-scale orchards in region of Thies, pruning is not widely practiced. The large canopies are not amenable to blanket spraying. However, in large commercial orchards pesticides are commonly used for blanket spraying against thrips, fruit flies, mealybugs and diseases. Calendar spraying is more likely than monitoring populations for economic action thresholds, but the project is aware of one operation where fruit fly monitoring is used to time control measures. Encouragement of monitoring could reduce pesticide use even in the absence of new control techniques. Where spraying is practiced, it may begin as early as the flowering stage (e.g. thrips). The effect of early, regular spraying on beneficial non-target arthropod communities in these orchards is not known. Research proposed by the project may encourage adoption of techniques (e.g. fruit fly trapping, spot application of bait sprays) that reduce harm to non-target communities.

2. Trapping with sexual or feeding attractants

Traps with sexual or feeding attractants are frequently used in fruit fly population monitoring programs. Traps containing pheromone attractants and a killing agent attract only male flies and are very species specific (**Figure 1**). Bait traps containing protein sources are more attractive to female fruit flies than males, but are less species specific. Bait traps do not require an insecticide. Long-term population monitoring can be carried out by agricultural agents whereas monitoring of orchards by orchard owners can be used to determine action thresholds and guide treatment decisions. Traps can even be used to manage populations. Male Annihilation Technique (MAT) uses high densities of parapheromone traps to attempt to eliminate all males from a breeding population. Traps isolate the toxicant from the environment. There is no contact of pesticides with developing fruit. Very small quantities of toxicant are used per trap, which minimizes exposure hazard both with respect to total quantity used per hectare and the potential exposure of people preparing, placing or otherwise coming in contact with the killing agent. Exposure during trap preparation is low compared to spraying. Exposure to bystanders during trap preparation and placement is extremely low compared to mixing and applying blanket or spot

sprays. Clean-up and disposal problems are minimal when using pesticides that volatilize. Non-target organisms have low probability of contact with toxicants.

3. Killing with attractants without traps.

Pheromones and toxicants can be used outside traps. “Plaquettes”, small blocks of plywood or fiberboard can be impregnated with sexual attractants and insecticide to draw flies and kill them upon contact. They can be used for population management, but not for monitoring. Compared to traps, plaquettes pose risks to people and non-target organisms. When plaquettes are attached to trees with nails, there is high probability of unnecessary hand contact with the insecticide-impregnated blocks. Furthermore, nails used to attach the wood en blocks will be left in the trees and could harm people who climb them. This risk could be overcome by using wire to hang them from branches). Preparation of plaquettes by well-trained people with proper safety precautions could minimize exposure. If the dipping is performed by individual farmers, there is a greater risk of insufficient personal protection. Traps are easier than plaquettes to find and recover in the field. However, plaquettes may be appropriate in places where high densities are required or where high winds may make trap maintenance difficult. In the Niayes mango zone round Thies, strong winds frequently accompany rains. The resilience of traps with respect to these winds needs consideration. Under such circumstances plaquettes suspended by wire might be more practical than traps.

4. Biological control

Biological control uses living organisms or their products to affect pest populations. Biological control with macro-organisms such as parasitic wasps or predatory arthropods can be done with native or introduced species. The introduction of a non-native species for biological control would require authorization through a PERSUAP. Augmentation of native beneficial organisms does not. Microbial pathogens or antagonists of pests can be used to control pest populations as microbial biopesticides. Microbial biopesticides are used like conventional pesticides to suppress pests. They are sprayed as needed without necessary expectation of the organisms establishing in the environment (inundative biological control). Inundative microbial control is when a microorganism is introduced to an environment in the hope of it establishing itself in the environment to provide long-term population suppression without further intervention.

Predators: The weaver ant, *Oecophylla longinoda* is documented as having reduced fruit fly damage in mango orchards in Benin (Van Mele et al., 2007). It is a native species in Senegal, but its benefits there have not been documented. People consider the ants a pest because of the bites they inflict upon harvesters. Weaver ant colonization may be encouraged by providing dispersion routes between trees using string. Managing ant walkways between trees might even be used to control the access of ants to trees at the time of harvest to reduce the risk of bites. Most smallholders in Senegal grow mangoes without benefit of spraying pesticides, so encouraging natural colonization of weaver ants is possible. Large growers, however, are known to blanket spray their orchards against fruit flies, thrips, and diseases. The effect of such spraying on the presence of weaver ants has not been documented. Reduced spraying, selection of more narrow-spectrum insecticides, or adoption of trapping instead of spraying could benefit ant populations.

Parasitic wasps in the family Braconidae that parasitize the larvae of tephritid fruit flies have been identified in Senegal. *Diachasmimorpha fullawayi*, *Fopius caudatus*, and *Psyttalia cosyrae* are native wasps in West Africa (Vayssieres, pers com). *P. cosyrae* is a parasitoid of *Ceratitus capitata* and *C. cosyra*. There is no native parasitoid that attacks eggs of the introduced fruit fly *Bactrocera invadens*. Whereas the indigenous species are adapted to dry environments the exotic species *Fopius arisanus* is adapted to humid environments and will parasitize *B. invadens* among other *Bactrocera species*. It probably has little potential to establish north of the Gambia. However, in the Casamance it could be an important regulator of populations. In Basse Casamance, mango trees grow wild in the forest. The fruit of these unmanaged trees doubtless represents a refuge for fruit flies even if they are well managed in orchards. Furthermore, there are several species of wild fruit in the Casamance known to support larval development of

tephritid fruit flies. Establishment of a parasitoid wasp is probably the only means of reducing forest populations of fruit flies in feral mangoes and wild forest fruits. The project currently has no intention to work on the introduced species *Fopius arisanus*. However, it may undertake some work on the native species. PERSUAP approval for working with native species of beneficial insects is not required. Work on *F. arisanus* would require submission of an amendment to the project's PERSUAP.

A difficult period to effectively exploit in the fruit fly life cycle is when larvae emerge from fallen fruit to enter the soil and pupate. Although *B. invaden*s is capable of pupating in the host fruit, this is not common. Chemical treatment of the soil under mango trees is not desirable, would likely miss contact with the target, and would probably require frequent re-application. There is better potential for long-term control if a microbial biopesticide could be sprayed to inoculate the soil. The shaded environment under a mango tree is ideal for protecting such insect pathogens from degradation from high temperatures and ultra-violet radiations. If successful, this approach could substitute for regular collection and destruction of fallen fruit. Collection and destruction is time-consuming, and the benefits insufficiently retained by the investing grower that the project considers this technique has little hope of widespread adoption. A biological pesticides providing long-term control of larvae would likely be better accepted by growers. Some research in this area is being undertaken by entities outside this project. The project has no immediate intention to pursue work on microbial biopesticides, but screening of native isolates of fungi and bacteria might be undertaken. PERSUAP approval is not required for this kind of screening research with native species.

5. Cultural control

Cultural management of fruit fly populations is the category of techniques that involve manipulation of the environment to indirectly affect pest populations. Gathering and destruction of aborted fruit has been promoted to prevent population growth early in the season (Quilici, 2006). Early harvesting late-bearing mango varieties has been documented in Thies, Ziguinchor, and Kolda. Early harvest removes the mangoes from the orchard before fruit fly populations reach their peaks. Cultural control overlaps with biological control when intentional modifications to the environment are made in order to encourage the establishment of natural enemies. The following cultural techniques have been proposed based on research or are in practice in other parts of the world.

- Destruction of fallen aborted mango fruit in the early season
- Early harvest of late-bearing mango varieties
- Facilitating the establishment of weaver ant nests in mango trees
- Plant early-bearing mango varieties
- Physically protecting fruit from egg laying

6. Area-wide management.

Area-wide management is an approach to control that focuses on zones of production as agroecological units and uses cooperative, concerted effort on the part of growers in order to reduce pest pressure over a wide area. It is the scale of the effort that merits separate discussion. It is the application of IPM packages across a larger scale than individual fields or orchards that distinguish this category: the techniques used derive from those already discussed in the preceding categories. Quantifying the distribution of benefits, and understanding the sociological incentives and disincentives for cooperation are important research elements for designing and implementing a successful area-wide management program. For commodities with export value, area-wide management can be used to establish zones of no or low pest prevalence. For importation to the United States, such zones have regulatory relevance.

7. Phytosanitary control

Phytosanitary measures must be considered as part of an IPM program when either: 1) the commodity is exported or imported; or 2) the pest is a non-native species of quarantine importance. In Senegal mangoes are imported from Guinea and Mali before local mangoes enter the market. There is little effort expended in intercepting contaminated shipments entering the country. It is unknown to what extent if any that regionally imported mangoes may augment or advance in time the fruit fly upsurge in Senegalese production zones.

Techniques unlikely to be recommended:

1. Prophylactic blanket spraying should not be a prophylactic method. When high pest pressure is verified through monitoring, then spraying may be necessary to prevent economic losses. In such case a product with low impact on beneficial orchard insects should be sought.

2. "Plaquettes". Small flat pieces of plywood or fiberboard are dipped in a parapheromone and an insecticide, such as methyl eugenol and malathion (**Figure 2**). The wood is then nailed to the trunk of mango trees. Flies attracted to the block are killed on contact. This technique has been observed in Ziguinchor. There appears to be no compelling advantage to using exposed wooden plaques over using traps made from water bottles unless extremely high densities are needed. Trapping with pheromones and toxicants should be just as efficient and reduces some hazards presented by plaquettes. No research is planned for plaquettes in 2009. The might, however, carry out comparisons between traps and plaquettes in the 2010 season.

Dipping blocks into liquid insecticide and removing them to dry present an exposure risk. If plaquettes were pierced and threaded, then dipped into the parapheromone/insecticide suspended from these wires, the exposure risk during preparation and mounting would be minimal. Piercing a corner of each wooden plaquette and attaching a hanging wire would allow many plaquettes to be dipped simultaneously. Dipping and drying could be done with little to no contact with the pesticide. The hanging wire would permit handling of the blocks for transport to the field, and placing them in trees with little exposure hazard, even if protective gloves were not worn. Mounting the insecticide-impregnated plaquettes on a tree with a nail poses unnecessary risks. Because the block must be handled to nail it, there is a high risk of exposure by the hands if protective gloves are not worn. Even if gloves are worn, they will undoubtedly get contaminated in the course of mounting the blocks in an orchard. Furthermore, the nail itself becomes a hazard. It is unlikely to be removed after the plaquette's useful life is over. Finally, because plaquettes are exposed, they may kill nontarget organisms that crawl over them and may leach pesticide down the tree trunk when it rains.

3. Collection of fallen fruit. Many mangoes in early developmental stages fall from a mango tree between the flowering stage and maturity. These mangoes can be a source of flies early in the mango season. A recommended cultural practice is to collect these fruit and destroy them to kill the larvae before they can enter the soil to pupate. However, the high time requirements make it unlikely to be adopted by most growers. Furthermore, the benefits of this great effort are diluted unless nearby growers also collect fallen fruit. Because benefits to individual farmers have not been validated, this technique is not being promoted as a recommendation to growers. It might be practical in an area-wide management scenario where this source of flies could be eliminated over a substantial area.

Proposed Research. A research program was finalized after the project's national fruit fly workshop held in Ziguinchor 12-16 January 2009. Research objectives are summarized in **Table 1**. The objective of the 2009 research program is to generate data in one season that can provide extension guidance for 2010.

Table 1. Field Research to Improve Best Practices -2009 mango season.

Activity	Objective	Comparison	Expected Results
Test efficacy of parapheromone trapping	Determine how effective male annihilation technique can be when used alone.	Bait traps will monitor whether pheromone traps can suppress populations sufficiently in the absence of other control methods. Bait stations will be used in both treated (pheromone) and untreated (no pheromone) orchards. The measure of efficacy is the reproductive state of females caught in bait traps. Supplemental measure is fruit fly damage to mangoes.	A. If parapheromone traps are effective for male annihilation, most of the females trapped in bait stations will be virgin. Mango damage will be light. B. If male annihilation is not effective, many of the female flies trapped in bait traps will be mated and have mature eggs. Mango damage will be heavy. Results will determine how strongly we must recommend tactics in addition to male trapping.
Test efficacy of bait trapping	Determine how necessary bait trapping is in combination with parapheromones trapping.	Both control and treatment orchards will have parapheromones used for male annihilation. Treatment orchards will have large numbers of bait traps as a control tactic. Control fields will have bait traps only for survey. The measure of efficacy is the reproductive state of females caught in bait traps. Supplemental measure is fruit fly damage to mangoes.	A. If bait traps are an important contribution to preventing population growth, then there should be few fertile, sexually mature females in the bait traps. Mango damage should be light. B. If bait traps are not an important contribution to preventing population growth, then there will be many fertile, sexually mature fruit flies in the bait traps. Mango damage will be heavy. Assuming that bait trapping provides economic benefits, the results will permit us to recommend the best timing of bait trapping to minimize labor and cost.
Test the efficacy of adding color to Success Appat	Determine whether adding color to spot treatments will increase the attractiveness to female fruit flies.	Within an orchard, alternate trees are sprayed with Success Appat. The remaining trees are sprayed with colored Success Appat. Comparison will be the number of females stuck to	A. Additives do not increase efficacy of Success Appat B. Additives do increase efficacy of Success Appat

Activity	Objective	Comparison	Expected Results
		leaves.	
Fruit bagging	Can bagging late season mangoes one month (at least 15 days) before harvest provide high quality fruit with essentially no probability of fruit fly damage. (especially after 15 August)	In Niayes and Ziguinchor, test whether: 1. bagged fruit are more susceptible to disease 2. bagging encourages development of latent diseases, allowing early triage 3. remaining unbagged fruit suffer compensatory damage Labor time, and the cost of bags must be measured. Mango damage of unbagged fruit in bagged orchards must be compared to mango damage in unbagged orchards.	A. Bagged fruits maintain quality and provide a means avoiding losses due to fruit fly B. Fruit with latent cercosporiose may be identified before sale to wholesalers. C. Bagged fruit encourages disease development or early maturation, or burning. D. Fruit bagging is too expensive
Long-term population monitoring	Follow long-term fruit fly population dynamics at eight stations as part of a national monitoring program.	Meteorological data will be collected. The physical environment will be characterized according to the schema of Jean Yves Rey. Populations will be followed by male baiting with standard traps and standard attractants (probably DDVP amulets).	Population patterns at different sites will be used to alert producers to increased presence of fruit flies. Correlations between fruit types (other than mangoes), mango variety, rainfall, wind direction, and regional trade routes (i.e. Diawbe) will be used to hypothesize factors that might be used to manage or anticipate the growth of fruit fly populations.

Figure 1. Two varieties of bottle traps built by growers in the Casamance and baited with Malatrap. Painting the trap yellow provides additional attraction. Male fruit flies can be seen in the bottom of both traps. The holes cut into the bottle make them useless for re-use as bottles. However, note that the drinking water label needs to be removed. The upper trap has a sponge for receiving the attractant/insecticide. The lower trap uses a suspended cigarette filter.

Figure 2. Insecticidal block (*plaquette*) of methyl eugenol parapheromone nailed to a mango tree in Ziguinchor. Note that the nail was driven entirely into the tree so that it is not easy to remove.

D. Expected Benefits and Beneficiaries

The expected benefits are described by the four project components in section B. Small, medium, and large mango growers will benefit. Wholesalers and retailers in the domestic market, most of who are women, will benefit if losses due to fruit flies can be reduced in the mangoes they purchase. If improved management reduces the number of rejections of mangoes arriving in Europe, the reputation of Senegal's mango sector will benefit.

E. Pesticide Characteristic Profiles.

Characteristics of phytosanitary products proposed for this project are described in this section. Some illustrative manufacturer products are discussed first. Material profiles for attractants, adjuvants and insecticides are presented in tabular form. These profiles provide detailed information on a substance's registration status, method of use, toxicology, and safety issues.

The profiles describe generic active ingredient, except for Success Appat. Success Appat is a brand name product registered for use on mango in Senegal. The brand name formulation is profiled as well as its active ingredient, spinosad.

For population monitoring research, uniformity of traps and attractant/toxicants is necessary in order for results from different stations of the national monitoring network to be comparable. For this reason, commercial traps and attractants will be used. Products from different manufacturers can be formulated differently and give differing results, so products will be bought in quantity from a single manufacturer to fulfill trapping requirements for two years. Measuring efficacy of fruit fly management techniques in the research program will also require commercial traps and materials. Farmatech is a pheromone supply company based in Washington State whose products may be used to achieve this uniformity. The active ingredients and attractants are:

Bactrocera cucurbitae*.* Cuelure is the substance used to attract male *B. cucurbitae*. Farmatech sells a cuelure-impregnated polymer strip called the **FT Cuelure Strip/M** containing 55% by weight of cuelure (2.2g per wafer).

Bactrocera invadens. **Mallet-MC/M** is a patent pending plastic wafer impregnated with17.7% methyl eugenol sex attractant, 3.5% DDVP (dichlorvos) as a killing agent, and 24% of a proprietary formula. It is currently used for population monitoring of *Bactrocera dorsalis* in Hawaii by the USDA. Mallet ME/M is a similar product without the proprietary formulation containing 57.9% methyl eugenol and 3.4% DDVP.

Ceratitis cosyra. Farmatech has an experimental lure for *C. cosyra* combining parapheromone with DDVP as in the Mallet methyl eugenol lure. The separate components are standard products for the stated purpose. The experimental nature is in the combination of them into a polymer wafer. The proprietary formulation technology used to combine the two components in the wafer matrix is claimed by Farmatech to provide superior results to traps in which pheromone plugs and DDVP strips are placed as separate components in traps. These results have been shared with the project. Using these wafers in traps in Senegal will provide efficacy information to Farmatech.

Ceratitis capitata. Trimedlure is the pheromone component used to attract Mediterranean fruit flies. Med flies occur in Senegal although they are not currently considered a serious pest of mangoes. Farmatech produces a polymer panel impregnated with 24% and no insecticide for use in monitoring traps.

Attractant/killing agents under development

Senchim (*Industrie Chemique du Sénégal*) is a formulator in Senegal that formulates and distributes pesticides in many West African countries. Much of its market share has been servicing the cotton, cacao, and banana sectors. In the aftermath of the invasion of *Bactrocera invaden*s, it began researching products to serve mango growers. It currently has under development two products specific for fruit fly management and one product already registered for other horticultural use, for which Senchim is interested in testing its potential for fruit fly control on mangoes. Neither of Senchim's two attract/kill products are registered. The project is interested in carrying out efficacy tests to support registration by the *Comité Sahelien des Pesticides*.

Malatrap (malathion 25%, methyl eugenol 75%). Malatrap combines the methyl eugenol parapheromone for *Bactrocera invaden*s and *B. cucurbita*e with the standard insecticide used in traps. This convenient combination allows an application of a single substance in order to bait a trap. Ten ml of Malatrap is applied to an absorbent material such as a cotton ball or cigarette filter, every two weeks. Assuming a trap density of ten traps/ha for MAT, and a seven month trapping season (which may vary in length according to mango variety, associated fruit species,

and pest pressure), the application rate is equivalent to approximately 1.4L of product per hectare per season. The application rate of active ingredient is approximately 350ml of malathion per hectare per season.

Bio-atrap (rotenone 6.6%, methyl eugenol 93.3%). Bio-atrap is Senchim's experimental formulation of parapheromone and the botanical insecticide rotenone. Rotenone is substituted for use in organic mango production where malathion or other synthetic chemical insecticides cannot be used in trapping programs regardless of their lack of contact with fruit or tree. Rotenone, however, is not less toxic than malathion. It is substantially more toxic to fish and other nontarget aquatic organisms than malathion and has a higher oral mammalian toxicity. It was the botanical insecticide of choice because it volatilizes, providing killing trapped flies without requiring them to contact the dispenser.

Suneem is Senchim's emulsifiable concentrate formulation of the botanical insecticide azadirachtin in a neem oil carrier. Both substances derive from the neem tree. Senchim uses locally available neem as its source of both the azadirachtin (10g/L) active ingredient and the oil. It is packaged in a 1L bottle. For horticultural applications a dose of one to two L/ha is recommended. Its use against fruit flies on mangoes is in the early stages of planning. The project is interested working with Suneem to see if it could play a role in a fruit fly IPM package. The current formulation under development contains organo-sulfurics compounds from the neem oil component which Senchim says are repulsive to fruit flies. Therefore, a comparison may be made with standard Suneem and a formulation using another vegetable oil to replace the neem oil. On the other hand, if the neem oil component is sufficiently repulsive to fruit flies, Suneem in its original formulation may be appropriate for spraying late-maturing varieties of mango (the kind most often exported) in the late stages of maturity. In the orchards around Thies, for example, fruit fly pressure typically becomes heavy around August 15 as the Kent and Keith mangoes are becoming mature. Because azadirachtin has no residue restrictions and a 0 day pre-harvest interval, it could be used until the day of harvest.

Some application information relevant to usage decisions and product choice for attractants and adjuvants are presented in **Table 2**. Similar information for the proposed pesticides are presented in **Table 3**. Pre-harvest interval is an indicator of concern with respect to persistence of a pesticide on harvested produce. A low number of days for PHI means that a pesticide may be applied close to harvest and still safely fall below maximal pesticide residue limits. Re-entry interval is a measure in hours that workers must stay out of a field after a pesticide is applied. High REI numbers are given to products that continue to pose an acute poisoning risk long after application. EPA toxicity classifications provide an approximate guide of acute toxicity risk for humans and the environment for specific formulations. A toxicity classification of I is given for the products that pose the most risk used according to label. A classification of IV is given for products that are essentially non-toxic when used according to label. Different formulations of the same active ingredient may be classified differently. Resistance class is a system devised by the Insect Resistance Action Committee (IRAC) to group insecticides according to their mode of action. Products in the same IRAC class have he same mode of action and, when used successively, can promote evolution of resistance to the insecticides in target populations. Development of insecticide resistance is discouraged by rotating products in different resistance classes. **Table 4** summarizes registration and toxicity class information. **Table 5** provides profiles of the materials the IPM CRSP intends to use in the project to carry out its research and extension activities. These material profiles present the required information for USAID Environmental Compliance Procedures for pesticides (Title 22 CFR 216.3(b) 1). The letters "A" through "L" represent items "a" through "1" under "Pesticide Procedures" in USAID's Environmental Compliance Procedure. Letter beyond "L" represent supplemental information specific to that product. A Safe Use Action Plan is presented programmatically rather than for each product (**Section II**).

Table 2 *Attractants and adjuvants proposed for use in fruit fly trapping.*

Name	**PHI (d)**[1]	**REI (h)**[2]	**EPA Toxicity Class**[3] **(formulation)**	**Resistance Class**[4]
borax	N/A	12	III-IV	non-specific action
Cuelure	N/A	N/A	N/A	Non-toxic sexual attractant
methyl eugenol	N/A	N/A	III-IV	Non-toxic sexual attractant
propylene glycol	N/A	N/A	IV	Food grade adjuvant
protein hydrolysate	N/A	N/A	N/A	Non-toxic food-grade feeding attractant
terpinyl acetate	N/A	N/A	N/A	Non-toxic sexual attractant
Torula	N/A	N/A	N/A	Non-toxic food-grade feeding attractant action
Trimedlure	N/A	N/A	III	Non-toxic sexual attractant

[1] Pre-Harvest Interval, refers to the required time between the last pesticide application and harvest of the treated crops in days. Typical values for common formulations. PHI must be followed for the particular formulation being used.
[2] Restricted Entry Interval refers to the time in hours after a pesticide application before which entry into the treated area is allowed. Typical values for common formulations. REI must be followed for the particular formulation being used.
[3] Pesticides are regulated by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The U.S. Environmental Protection Agency classifies every pesticide formulation into one of four groups, from highly toxic Classes I to essentially non-toxic Class IV. Classes I through III are required to carry a corresponding signal word on the label (Danger, Warning, Caution). A pesticide may be designated a Restricted Use Pesticide if risks of adverse effects to humans or the environment are substantial even when used according to the label. RUPs may be purchased and used only by certified applicators.
[4] Refers to Insect Resistance Action Committee (IRAC) classification of common modes of action. Rotating use of insecticides in different IRAC classes reduces the probability of resistance developing to a particular mode of action.

Table 3 Pesticides proposed.

Name	**PHI (d)**[1]	**REI (h)**[2]	**EPA Toxicity Class**[3] **(formulation)**	**Resistance Class**[4]
Azadiractin	0	4	IV	18B
dichlorvos (DDVP)	1	48	III (impregnated polymer)	1B
Malathion	1 to 7	12	II-III	1B
rotenone	0	12	I - III	IRAC 21
Success Appat (bait with 0.02% spinosad)	3	4	IV	IRAC 5 Feeding attractant combined with toxicant
Spinosad	3	4	III + IV	IRAC 5

See footnotes in Table 2.

Table 4 Registration status and toxicity classification of requested phytosanitary products.

Name	Host Country Registration	U.S. EPA Registration	EPA Toxicity Class[5] (formulation)	WHO Toxicity Class[6] (technical grade active ingredient)
Attractants and adjuvants proposed for use in fruit fly trapping				
borax	No	Yes	III-IV	U
cuelure	No	Yes	N/A	Not applicable
methyl eugenol	No	Yes	III-IV	Not applicable
propylene glycol	Not applicable	Not applicable	IV	Not applicable
protein hydrolysate	Not applicable	Not applicable	Not applicable	Not applicable
terpinyl acetate	Not applicable	Not applicable	Not applicable	Not applicable
torula	Not applicable	Not applicable	Not applicable	Not applicable
trimedlure	Not applicable	Not applicable	III	Not applicable
Pesticides proposed				
azadiractin	No	Yes	IV	Not applicable
dichlorvos (DDVP)	No	Yes	I	Ib
malathion	Yes (for cotton bollworm)	Yes	II-III	III
rotenone	No	Yes (piscicide)	I + III	II
Success Appat (bait with 0.02% spinosad)	Yes	Yes	IV	U
spinosad	Yes (for cotton bollworm)	Yes	III + IV	U

[5] See footnote 3 in Table 2.

[6] World Health Organization (2004) classification is based on the toxicity of the active ingredient, whereas EPA's classifies formulated products. WHO toxicity classification codes for a pesticide are determined according to the following toxicological characteristics of the active ingredient:

Ia = Extremely hazardous. Oral LD_{50}rat (mg/kg body wt): solids ≤5; liquids ≤20. Dermal LD_{50}rat: solids ≤10; liquids ≤40

Ib = Highly hazardous. Oral LD_{50}rat (mg/kg body wt): solids 5-50; liquids 20-200. Dermal LD_{50}rat: solids 10-100; liquids 40-400

II = Moderately hazardous. Oral LD_{50}rat (mg/kg body wt): solids 50-500; liquids 20-2000. Dermal LD_{50}rat: solids 100-1000; liquids 400-4000

III = Slightly Hazardous. Oral LD_{50}rat (mg/kg body wt): solids >500; liquids >2000. Dermal LD_{50}rat: solids >1000; liquids >4000

U = Unlikely to present acute hazard in normal use. Oral LD_{50}rat (mg/kg body wt): solids >2000; liquids >3000. Dermal LD_{50}rat: solids >4000; liquids >6000

Table 5. Material Profiles of Attractants, Insecticides, and Adjuvants (pp 23 – 53)

azadirachtin (Suneem)
A. Registration status of the requested pesticide (USEPA and host country). There are many registered insecticides containing azadirachtin. For example, Aza-Direct is a general use insecticide registered by the U.S. EPA as Aza-Direct (Registration No. 71908-1-10163) by Gowan Company. It is a Toxicity Class IV insecticide with the signal word Caution and has an insecticide resistance rating of IRAC Class 18B. Suneem, produced by Senchim, is not yet registered in Senegal or other CILSS countries. It is an azadirachtin formulation in neem oil.
B. Basis for selection of the requested pesticide and the proposed methods of application. Azadirachtin is registered as a botanical biopesticide in the United States where it is used against pests in food crops. It is a complex mixture of related tetraterpene limonoids extracted from seeds or leaves of the neem tree, *Azadirachta indica*. It works on contact or through ingestion and can be used to control over 600 types of pests as either an insect growth regulator, disrupting growth/molting, or as an anti-feedant. It also acts as an insect repellent and is used as a fungicide and an acaricide. Azadirachtin extraction can be done artisanally by farmers or in small scale commercial operations. Its content in formulations can vary widely because of variations in trees, harvest, post-harvest, processing, and extraction efficiency. For example, leaf extractions have a lower content of azadirachtin than kernel extractions, but reduce the possibility of phytotoxic burning. Suneem was selected for use as a low risk toxicant with an attractant placed in a pheromone trap. It was also selected to investigate its effectiveness as a spray repellent.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Azadirachtin is very compatible with IPM programs because it has a low toxicity profile. It is proposed for use as a potential alternative to synthetic pesticides (See Table 2) in pheromone traps and as a spray repellent.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Suneem will be used as a foliar spray.
E. Acute and long-term toxicological hazards and risk avoidance. Azadirachtin is relatively non-toxic to mammals with an acute oral toxicity LD_{50rat} >5000mg/kg, and an acute dermal toxicity LD_{50rat} >2000mg/kg. It is not a skin or eye irritant, nor is it a skin sensitizer. PPE should be worn when mixing, loading, and applying any product. PPE will be supplied by the project as needed.
F. The effectiveness for the proposed use. Azadirachtin is effective against pests of fruits and vegetables. Suneem's current formulation contains organo-sulphur compounds that cause repulsion by fruit flies.
G. Compatibility of the proposed pesticide with target and nontarget ecosystem. Azadirachtin and/or neem extract is very compatible with target and nontarget organisms because it has a very low toxicity profile. Azadirachtin has low toxicity to fish (LC_{50} (96h) for trout = 8.8mL/L) and other aquatic organisms. It is practically non-toxic to birds. Ducks fed basic diet plus azadirachtin at the same concentration for 5 days remained active and healthy throughout the test period. Dose levels of 1-16 mL of azadirachtin/kg elicited no negative effects.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Azadirachtin is proposed for use against the tephritid fruit flies in Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Azadirachtin is a preferred alternative to more toxic insecticides. However the effectiveness of azadirachtin is often lower than traditional synthetic chemical insecticides. Azadirachtin is a desirable choice when effectiveness for a particular target pest under local conditions has been tested, but it should not be relied upon for controlling heavy infestations prior to supporting experience. It can be used in addition to cultural techniques which can discourage the build-up of economically damaging populations of target organisms. Crop rotation, use of resistant varieties,

and good field sanitation can discourage pest build-up. When chemicals must be used, a resistance management plan should be followed that limits the number of applications of a particular product and provides guidance on rotation of pesticides in different resistance classes.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Assessing the effectiveness of Suneem and modified formulations of it is the objective of the proposed research.
M. Mitigation of possible adverse effects. Adverse effects are not anticipated. It has a 0-day PHI. Residues and sprays are not considered hazardous.
N. Restricted Use Status. Azadirachtin is not a U.S. EPA Restricted Use Pesticide.

borax
A. Registration status of the requested pesticide (USEPA and host country). Borax products have been registered with the U.S. EPA since 1948 for uses such as cleaning, preserving organic materials such as wood and animal hide, and as a pesticide. Borax (Na2B4O7.10H2O) (CAS 1303-96-4) is classified by the EPA as an Inert Ingredient Permitted for Use in Nonfood Use Pesticide Products. There are several formulations of insecticide containing borax, such as Timbor (EPA Reg. Number 64405-8) which bears the signal word Caution. Borax has an insecticide resistance classification IRAC NSA (Non-Specific Action), and is a Toxicity Class III and IV insecticide bearing the signal word Warning and/or Caution. Borax has a 12h REI. The EPA has established no PHI because boron, the molecular form of borax, occurs naturally in higher levels than contained in borax spray.
B. Basis for selection of the requested pesticide and the proposed methods of application. Borax is a mild antiseptic fungicide/insecticide with a multi-site action. When added to fruit fly bait traps, it buffers the pH of the liquid food attractant such that the bait remains attractive longer. It was also selected for use in fruit fly protein bait traps for the purpose of preserving the fruit fly cadavers as they enter the trap and die (IAEA, 2003). By preserving the cadavers the fruit fly trap mixture maintains the appropriate pH for a longer period of time. Borax may also be tested as an adjuvant to Success Appat.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Borax will be used in bait traps to help maintain a pH balance that will allow the bait to remain effective for a longer period of time. As part of an IPM program this increase trap servicing intervals, as well as the quantities of material required throughout the program. As opposed to pheromone traps which only attract male flies, bait traps attract female flies. Their effect on future population growth can reduce the intensity of control efforts required later in the season and may reduce need for spray applications of pesticides. Borax will also be used as an addition to a spot treatment to make the spray more effective. The spray may also contain spinosad for trials to determine effectiveness as an attractant/insecticide.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Borax will be added in small quantities to bait traps or to sprays. No special protective measures are necessary for the proposed uses.
E. Acute and long-term toxicological hazards and risk avoidance. Toxicological information for Timbor Professional: Timbor Professional has a low acute toxicity (LD_{50} rat = 2,550mg/kg of body weight), a low acute dermal toxicity (LD_{50} rabbits > 2000 mg/kg of body weight. It is not a skin irritant or sensitizer and has low acute inhalation toxicity (LD_{50} rat > 2.0 mg/L) and is not considered an eye irritant under normal industrial use.
F. The effectiveness for the proposed use. Addition of borax slows down decomposition of fruit flies in bait traps. It also slows the acidification of feeding attractant broths, thereby extending their useful life.
G. Compatibility of the proposed pesticide with target & nontarget organisms. Boron, the elemental form of borax occurs naturally in fruits and vegetables and can be found in significant amounts in soil and water. It is practically nontoxic to birds, fish and aquatic invertebrates and relatively nontoxic to non-target insects (EPA R.E.D. Facts for boron, boric acid, and borax 1993).
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Borax is proposed for use in small amounts as an additive to fruit fly bait stations or a spot treatment spray in mango orchards of Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Borax is a low-toxicity substance possessing the required adjuvant properties. There are no preferred alternatives.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal.

(See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provision for monitoring the use and effectiveness. As a bait trap adjuvant, borax will be part of a standard trap preparation protocol. Its effectiveness will not be tested separately because it is already considered a standard part of effective bait trapping.
M. Mitigation of possible adverse effects. No adverse effects are expected. Borax will be used in very small volumes equal to or less than the amounts found naturally in fruits and vegetables (EPA R.E.D. Facts for boron, boric acid, and borax 1993).
N. Restricted Use Status. Borax is proposed for use as an adjuvant rather than active ingredient. Borax is not a U.S. EPA Restricted Use Pesticide.

cuelure (fruit fly sex attractant)
A. The registration status of the requested pesticide (USEPA and host country). Cuelure sex pheromone is registered in the U.S. (U.S. EPA Registration No. 81325-1). Cuelure is nontoxic and does not have a Toxicity Classification. Cuelure is acceptable for use in organic farming in the United States. Cuelure is not registered in Senegal. There are no fruit fly pheromones registered by the CSP for use in CILSS countries.
B. The basis for selection of the requested pesticide and the proposed methods of application. Cuelure is the sex attractant used to lure *Bactrocera cucurbitae* and numerous other species in the genus *Bactrocera*. Cuelure's chemical name is 4-(3-oxybutyl) phenyl acetate or alternately 4-p-acetoxyphenyl]-2-butanone). It is very similar to the natural pheromone released from a female fruit fly to attract males for mating. Synthetic formulas are more effective than natural ones. It is most commonly associated with fruit fly control. Cuelure sex pheromone is a safe and effective alternative to chemical sprays. There are no adverse effects to humans or the environment expected from formulations containing cuelure. Cuelure was selected as a pheromone lure in mango fruit fly traps for monitoring and controlling fruit fly populations while reducing synthetic chemical pesticide use. It is proposed for use in pheromone traps. Some traps may include the addition of chemical pesticides.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Cuelure pheromone is an excellent component for an IPM program. It is not a toxicant, but rather an attractant that attracts only males of a narrow species range. By attracting fruit flies to traps it provides effective control of target populations without requiring repetitive spraying of pesticides. There are several methods of using cuelure traps. One method is to use the traps for monitoring insects in order to determine the best time to use other methods of pest control. Another method, called male annihilation technique (MAT), is to impregnate the lures with small amounts of chemical pesticides in order to trap and kill males, removing them from the reproductive population.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Contingent upon approval, cuelure will be applied as small volatilizing capsules placed inside insect traps in mango orchards. Other methods include the use of cuelure impregnated sticky traps alone or together with a chemical pesticide. Cuelure capsules are non-toxic if ingested. Pheromone traps can physically eliminate flies by preventing their escape or kill flies outright by attracting them to a toxicant. PPE will be supplied by the program as needed.
E. Acute and long-term toxicological hazards and risk avoidance. The U.S. EPA determines that there are no hazards to mammals from oral, dermal, or inhalation exposure to cuelure. It is considered non-toxic. The acute oral LD_{50} for rats is 3038 mg/kg and the acute dermal LD_{50} for rabbits is >2025 mg/kg. There are no reports of allergic or other adverse toxicological effects from researchers, manufacturers, formulators or field workers from the use of cuelure.
F. The effectiveness for the proposed use. By attracting fruit flies to traps, cuelure provides effective control of target populations without requiring spraying of pesticides on the protected plants. This product is not a toxicant and does not kill the target insect.
G. Compatibility of the proposed pesticide with target & nontarget organisms. There is no anticipated harm to nontarget organisms. The species specificity of this pheromone means that is will attract only male fruit flies. Its deployment in capsules in traps means that potential exposure to other than volatilized molecules is small. Cuelure is toxic to fish (LC_{50} (24h) rainbow trout 21, bluegill sunfish 18 mg/L) but exposure of fish is extremely unlikely. It will have no nontarget effects beyond fruit flies in the genus *Ceratitis* and to some extent *Bactrocera*. Widespread use of pheromone traps will result in substantial reductions in synthetic chemical pesticide use. It is also accepted for use in organic farming.

H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Cuelure is proposed for use in fruit fly traps in mango orchards of Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Cuelure is the only substance used as a sex attractant for *B. cucurbitae*. There are no alternatives.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Assessing the effectiveness of this product is the objective of the proposed research.
M. Mitigation of possible adverse effects. Cuelure has a nontoxic mode of action. No adverse effects are anticipated.
N. Restricted Use Status. Cuelure is not a U.S. EPA Restricted Use Pesticide.

dichlorvos (DDVP)
A. Registration status of the requested pesticide (USEPA and host country). There are several formulations of dichlorvos registered with the U.S. EPA, such as ALCO No-Pest Strips (Registration No. 5481-338). Alco No-Pest Strips have a Toxicity Class III with the signal word Caution. In the United States many of the deployment methods for dichlorvos have been voluntarily canceled by the manufacturers (e.g. dog and cat pest collars and in indoor pest strips). Vaportape II Insecticidal Tape manufactured by Hercon Environmental is registered in the United States for use in fruit fly traps (EPA registration No. 8730-50). Vaportape II Insecticidal Tape (10% DDVP) is a Toxicology Class III insecticide with signal Word Caution. There are no agricultural registrations for dichlorvos by CSP. However, it is an active ingredient commonly found in household insect sprays sold in West Africa.
B. Basis for selection of the requested pesticide and the proposed methods of application. Dichlorvos is an aliphatic organophosphate with a high vapor pressure, which gives it strong fumigant properties. It is a cholinesterase inhibitor that acts as an insecticide and acaricide with inhalation, contact, and stomach action. It is used in agriculture as a spray or a soil fumigant. When formulated in a matrix, it acts as a slow-release insecticide. It is proposed in this project for use as a the killing agent in parapheromone traps for monitoring fruit fly populations for research or treatment decisions or for carrying out male annihilation technique (MAT) to reduce population fecundity..
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Using dichlorvos in small quantities in fruit fly traps is appropriate for a fruit fly IPM program. Dichlorvos for fruit fly control is usually formulated in a polyvinyl chloride matrix for slow release. This formulation is substantially safer than a liquid formulation and makes dermal and inhalation exposure much less likely. Handlers have very little exposure to dichlorvos when used in a plastic matrix formulation. When these plastic strips are used within a parapheromone trap, there is very little exposure of humans or the environment to dichlorvos. Quantities used per hectare is small, so handling risks are low. Commercially formulated wafers, such as those produced by Farmatech are sealed in envelopes, requiring no personal protective clothing until they are opened. Slow-release of pheromone and DDVP by these wafers extends replacement times and thereby reduces handling further. As part of an IPM program for monitoring or population management, fruit fly traps can reduce the volume of chemical insecticides used. Using sexual attractants and insecticides to trap fruit flies is a standard component of fruit fly IPM around the world. In places where spraying insecticides is a standard treatment, the correct IPM approach is to make treatment decisions based upon a pest population reaching an economic threshold. Monitoring male fruit fly populations with parapheromone traps makes it possible for insecticides treatments to be applied only when necessary rather than a routine basis. The result of using fruit fly traps is the reduced frequency and volume of pesticide applications.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Dichlorvos is proposed for application as an addition to parapheromone traps. Very small amounts will be used with extremely limited exposure to personnel. DDVP will be used as commercially formulated wafers combined with methyl eugenol sex attractant for male *Bactrocera invadens*. The project intends to use DDVP incorporated in reduced risk formulation, such as DDVP-impregnated plastic matrix. These reduced risk formulations are also control release formulations that extend the period of effectiveness of attract/kill traps before servicing is required. Sprayable formulations containing DDVP are commonly sold as household insect sprays in W. Africa. Research might be done on the effectiveness of these household sprays as a killing agent constrained in a trap.

A lure wafer contains 7g of DDVP. PPE for handling sprayable quantities of liquid dichlorvos in standard agricultural applications includes coveralls, long-sleeved shirt, chemical resistant gloves and boots and goggles. Using commercially prepared wafers requires only use of gloves. Packaging may be discarded in the trash. Lures may be disposed of in the trash after exhausting most of their DDVP (12-24 weeks). After a ten to twelve weeks of use, the project recommends allowing spent lures to de-gas in an open environment for another ten weeks before discarding

E. Acute and long-term toxicological hazards and risk avoidance.

Dichlorvos is a cholinesterase inhibitor in the form of a colorless liquid. It is highly toxic by inhalation, dermal absorption, and ingestion. It has an acute oral LD_{50}rat ≈ 50mg/kg, a percutaneous LD_{50}rat ≈ 224mg/kg, and an inhalation LC_{50}rat ≈ 230mg/m^3. Because dichlorvos is volatile, inhalation is the most common route of exposure. High environmental temperatures or exposure of dichlorvos to light may enhance its toxicity. Dichlorvos is mildly irritating to skin and concentrations of dichlorvos may cause burning sensations, or actual burns. Dichlorvos is proposed to be used in very small volumes posing very little risk to humans. Animal studies (rats, mice, rabbits) indicate that high chronic doses of dichlorvos can lead to benign tumor formation in various organs. In male rats, chronic exposure resulted in a higher incidence of leukemia, but not female rats (Carcinogenicity Potency Project.
http://potency.berkeley.edu/chempages/DICHLORVOS.html) and
Extoxnet http://extoxnet.orst.edu/pips/dichlorv.htm
For these reasons, dichlorvos is considered a possible human carcinogen.

F. The effectiveness for the proposed use.

Dichlorvos is an effective killing agent in fruit fly parapheromone traps because its high vapor pressure permits volatilization in concentrations that kill insects. Dichlorvos strips are commonly used as killing agents for fruit fly programs in the United States and other developed countries.

G. Compatibility of the proposed pesticide with target & nontarget organisms.

Dichlorvos is highly toxic to birds (oral LD_{50}≈12 mg/kg), fish (LC_{50} (96h) for rainbow trout = 200 µg /L) and aquatic organisms (daphnia LC_{50} (48h) = 0.19 µg/L). UV light makes dichlorvos 5 to 150 times more toxic to aquatic life. Dichlorvos does not significantly bioaccumulate in fish. It is highly toxic to bees with an acute oral LD_{50}bee ≈ 0.29µg/bee. Dichlorvos is proposed for use in commercially prepared pheromone traps in very small volumes where it is very unlikely to pose a risk to nontarget terrestrial or aquatic organisms.

H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils.

Dichlorvos will be used in a polymer matrix formulation combined with methyl eugenol in fruit fly parapheromone traps. This formulation drastically reduces the exposure risk of the product. These wafers are sealed until use and are contained within the trap during use. It will be used according to the label and is therefore, not expected to come in contact with the soils or water while active. When DDVP is placed in traps separately from the pheromone, it is still used in the form of insecticide impregnated polymer strips which pose relatively minor exposure risks.

I. Availability and effectiveness of other pesticides or nonchemical control methods.

DDVP is a commonly used insecticide for killing male fruit flies attracted to parapheromone traps because of its capacity to kill by vapor in small quantities. Nonchemical methods would not be effective.

J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal.

(See Section II B, Safe Use Action Plan)

K. Provisions made for training of users.

(See Section II A, Safe Use Action Plan)

L. Provision for monitoring the use and effectiveness.

Dichlorvos is part of a standard combination of products used for trapping fruit flies. It will be used to test the effectiveness of other control techniques.

M. Mitigation of possible adverse effects.

DDVP-impregnated pheromone lures pose very small risk of adverse effects. The greatest risk of exposure is to high concentrations of vapor and absorption of liquid by the skin. Controlled release wafers eliminate a liquid phase favoring fast volatilization or absorption by the skin. By

ensuring that all applicators and handlers are properly trained and adhere to label information, adverse effects to people and the environment can be avoided.
N. Restricted Use Status. Dichlorvos formulated in a controlled-release matrix is not a U.S. EPA Restricted Use Pesticide.

malathion
A. Registration status of the requested pesticide (USEPA and host country). Many formulas of malathion are registered with the U.S. EPA such as Gowan Malathion 8 (Registration No. 10163-21) and Malathion 5 (Registration No. 9779-5). Depending on the formulation it can be a Toxicity Class III or II, with the signal word Caution, or Warning respectively. It has an insecticide resistance classification IRAC 1B. In the U.S. malathion is registered for use on over 130 crops as well as public health spray programs for mosquito control and specifically for tephritid fruit fly control on citrus in Florida. Malathion sprays are registered by the CSP for locust control and cotton pests in CILSS countries, but not for mangoes. Fyfanon 880EC (880g a.i./L) manufactured by Cheminova is used for caterpillars on cotton. Its provisional sales authorization will expire in July 2009. Fyfanon 925UL (959g a.i./L) manufactured by Cheminova has a provisional sales authorization for locust and grasshopper control until July 2001. Maximal residue levels are currently permitted by the European Commission for mango imported into Europe.
B. Basis for selection of the requested pesticide and the proposed methods of application. Malathion is an organophosphate insecticide. It is a cholinesterase inhibitor with a non-systemic contact, stomach and inhalation modes of action. Malathion is a standard killing agent for use in parapheromone fruit fly traps. It is a stomach poison, contact poison, and inhalation poison. Its inhalation mode of action makes it effective for killing trapped fruit flies before they escape. It has also been widely used for emergency aerial spray programs when introduction of fruit flies of quarantine importance are detected. The proposed research use in the project is as a killing agent in fruit fly traps.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Malathion contained within a fruit fly trap can be an effective tool for an IPM program. When contained within a parapheromone trap, there is very little exposure of humans or the environment to malathion. Quantities per hectare are small, so handling risks are low. As part of an IPM program for monitoring or population management, fruit fly traps can reduce the volume of chemical insecticides used. Using sexual attractants and insecticides to trap fruit flies is a standard component of fruit fly IPM around the world. In places where spraying insecticides is a standard treatment, the correct IPM approach is to make treatment decisions based upon a pest population reaching an economic threshold. Monitoring male fruit fly populations with parapheromone traps makes it possible for insecticides treatments to be applied only when necessary rather than a routine basis. The result of using fruit fly traps is the reduced frequency and volume of pesticide applications.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Whether commercially formulated with sexual attractants (e.g. Malatrap) or mixed with fruit fly pheromones at trap preparation time according to standard trapping protocols used globally (IAEA, 2003), malathion is typically used in a 1:3 v/v ratio. Doses per trap are typically 10ml, meaning that each trap contains 2.5ml of malathion. With 8-10 traps per hectare for male annihilation treatment and up to fourteen trap servicing per season, the overall application rate is 350ml/ha/year. Senchim, a Senegalese pesticide formulating company has a 1:3 malathion/methyl eugenol product under development called Malatrap. It is packaged in 125ml bottles containing 31.25ml of 98% malathion. Milliliter quantities are applied with a dropper or syringe to absorbent material in the traps and replaced approximately every 14 days after the attractant and malathion have evaporated. The greatest spill risk is only 125ml. There is no disposal of liquid involved. PPE for handling the material should focus on avoiding exposure via the hands. Chemical resistant gloves are recommended..
E. Acute and long-term toxicological hazards and risk avoidance. Malathion is slightly toxic orally (oral LD_{50}rat ≈ 1000 mg/kg to > 10,000 mg/kg). It is also slightly toxic dermally (dermal LD_{50}rat > 4000 mg/kg). Effects of malathion are similar to those observed with other organophosphates; however, larger doses of malathion are required to produce these effects.

By ensuring that all applicators and handlers are properly trained and adhere to label information, adverse effects to people and the environment can be avoided. Steps will be taken to avoid application in adverse weather conditions and contact with irrigation systems not consistent with the label. PPE will be provided as necessary by the project for its on-station and on-farm research.
F. The effectiveness for the proposed use. Malathion is a commonly used insecticide for killing fruit flies attracted to parapheromone traps. It volatilizes and kills without contact, and it does not repulse flies.
G. Compatibility of the proposed pesticide with target & nontarget organisms. Malathion is moderately toxic to birds (LD_{50} (5d) bobwhite quail = 3500, ring-necked pheasants = 4320 mg/kg diet). Malathion has a wide range of toxicities in fish (LC_{50} (96h) for bluegill sunfish = 0.1mg/L, large-mouth bass = 0.28 mg/L). It is also toxic to bees (LD_{50} (topical) = 0.71µg/bee). Malathion is highly toxic to aquatic invertebrates and to the aquatic stages of amphibians. Because of its very short half-life, malathion does not bio-accumulate in aquatic organisms. The compound is highly toxic to honeybees. The proposed method will use a species specific sex pheromone to attract pests to the malathion bait station. Therefore, it is highly unlikely that it will enter the water-table or that any nontarget species or ecosystems will be affected by the pesticide.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Malathion will be used in mango fruit fly traps in mango orchards of Senegal. It will be purchased pre-packaged and contained within the pheromone traps.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Pheromone trapping is the preferred method to manage fruit flies. It avoids the need to spray malathion directly onto target crops and allows pest managers to monitor pest populations avoiding routine sprays of other chemicals.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Malathion is a standard toxicant for trapping fruit flies. Fruit fly trapping will be used to test the effectiveness of differing control techniques.
M. Mitigation of possible adverse effects. Malathion is proposed for use as a pre-packaged sticky trap or as an additive to a pheromone lure. No adverse effects are expected. By ensuring that all applicators and handlers are properly trained and adhere to label information, adverse effects to people and the environment can be avoided. Steps will be taken to avoid application in adverse weather conditions and contact with irrigation systems not consistent with the label. Protective clothing, including chemical resistant gloves, will be provided by the program, as necessary. Treatment areas will be closely monitored, not only for treatment efficacy, but also application according to the label.
N. Restricted Use Status. Malathion is not a U.S. EPA Restricted Use Pesticide

methyl eugenol sex pheromone
A. Registration status of the requested pesticide (USEPA and host country). Methyl eugenol is registered by the U.S. EPA (Registration No. 081325-00002). Methyl eugenol sex pheromone is Toxicity Class III – IV bearing the signal word Caution. Methyl eugenol is not registered in Senegal. There are no fruit fly pheromones registered by the CSP for use in CILSS countries.
B. Basis for selection of the requested pesticide and the proposed methods of application. Methyl eugenol is a sex attractant for males for many species of the genus *Bactrocera* (e.g. *B. invadens*) (IAEA, 2003). It is used in trapping programs to monitor fruit fly populations and to manage them without resorting to sprayed insecticides. Methyl eugenol is naturally occurring in many plants and essential oils and is a common flavoring ingredient added to foods, candy and gum. No harm to humans, nontarget organisms, or the environment is expected from use of this substance.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Methyl eugenol parapheromone is an excellent component of an IPM program. It, like other sex pheromones, can be used for monitoring, mass trapping (attraction – annihilation), and for mating disruption of target insects. When used for mass trapping, small amounts of synthetic chemicals will be placed in the trap along with the pheromones. Together they will attract and kill target pests (i.e. male mango fruit fly in Senegal). Both monitoring and mass trapping are used to measure when population densities have reached an economic threshold, or a point where the pest is expected to cause more damage than is economically acceptable. When a pest population reaches the economic threshold it elicits a treatment response. Pesticides are then used only when absolutely necessary and not on a routine basis with disregard to pest populations. The overall result of using pheromone lures is the reduced frequency and volume of pesticide applications. When used for mass trapping, methyl eugenol pheromone traps may be laced with traces of chemical pesticide to kill fruit flies that are lured into the trap. This is called the male annihilation technique (MAT) and is often used as part of a regional management plan.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Methyl eugenol will be incorporated into traps to monitor fruit flies. Traps will contain small volumes of synthetic chemical pesticides. Methyl eugenol requires no special protective equipment other than gloves. Personal protective equipment appropriate for the companion toxicant will be used.
E. Acute and long-term toxicological hazards and risk avoidance. Methyl eugenol has a slight acute oral (LD_{50rat} ≈810mg/kg) and dermal ($LD_{50rabbit}$ >5000 mg/kg) toxicity (http://www.inchem.org/documents/jecfa/jecmono/v16je11.htm). It is not toxic for acute inhalation toxicity, primary eye irritation, and primary skin irritation studies (Toxicity Class IV). Published literature suggests methyl eugenol is a dermal sensitizer. Therefore, precautionary statements were put on the label to warn users that, "Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals exposed to this product". Because methyl eugenol is placed within traps, no human contact is expected, except for loading traps. In addition, quantities per trap are miniscule. http://www.inchem.org/documents/jecfa/jecmono/v16je11.htm Beroza M, Inscoe MN, Schwartz PH Jr, Keplinger ML, Mastri CW. Acute toxicity studies with insect attractants. Toxicol Appl Pharmacol. 1975; 31:421–429.]
F. The effectiveness for the proposed use. Methyl eugenol is a popular attractant for numerous *Bactrocera* species. It will be used to lure male *Bactrocera invadens* to killing traps, providing effective monitoring of population densities. This product is non-toxic and does not kill the target pest.
G. Compatibility of the proposed pesticide with target & nontarget organisms. There is no anticipated harm to nontarget organisms. The species specificity of this pheromone means that it will attract only fruit flies. It will have no nontarget effects beyond fruit flies in the

genus *Bactrocera spp.* and to some extent *Ceratitis*. Widespread use of pheromone traps is expected to result in substantial reductions in synthetic chemical pesticide use.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Methyl eugenol is proposed for use as pheromone lures for the management and control of fruit flies in mango orchards in Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Methyl eugenol is the preferred control method because it avoids contact pesticide sprays. Pheromone traps are alternative control methods that, if successful, can substantially reduce the spraying of synthetic pesticides. A small amount of pesticide, (See Table 2) may be used in the tray itself, but this insecticide never comes in contact with crops.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provision for monitoring the use and effectiveness. Assessing the effectiveness of methyl eugenol is the objective of the proposed research.
M. Mitigation of possible adverse effects. No adverse effects are anticipated.
N. Restricted Use Status. Methyl eugenol is not a U.S. EPA Restricted Use Pesticide.

propylene glycol
A. Registration status of the requested pesticide (USEPA and host country). As an inert ingredient, propylene glycol facilitates delivery of formulated pesticide chemical products that are used as herbicides, fungicides, insecticides, growth regulators and attractants on various commodities. It has a U.S. EPA Toxicity Classification IV and is considered essentially non-toxic.
B. Basis for selection of the requested pesticide and the proposed methods of application. Propylene glycol is a fatty acid monoester. It is used in hospitals as a surface disinfectant for equipment and materials. As a pesticide, it can be used to control fungi, bacteria, and mites. As an inert ingredient, propylene glycol facilitates delivery of formulated pesticide chemical products that are used as herbicides, fungicides, insecticides, growth regulators and attractants on various commodities. In fruit fly bait traps using liquid attractants, it serves to slow evaporation and to preserve drowned fly cadavers for research.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Fruit fly bait stations are used for population monitoring and mass trapping. The result of using pheromone and protein baits is the reduced damage from fruit flies and reduction or elimination of spray applications.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Propylene glycol will be incorporated into traps to preserve the trap materials for the monitoring of mango fruit flies. Some traps may contain small volumes of pesticides (See Table 2), for mass trapping. PPE will be supplied by the project as needed.
E. Acute and long-term toxicological hazards and risk avoidance. Propylene glycol has a low toxicity profile and is practically nontoxic orally (LD_{50} rat 8000-46000 mg/kg). It is not an eye irritant nor is it a skin irritant. There are several different forms that can be used. For this program the inert form will be used as an adjuvant in bait traps to reduce evaporation of liquid feeding attractant.
F. The effectiveness for the proposed use. Propylene glycol is a food-grade adjuvant effective at reducing evaporation of liquid food attractants in bait traps.
G. Compatibility of the proposed pesticide with target & nontarget organisms. There is no expected harm to nontarget organisms. Widespread use of protein bait traps are expected to result in substantial reductions in synthetic chemical pesticide use.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Propylene glycol will be added in small quantities to bait traps. Its nontoxic nature poses no risk to the environment.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Bait and pheromone traps are an alternative fruit fly management method that, if successful, can reduce economic damage to Senegal's mango sector and substantially reduce the spraying of synthetic pesticides.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Propylene glycol is a well known standard component of bait trapping with liquid feeding attractants. There are no provisions for monitoring its effectiveness.
M. Mitigation of possible adverse effects. The propylene glycol used in this study is an inert ingredient, there are no adverse effects expected.
N. Restricted Use Status.

Propylene Glycol is not a U.S. EPA Restricted Use Pesticide

protein hydrolysate
A. Registration status of the requested pesticide (USEPA and host country). Protein hydrolysate is not a pesticide and is therefore not registered with the U.S. EPA. Hydrolyzed proteins are used as food additives for many sauces and protein drinks. Aside from common use as protein bait in fruit fly traps, protein hydrolysate is also used as a medium broth for bacterial growth in laboratories. Its use as a bait does not require registration in Senegal.
B. Basis for selection of the requested pesticide and the proposed methods of application. Protein hydrolysate is a protein bait attractant for male and female tephritid fruit flies. It is listed in Title 21 of the Code of Federal Regulations (21CFR573.200) as a food additive. It comprises amino acids and peptides from animals or vegetables and is commonly used in protein drinks for bodybuilding. It has been selected for use as protein bait in fruit fly traps for population monitoring and/or control measures. As opposed to pheromone traps which only attract male flies, bait traps also attract female flies. In McPhail style traps, it is made into a liquid broth that drowns trapped flies without use of an insecticide.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Bait trapping is a standard component of fruit fly IPM around the world. In population monitoring programs, protein hydrolysate provides population information on female reproductive state that parapheromone traps cannot. Their effect on future population growth can reduce the intensity of control efforts required later in the season and may reduce need for spray applications of pesticides. When spraying insecticides is a standard treatment, the correct IPM approach is to make treatment decisions when pest population reach an economic threshold. Monitoring fruit fly populations with parapheromone or bait traps makes it possible for insecticides treatments to be applied only when necessary rather than a routine basis. The result of using protein baits is the reduced frequency and volume of pesticide applications.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. The basin of McPhail or improved McPhail fruit fly traps are filled with aqueous suspension of protein hydrolysate or torula (400- 1200ml depending upon trap). McPhail type traps have a yellow funnel opening at the bottom of the trap into which flies are drawn by odor. Flies then drown when they contact the liquid in the bottom of the trap. Adjuvants may be added. Propylene glycol reduces evaporation of the bait mixture to increase servicing periods. It also slows decomposition of some amino acids, and helps preserve cadavers for identification. Borax is also commonly used as an adjuvant to slow the acidification of bait and also as a cadaver preservative for research.
E. Acute and long-term toxicological hazards and risk avoidance. Protein hydrolysate is non-toxic. It is approved for use as a food additive. It may be an eye or skin irritant.
F. The effectiveness for the proposed use. Protein hydrolysate is an effective attractant for fruit fly bait traps.
G. Compatibility of the proposed pesticide with target & nontarget organisms. Protein hydrolysate is a nontoxic food additive. There is no expected substantive harm to nontarget organisms. Protein hydrolysate itself poses no risk to the environment. In comparison to parapheromone traps which are very host-specific, bait traps will attract some nontarget insects. Widespread use of protein bait traps are expected to result in substantial reductions in synthetic chemical pesticide use.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Bait traps are placed in fruit fly habitat – typically orchards, but might also be placed in native forest habitats in Basse Casamance where mango trees grow wild.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Bait trapping using protein hydrolysate is a nonchemical method of pest management.

J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Protein hydrolysate bait traps will be used for population monitoring and for monitoring the effectiveness of other control techniques. It is a well-known component of fruit fly trapping programs.
M. Mitigation of possible adverse effects. There are no adverse effects expected. Some non-target insects that feed on decomposing organic material (e.g. flies and beetles) will be attracted to protein traps.
N. Restricted Use Status. Protein hydrolysate is not regulated as a pesticide.

rotenone
A. Registration status of the requested pesticide (USEPA and host country). Rotenone is a commonly used piscicide in the United States (Prentox U.S. EPA Registration No. 655-691). Rotenone was registered by the U.S. EPA in 1988 for many uses including the management of fleas on dogs and cats in households and was often used by organic growers, but there are no certified organic uses presently. Due to voluntary requests by producers to cancel registrations of rotenone products, it underwent review in 2007. On March 31, 2007, it was certified for re-registration only as a piscicide. It is a Toxicity Class I and III insecticide with variable signal words from Danger and Poison to Caution, depending on formulation. Rotenone is not registered as an insecticide by CSP.
B. Basis for selection of the requested pesticide and the proposed methods of application. Rotenone is an extract of the leaves, roots or seeds of several species of plants in the Leguminosae (e.g. *Tephrosia vogelii*, *Derris elliptica*, *Lonchocarpus nicou*) that can be used as an insecticide or fish poison. Rotenone has been used in commercial agriculture prior to the 1940's (Ware & Whitacre, 2004). It has contact and ingestion toxicity in insects. Rotenone interferes with the electron transport system in the mitochondria, thereby inhibiting cellular respiration. Rotenone is proposed for research by the project because Senchim, a local pesticide formulation company, is developing a methyl eugenol/rotenone fruit fly product for use in organic mango production in place of its methyl eugenol/malathion product. Rotenone is Senchim's botanical insecticide of choice because of its ability to kill insects by inhalation (Leseuer, pers.comm.).
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Rotenone is a reasonable choice for a botanical toxicant in parapheromone traps to replace synthetic pesticides such as malathion. Rotenone is more toxic orally, dermally, and by inhalation than malathion, but a malathion cannot be used in fruit fly traps in organic mango production, even though it would have no contact with fruits. Rotenone breaks down rapidly in sunlight, water, or soil. This product will be used conservatively with only 10ml per trap. At a concentration of 6.6g a.i./L, the amount of rotenone used per trap will be 66mg/trap. The manufacturer's recommended dose is 8 traps/ha for a total application rate of 528mg a.i. /ha.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Rotenone in a 6.6% formulation will be used in very small volumes (10ml per trap) in fruit fly bait stations in the mango orchards of Senegal. Standard PPE must be worn when mixing, loading, applying, or cleaning up. PPE for this product is long-sleeved shirts and pants, chemical resistant gloves, shoes and socks. PPE will be provided as necessary by the project for its on-station and on-farm research.
E. Acute and long-term toxicological hazards and risk avoidance. Rotenone is toxic to highly toxic orally in rats, depending on sex (rat acute oral toxicity $LD_{50\ male} \approx$ 102mg/kg, $LD_{50\ female} \approx$ 39.5 mg/kg). In humans a 95%-98% the oral LD50 is estimated at 143mg/kg (http://www.sigmaaldrich.com/MSDS/MSDS/DisplayMSDSPage.do) to as high as 300 to 500mg/kg (Hays, 1991 in Extoxnet Pesticide information Profile http://extoxnet.orst.edu/pips/rotenone.htm Spray or powder particles are highly toxic to rats by inhalation, depending on sex (acute inhalation toxicity (4 hour) $LC_{50\ female} \approx$ 0.0194 mg/L, $LC_{50\ male} \approx$ 0.0235 mg/L). It is practically nontoxic dermally ($LD_{50\ rabbit}$ > 5000 mg/kg). It is not an eye or skin irritant, but it is a skin sensitizer (pigs). Poisoning effects include conjunctivitis, dermatitis, sore throat, congestion, depression, and convulsions. Standard PPE should be worn when mixing, loading, and applying any product. By ensuring that all applicators and handlers are properly trained and adhere to all label information, adverse

effects to people and the environment can be avoided.

F. The effectiveness of the requested pesticide for the proposed use.
Rotenone is effective against the mango fruit fly. It is proposed to be tested under local conditions in pheromone bait stations with protein or pheromone baits such as methyl eugenol.

G. Compatibility of the proposed pesticide with target and nontarget organisms.
Rotenone is slightly toxic to birds ($LD_{50\ mallards}$ > 2000 mg/kg) and extremely toxic to fish (LC_{50} (96h) $_{rainbow\ trout}$ = 1.9 µg/L, $LD_{50\ bluegill\ sunfish}$ = 4.9 µg/L). It is nontoxic to bees. Rotenone breaks down quickly in the soil and water and its half-life is 1-3 days. It has not been demonstrated to have carcinogenic effects on laboratory animals. This chemical is a highly active but short-lived photosensitizer. It is a non-residual pesticide. It breaks down quickly in sunlight such that evening application is recommended when possible.

H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils.
Contingent upon approval, rotenone will be used in mango fruit fly bait stations in mango orchards in Senegal.

I. Availability and effectiveness of other pesticides or nonchemical control methods.
Rotenone is effective against the mango fruit fly. Other control methods are available, however, Senchim, a local/regional chemical company is replacing its methyl eugenol/malathion product with a methyl eugenol/rotenone product. Conducting research to compare this combination with other combinations is important as this product is entering the local market.

J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal.
(See Section II B, Safe Use Action Plan)

K. Provisions made for training of users.
(See Section II A, Safe Use Action Plan)

L. Provisions made for monitoring the use and effectiveness.
Evaluating the effectiveness of rotenone in pheromone bait traps will be done by comparing to traps serviced with a pheromone/malathion cocktail.

M. Mitigation of possible adverse effects.
Rotenone induces vomiting in mammals, which reduces the probability of obtaining a lethal dose. Inhalation of dust is particularly hazardous and should be avoided. Its proposed use in a non-sprayed liquid form mitigates the inhalation toxicity. Bio-attrap is proposed for sale by the manufacturer in a 250ml bottle. The experimental formulation contains 6.6% w/v of rotenone for a total of 1.65g of active ingredient per 250ml bottle. At the lowest estimated LD50 for humans (143mg/kg), a 250ml bottle of Bio-atrap would contain a potentially lethal dose for an 11.5kg child. At the highest LD_{50} of 500mg/kg, a bottle would not contain a fatal dose for a child. Adults would have little risk of accidental poisoning in the handling of the product. By ensuring that all applicators and handlers are properly trained and through adherence to all label instructions, adverse effects can be avoided. The most important mitigating factor is ensuring that the product is stored safely away from children. Risk to children will be mitigated by recommending to the manufacturer that the product be offered in 125ml bottles like its Malatrap product. Rotenone has high toxicity to aquatic organisms, but its proposed method of application makes contact with surface water highly unlikely.

N. Restricted Use Status.
Rotenone is classified by the U.S. EPA as a Restricted Use Pesticide due to acute inhalation, acute oral, and aquatic toxicity.

Reference: http://gears.tucson.ars.ag.gov/book/chap9/tephrosia.html
http://www.pan-uk.org/pestnews/Actives/rotenone.htm
http://extoxnet.orst.edu/cgi-webglimpse/webglimpse.cgi?ID=1&query=rotenone&case=on
http://www.nysaes.cornell.edu/pp/resourceguide/mfs/11rotenone.php

Success Appat (GF-120 Naturalyte Fruit Fly Bait)
A. Registration status of the requested pesticide (USEPA and host country). GF-120 Naturalyte Fruit Fly Bait containing spinosad 2.4 g/l. is registered in the United States (EPA Reg. Number 62719-498). It is produced by Dow AgroSciences. In May 2008 the *Comité Sahelien des Pesticides* (CSP) gave it a three-year provisional sales authorization (APV) for use in fruit fly management on mangoes in the nine CILSS countries including Senegal under the name Success Appat 0.24 CB. It is has toxicity class IV. GF-120 is authorized by OMRI for organic production. It has an insecticide resistance classification IRAC 5. Authorization to use Spinosad, the active ingredient in GF-120, is also being requested for research purposes.
B. Basis for selection of the requested pesticide and the proposed methods of application. Success Appat is a mixture of plant proteins, sugars, and plant extracts (99.98%) which serve as an attractant for male and female tephritid fruit flies. It contains a very small volume of spinosad (0.02%) as a toxicant. (See table on spinosad as an independent active ingredient). Success Appat is Toxicity Class IV. It was selected because it is the only product currently authorized by CSP for use in managing fruit flies. It is used as a foliar spray. Because Success Appat is attractive to fruit flies, spot application is frequently used. In spot application, material is applied to a portion of a tree, sometimes skipping trees or skipping rows between applications.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Success Appat can be used as both a foliar spray for spot treatment and a protein bait station attractant/toxicant for monitoring fruit fly populations, or when used with many traps as a management technique. Its low impact on non-targets and novel mode of action make it appropriate for incorporation in IPM programs. It can be used in both conventional and organic production. This product has the potential to reduce both frequency and volume of pesticide applications compared to other insecticides used on mangoes, protecting both the people and the environment.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Success Appat is often applied as a sprayed spot treatment to a $1m^2$ area of mango foliage. It attracts and kills both male and female fruit flies. Standard PPE must be worn when mixing, loading, applying, or cleaning up. PPE for this product is long-sleeved shirts and pants, chemical resistant gloves (only upon early re-entry), shoes and socks.
E. Acute and long-term toxicological hazards and risk avoidance. GF-120 is practically nontoxic to humans with an acute oral LD_{50} rats >5000 mg/kg, and dermal LD_{50} rabbits >5000mg/kg. It has a low toxicity if swallowed, but it is an eye, skin and inhalation irritant.
F. Effectiveness of the requested pesticide for the proposed use. Success Appat is an effective fruit fly bait. This study will investigate its effectiveness as an IPM management tool for mango fruit fly populations in mango orchards of Senegal.
G. Compatibility of the proposed pesticide with target & nontarget organisms. Success Appat is practically nontoxic to fish (LC_{50} > 100mg/L to most sensitive species), slightly toxic to birds, and moderately toxic to aquatic organisms. It should be used with caution when bees are foraging and should not contaminate water.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Success Appat will be used in fruit fly bait stations or as a spot treatment spray in mango orchards of Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Because of its low toxicity, Success Appat is the preferred method when a toxicant is required. This study will compare it with fruit fly bait stations containing other chemical pesticides (all listed in this document) for efficacy.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)

K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Success Appat will be compared against conventional sprays. It will also be compared to a mixture of Success Appat and a yellow colorant to test whether colorant provides additional attractiveness.
M. Mitigation of possible adverse effects. Success Appat will be used according to the label. All necessary PPE will be provided by the project as necessary.
N. Restricted Use Status. GF-120 Naturalyte Fruit Fly Bait, the U.S. product name for Success Appat, is not a U.S. EPA Restricted Use Pesticide.

spinosad (Conserve, Entrust, SpinTor, Tracer)
A. Registration status of the requested pesticide (U.S. EPA and host country). Spinosad is registered as eight formulations of eight brand name products in the United States by Dow Chemical (e.g. SpinTor, Registration No. 62719-294; Entrust, Registration No.62719-282). It is a Toxicity Class III and IV insecticide, depending upon formulation. Class III formulations carry the signal word Caution. Class IV formulations carry no signal word. Spinosad is the active ingredient in Success Appat, which is the only insecticide registered for fruit fly control on mangoes in Senegal. LASER-480 SC (spinosad 480 g/L a.i.) by Dow AgroSciences is registered for use in CILLS countries against the cotton bollworm on tomato and green bean.
B. Basis for selection of the requested pesticide and the proposed methods of application. Spinosad is a nicotinic acetylcholine receptor agonist (IRAC Class 5) derived from the fermentation product of bacterial metabolism. Spinosad acts by altering the function of nicotinic- and GABA-gated nerve cell ion channels of insect nervous systems, leading to neuromuscular exhaustion. Spinosad does not cross-react with binding sites for other nicotinic- or GABA-agonistic insecticides. The binding sites of spinosad are apparently not shared with mammals, resulting in very low mammalian toxicity. The main reason for choosing this product is the low level of toxicity for mammals and its low persistence in the environment. This means there is less of a risk for farmers. Another criterion in choosing this product is that it is an ingestion product, which will allow for the control of larvae during the early stages of development of the insects. Therefore, it can be used in rotation with other insecticides.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Spinosad is an insecticide approved for organic production systems. It is a preferred chemical for IPM programs. In the fruit fly project, it will most commonly be used in a commercially formulated protein bait spray. (See Success Appat), but may also be used as a liquid for research comparisons, or as a reduced risk blanket spray when pest pressure is very high.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Spinosad may be applied as a foliage spray treatment. For fruit fly control it is usually combined with a bait attractant to reduce the surface that must be sprayed. Standard PPE must be worn when mixing, loading, applying, or cleaning up. PPE for this product is long-sleeved shirts and pants, chemical resistant gloves (when prolonged contact is expected), shoes and socks. PPE will be provided as necessary by the project for its on-station and on-farm research.
E. Acute and long-term toxicological hazards and risk avoidance. Spinosad has low acute oral toxicity (oral LD_{50} rat from 3738 to >5000 mg/kg depending upon formulation), and practically non-toxic dermally (dermal LD_{50} rabbits > 5000 mg/kg). It is moderately toxic through inhalation (LC50 rat (4h) >5mg/L). PPE should be worn when mixing, loading, and applying any product. By ensuring that all applicators and handlers are properly trained and adhere to all label information, adverse effects to people and the environment can be avoided. The product must be applied such that it cannot be carried into bodies of water as irrigation runoff. Tank mixes and clean-up rinsate must not enter bodies of water or be disposed of near wells.
F. Effectiveness of the requested pesticide for the proposed use. Spinosad is effective against thrips.
G. Compatibility of the proposed pesticide with target and nontarget ecosystems. Spinosad is highly toxic to aquatic organisms ($LC_{50\ Daphnia}$ =97.2 mg/L) and fish (LC_{50} (96h) bluegill sunfish 5.9 mg/L). It is moderately toxic to birds (LD_{50} mallard ducks >2000 mg/kg). Spinosad is toxic to bees (topical LD_{50} (48h) 0.0029 µg/bee) for up to three hours of applications and caution should be exercised to avoid application when bees are foraging although residues once dry have little effect on them. Applications should be conducted with special care to avoid contaminating water sources. Because spinosad strongly binds to soil particles giving it low soil mobility, it is unlikely to leach into groundwater.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils.

Spinosad will be used as the killing agent in sprayed bait formulations or impregnated pheromone blocks placed in fruit tree orchards in the course of research for reduced risk methods to manage fruit flies.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Spinosad is a reduced risk pesticide that is commercially formulated as the fruit fly attractant/insecticide Success or GF-120. Although it has a broad spectrum it has a very narrow spectrum when combined with a feeding attractant. The feeding attractant makes it possible to use very small quantities of insecticide sprayed over small areas instead of doing blanket spraying.
J. Requesting country's ability to regulate or control the distribution, storage, use and disposal. (See Section II B, National Pesticide Regulation)
K. Provisions made for training of users. (See Section IIA, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Spinosad is the active ingredient of Success Appat. Success is registered and its efficacy is not in question. The effectiveness of Success in consideration of dose, distance between spot treatments, and contribution of adjuvants may be tested as well as its effectiveness in combination with other fruit fly management techniques.
M. Mitigation of possible adverse effects. The primary mitigating action is ensuring applicators are properly trained in safe use and have knowledge about proper use of the specific product. Spinosad is a reduced risk pesticide with low probability of adverse effects compared to more toxic conventional chemicals.
N. Restricted Use Status. Spinosad is not a U.S. EPA Restricted Use Pesticide

terpinyl acetate
A. Registration status of the requested pesticide (USEPA and host country). Terpinyl acetate is considered an inert ingredient of pesticide products by the EPA (EPA CAS Number. 10235-63-9). It has been approved by the Joint FAO/WHO Expert Committee on Food Additives as a flavoring agent according to Report TRS 891-JECFA 51/79. Terpinyl acetate is nontoxic so it does not have a Toxicity Classification. It is not a pesticide and is therefore not registered with the U.S. EPA as a pesticide. Terpinyl acetate is not registered in Senegal. There are no fruit fly pheromones registered by the CSP for use in CILSS countries.
B. Basis for selection of the requested pesticide and the proposed methods of application. Terpinyl acetate is a synthetic pheromone (parapheromone) used as a lure to attract *Ceratitis* fruit flies. It has been selected for use as a chemical lure in mango fruit fly traps for monitoring and controlling fruit fly populations while reducing pesticide spray applications.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Parapheromone traps can be used to monitor fruit fly populations or to manage population through Male Annihilation Technique (MAT) – restricting female fecundity by removing nearly all males the breeding population. Using parapheromone traps to monitor populations, time control measures, or directly manage fruit fly populations can reduce the volume of chemical pesticides applied.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Terpinyl acetate will be used in parapheromone traps in fruit fly habitats in Senegal, primarily mango orchards. Required PPE is determined by the pesticide used in combination with the attractant.
E. Acute and long-term toxicological hazards and risk avoidance. Terpinyl acetate is a non-toxic fragrance and/or food flavoring. It has been listed on the FMA Fragrance Ingredient Database as an inert ingredient in pesticide products as of April 16, 2007. It is listed in Title 21 of the Code of Federal Regulations (21CFR172) as a food additive. Terpinyl acetate can be irritating to the eyes and to the skin. Because terpinyl acetate is placed within traps, no human contact is expected, except for loading traps. Quantities per trap are less than 10ml.
F. The effectiveness for the proposed use. Terpinyl acetate is a sexual attractant that lures male *Ceratitis cosyra* to traps. It is not a killing agent. Parapheromone traps provide an effective means of monitoring of pest population densities. Parapheromone traps can also be used in male annihilation Technique (MAT).
G. Compatibility of the proposed pesticide with target & nontarget organisms. There is no anticipated harm to nontarget organisms. The species specificity of this pheromone means that is will attract only *Ceratitis* fruit flies. Widespread use of parapheromone traps is expected to result in substantial reductions in synthetic chemical pesticide use.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Terpinyl acetate is proposed for use as pheromone lures for the management and control of fruit flies in mango orchards in Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Terpinyl acetate is the preferred control method because it avoids contact pesticide sprays. Pheromone traps are an alternative control method that, if successful, can substantially reduce the spraying of synthetic pesticides. A small amount of pesticide, (See Table 2) may be used in the traps.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provision for monitoring the use and effectiveness.

Terpinyl acetate is the standard sex attractant for *Ceratitis cosyra* and a number of other *Ceratitis* species. Its effectiveness is not in question. It will be used for population monitoring to evaluate effectiveness of other treatments.
M. Mitigation of possible adverse effects. No adverse effects are anticipated.
N. Restricted Use Status. Terpinyl acetate is not considered a pesticide by the U.S. EPA.

torula
A. Registration status of the requested pesticide (USEPA and host country). Torula, or torula yeast, is not a pesticide; it is a food based fruit fly attractant and is therefore not registered with the U.S. EPA as a pesticide. It is not registered in the host country for the same reason. Torula is a nontoxic food additive and it does not have a U.S. EPA Toxicity Classification. Registration in Senegal is not required for use.
B. Basis for selection of the requested pesticide and the proposed methods of application. Torula is a protein made from yeast that is cultured on wood or fruit products. It is a natural protein that can be used as medicine or as a food additive and is often used in fruit fly protein bait traps as a general fruit fly lure. It has been selected for use as protein-based feeding attractant for trapping mango fruit flies.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Like other protein baits, totula can be used for monitoring and mass trapping of fruit flies. Torula, when compared to hydrolyzed protein, is expected to be more effective over time because it maintains a stable pH and therefore continues to attract fruit flies after hydrolyzed protein has lost effectiveness. As opposed to pheromone traps which only attract male flies, bait traps attract female flies. Their effect on future population growth can reduce the intensity of control efforts required later in the season and may reduce need for spray applications of pesticides. Monitoring programs with traps are used to measure when population densities have reached an economic threshold, or a point where the pest is expected to cause more damage than is economically acceptable. When a pest population reaches the economic threshold it elicits a treatment response. If pesticides sprays are used, trap monitoring programs allow treatment to be reserved for when they are necessary. The expected result of using protein baits in intensively managed orchards is the reduced frequency and volume of pesticide applications.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. The basin of McPhail or improved McPhail fruit fly traps are filled with aqueous suspension of torula (400- 1200ml depending upon trap). McPhail type traps have a yellow funnel opening at the bottom of the trap into which flies are drawn by odor. Flies then drown when they contact the liquid in the bottom of the trap. Adjuvants may be added. Torula for fruit fly monitoring are often sold a pellets containing borax. Borax slows the acidification of the bait and also as a cadaver preservative for research. Use of torula requires no safety equipment.
E. Acute and long-term toxicological hazards and risk avoidance. Torula has a non-toxic mode of action and is approved for use as a food additive. It may be an eye or skin irritant.
F. The effectiveness for the proposed use. Torula is an effective fruit fly bait and is a standard component for fruit fly monitoring programs.
G. Compatibility of the proposed pesticide with target & nontarget organisms. Torula is a nontoxic protein and amino acid mixture and poses no risk to the environment. There is no anticipated harm to nontarget organisms from the substance itself. Bait traps will be used in fruit fly habitat – typically orchards, but might also be placed in native forest habitats in Basse Casamance where mango trees grow wild. Compared to parapheromone traps which are very host-specific, bait traps attract some nontarget insects.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. Torula will be used in mango fruit fly bait stations in mango orchards in Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Torula as a fruit fly protein bait is the preferred method. The use of bait traps has the potential to reduce chemical pesticide application and economic damage.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)

K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Bait traps containing torula will be used for population monitoring and for monitoring the effectiveness of other control techniques.
M. Mitigation of possible adverse effects. Because torula has a nontoxic mode of action, no adverse effects are anticipated.
N. Restricted Use Status. Torula is not regulated as a pesticide.

trimedlure
A. Registration status of the requested pesticide (USEPA and host country). According to the U.S. EPA, if trimedlure is the sole active ingredient, it does not need to be registered for incorporation into end-use products intended for use in traps to attract and kill fruit flies. It is classified by EPA as a biochemical pesticide. The technical grade product may also be used alone in traps and lures without further registration requirements, in accordance with 40 CFR 152.25(b). Trimedlure is a Toxicity Class III biochemical pesticide bearing the signal word Caution. Trimedlure is not registered in Senegal. There are no fruit fly pheromones registered by the CSP for use in CILSS countries.
B. Basis for selection of the requested pesticide and the proposed methods of application. Trimedlure is a synthetic compound that mimics naturally occurring substances of insect origin and functions by a non-toxic mode of action. It is the parapheromone used to trap Mediterranean fruit fly *Ceratitis capitata*. No harm is expected from use of this substance in pesticide products when used according to instructions. It is proposed for use in fruit fly baits to monitor and/or control fruit fly populations in Senegal. It is considered safe for human health, the environment and preserving invertebrate biodiversity.
C. Extent to which the proposed pesticide is part of an Integrated Pest Management program. Trimedlure pheromone is an a required component for an IPM program for Mediterranean fruit fly. By attracting fruit flies to traps where they are killed by small amounts of insecticide, tri-med-lure makes population monitoring possible. Trimedlure can also be used for population control. When high concentrations of parapheromone traps are used for MAT, blanket spraying of insecticides can be avoided.
D. Proposed method or methods of application, including availability of appropriate application and safety equipment. Trimedlure will be incorporated into traps for the monitoring of mango fruit flies. Some traps may contain small volumes of synthetic chemical pesticides (See Table 2) for mass trapping. PPE will be supplied by the project as needed.
E. Acute and long-term toxicological hazards and risk avoidance. is practically nontoxic orally (LD_{50} rat >4556 mg/kg) and a slight dermal toxicity (LD_{50} rat >2025 mg/kg). It is non-toxic through inhalation (LD_{50} rat >2.9ml/L) and is a slight eye and skin irritant.
F. The effectiveness for the proposed use. Trimedlure the only parapheromone lure for male *Ceratitis capitata*.
G. Compatibility of the proposed pesticide with target & nontarget organisms. is accepted for use in organic farming. It is not known to cause significant adverse effects on non-target organisms or to have had an adverse environmental impact. The U.S. EPA determined that as an arthropod pheromone which will be used in retrievable dispensers it will have limited exposure to nontarget organisms. Furthermore, the low toxicity of this compound will limit the possibility of adverse ecological effects resulting from use. As a result, no environmental effects data were deemed necessary for hazard identification, and were therefore waived.
H. Conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils. is proposed for use in fruit fly bait traps in mango orchards located in Senegal.
I. Availability and effectiveness of other pesticides or nonchemical control methods. Trimedlure is the only parapheromone capable of attracting male *Ceratitis capitata*. There are no alternatives.
J. Requesting country's ability to regulate or control the distribution, storage, use, and disposal. (See Section II B, Safe Use Action Plan)
K. Provisions made for training of users. (See Section II A, Safe Use Action Plan)
L. Provisions made for monitoring the use and effectiveness. Assessing the effectiveness of trimedlure is the objective of the proposed research.
M. Mitigation of possible adverse effects.

Because trimedlure has a non-toxic mode of action, no adverse effects are expected.
N. Restricted Use Status. Trimedlure is not a U.S. EPA Restricted Use Pesticide.

Sources for materials profiles unless otherwise noted:

Manufacturer labels. U.S. EPA registered products and MSDS available at the CDMS Agrochemical database http://www.cdms.net/

The Pesticide Manual: A World Compendium, 14th Edition; Editor E. D. S. Tomlin; 2006 BCPS. (British Crop Protection Council), Published by BCPC, UK; ISBN 1 901396 14 2

ExToxNet http://extoxnet.orst.edu/

National Pesticide Information Retrieval System (NPIRS) in collaboration with Purdue University: http://ppis.ceris.purdue.edu/htbin/ppisprod.com

U.S. EPA pesticide website: http://www.epa.gov/pesticides/

II. Safe Use Action Plan

A. Safe Use Action Plan

Training

For research trials, all applicators and handlers will be properly trained and will observe all advisory information according to pesticide labels. Personal protective equipment (PPE) will be provided by the project for carrying out research. Agents will be trained in proper use of any pesticides they use. The IPM CRSP West Africa program hosts a web site for pesticide safety training (http://www.wapp.biochem.vt.edu/). These the training materials in these eleven modules (http://www.wapp.biochem.vt.edu/en/17a-educators-training.html) will be used for training within the project and shared with cooperating entities to trainer growers. In order to promote pesticide safety among mango growers, the project is cooperating with projects such as SAGIC, grower groups such as COOPROFEL, ONAPES, and APRAN, non-governmental organizations such as CARE/Senegal to ensure growers receive proper safety training in pesticide application. The IPM CRSP already has the pesticide safety training curriculum available in Wolof, Wolof Hal, Pulaar and Arabic. During the mango project, it will be turned into Diola Foni, Serer, and Pulaar Fuladou. This curriculum will be promoted for use by grower groups and NGOs.

Spray applications will not be made during adverse weather that would facilitate drift of residue runoff or in a manner that poses a threat to waterways or irrigation systems. PPE will be provided as necessary by the project for all IPM CRSP research. The project coordinator, Larry Vaughan, and the national coordinator, Kemo Badji, have responsibility to ensure proper training is given, proper application is respected, and good pesticide stewardship is observed.

Planned research on large-scale plantations: includes comparing trapping programs or Success Appat with conventional blanket sprays currently used by large growers. Only large orchards in Senegal use substantial amounts of insecticides. In order to validate new techniques such as spot treatment with Success Appat or male annihilation technique (MAT) with parapheromone traps to compare them with conventional pesticides, we must work in fruit plantations where these insecticides are used. Some of these pesticides are very toxic broad-spectrum pesticides such as chlorpyriphos methyl, and lannate. Chemicals applied as blanket sprays by large-scale growers in Senegal for controlling fruit flies or other insect pests such as thrips are not being recommended for research in the project. Our objective is to test whether such products can be replaced with less toxic alternatives and achieve equivalent or superior results. The conventional treatments will be applied by orchard workers. The project is not in a position to choose the conventional products used by large growers. It can give and will give recommendations to improve application safety and environmental protection. The interventions of the project will not increase exposure of workers to the pesticides already being used by large-scale growers. In choosing orchards for participation in field trials we may use knowledge from the owner of the anticipated conventional products that will be used. We will provide pesticide application training and will provide personal protection clothing such as gloves. Project intervention will reduce the use of these chemicals in experimental orchards and the results may result in reduction or replacement of blanket spraying.

Mitigating risks

Successful completion of the project activities should lead to better fruit fly control using low-risk techniques and reduced risk pesticides and formulations. In this sense the proposed techniques are preferred alternatives to blanket spraying of insecticides or no treatment. **Table 6** presents estimated quantities of insecticides that will be used per year per research activity. The small quantities relative to the area under management annually demonstrate the low impact that can be expected from the proposed interventions. Risk reduction efforts are summarized; risk management indicators are given along with assigned responsibility for risk management.

When pesticides like malathion and dichlorvos are used, they will be used in formulations that reduce volumes per hectare relative to blanket spraying. For example, compare blanket spraying of malathion ultra-low volume concentrate at a typical dose of 68ml active ingredient per hectare per single aerial application every 10 days or 660ml of active ingredient in conventional formulations per hectare per ground application to only 175ml of malathion active ingredient per hectare per ***year*** for continuous treatment using Malatrap as a lure/killing agent in fruit fly traps for male annihilation technique (10 traps/ha). Consider also dichlorvos. Dichlorvos, has no registered uses in the U.S. as a blanket spray in agriculture. When incorporated in a time-release polymer matrix and placed with fruit fly lures in traps for male annihilation technique, dichlorvos strips are used at a rate of 490g active ingredient per hectare per ***year*** for continuous treatment. In this sense, parapheromone trapping with the proposed products poses low risks for handlers and the environment. For annual population monitoring, the field rate of malathion and dichlorvos will be 1/5 the amounts for male annihilation technique. Traps will be hung out of reach of children. Accidental exposure to on the skin of pesticide in any single trap will be insufficient to pose a danger to people making unauthorized contact with traps.

The primary risk of using the proposed products is product storage and disposal of containers. The principal safeguard to people and the environment is ensuring safe storage of pesticides and proper disposal. Liquid parapheromone/insecticide formulations containing are packaged in small bottles (malathion 125ml, rotenone 225ml), so the damage from a spill will be small and easily contained. Solid matrix controlled-release formulations of dichlorvos pose no spill containment problem. They are packaged in sealed envelopes. After use they are largely depleted of volatilized insecticide. Spent dichlorvos strips will be stored outdoors out of reach of children until sufficient time for de-gassing of the insecticide permits disposal of the plastic strips as normal trash. Both liquid and solid insecticides will be stored securely out of reach of children. Containers will be triple rinsed as is industry standard. Rinse water will not be allowed to enter water streams, wells, or other water sources. Containers will be punctured before disposal to make them unavailable for re-use.

Because small quantities of products will be applied in reduced risk formulations, the risk to applicators and the environment is small both in absolute terms and compared to blanket spraying of insecticides. When pesticide containers are handled manually or when pesticides are applied with backpack sprayers, the greatest exposure risk is the hands. Wearing proper gloves during mixing, loading, and clean-up can eliminate 70% of personal exposure. Gloves will be used for applying liquid substances to traps if the substance contains insecticides. (Bait traps contain no insecticides and contain only food-grade ingredients.) Pesticide handlers and users will be trained to use gloves and will be supplied with gloves. Long-sleeved shirts, long pants, socks and closed-toed shoes will be worn for manipulation of sprayable liquids as required on product labels.

Table 6. Risk Mitigation actions

Activity	Estimated Quantity of Active Ingredient (a.i.)	Targets	Indicators	Information Sources	Monitoring Responsibility
Population monitoring	8 stations * 2 traps/ha * 10ha * 6 replacements/year = **960 insecticidal lures/year** per species monitored = **6.7kg dichlorvos** per year per species over 80 ha	Tephritid fruit flies: Priority: *Bactrocera invadens* *Ceratitis cosyra* Secondary: *C. capitata* *B. cucurbitae*	Trained agents Gloves supplied	Research reports Field inspections	L. Vaughan, VT K. Badji, DPV
Male annihilation technique (MAT)	300ha * 350ml a.i./ha/year per season = **105L malathion a.i.** (10 traps/ha)	same	Trained agents with emphasis on storage and disposal Gloves and other PPE supplied	Research reports Field inspections	L. Vaughan, VT K. Badji, DPV
Spot spraying with Success	50ha * 330ml a.i./ha * 3 applications/year = **49.5L spinosad a.i. per year**	same	Trained agents and orchard workers with emphasis on proper storage and disposal Gloves provided	Application reports Application surveillance	K. Badji, DPV L. Vaughan, VT
Testing Suneem	50ha * 20g a.i./ha * 5 applications per season = **5kg azadirachtin a.i. per year**	same	Trained agents and orchard workers. Gloves provided	Application reports Application surveillance	K. Badji, DPV L. Vaughan, VT
Testing Bio-attrap	50ha * 6.6ml a.i./ha * 7 replacements/season = **2.3L rotenone a.i. per year** (10 traps/ha)	same	Trained agents. Gloves provided	Research reports Application surveillance	K. Badji, DPV L. Vaughan, VT

B. National Pesticide Regulation

Pesticides in Senegal are registered through the regional *Comité des Pesticides* (CSP) managed by the *Institut du Sahel* (INSAH) in Bamako. INSAH is the science and policy body for agriculture within the *Comité Permanent Inter états de Lutte contre la Sécheresse dans le Sahel* (CILSS). CILSS comprises nine countries in W. Africa working on common problems in agriculture, natural resources management, and climate science. The CSP comprises members from every member country in order to pool intellectual resources. The committee accepts registration dossiers from manufacturers or importers and reviews them for provisional and possible full registration. Import authorizations must be sought at the country level, but a registration decision by the CSP is valid for all CILSS countries. Any pesticide necessary for growers to manage fruit flies on mangoes needs to be submitted to the CPS by a commercial entity.

There is only one insecticide that is approved by CSP for use in mango production. A provisional sales authorization for sale of Success Appat was given by the CSP in May 2008. The provisional term limits the authorization to three years. Before Success was authorized, there were no products registered in CILSS countries for use against fruit flies on mango.

CSP does not have a policy for pheromones. It is unclear whether chemical attractants that do not come in contact with vegetation require registration by CILSS. If so, guidelines need to be developed by CPS. The use of insecticides as toxicants inside traps is also an area in which CSP has no definite policy, but any manufacturer, formulator, or importer should develop dossiers for CPS unless an explicit policy to the contrary is made by the CSP.

Although the CSP serves as a regional registration authority, Senegal nevertheless has a national pesticide registration committee. Guidelines for the operation of the committee are still in development. The focus of national committee's work is authorizing importation of pesticides registered by CSP.

Large producers who intend to sell their mangoes for export to Europe must only use pesticides allowed by the European Union. For mangoes destined for export, the producer must choose products and application interval to respect maximum residue tolerances of importing countries. Senegal law permits use of pesticides not registered in Senegal for food commodities that are destined for export as long as the pesticides comply with rules of the importing country. Producers who intend to sell their mangoes for export to Europe must, therefore, follow European regulations regarding pesticide selection, pre-harvest interval, and maximum residue limits. Most medium size mango growers sell only part of their crop to export; the rest goes into the domestic market. However, most medium size growers do not spray insecticides. If sprayed mangoes going into the domestic market are compatible with EU requirements, there is no cause for concern. Growers complying with European certification programs such as Tesco or Europgap are conforming to the highest standards.

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