Sustainable Agriculture Development Project Utilizing the World Bank Loan in Hunan Province

Pest Management Plan

Comprehensive Agricultural Development Office of Hunan Province
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### Contents

1. Summary of Recommendation ............................................................................... 1

2. Background to Set the Context ......................................................................... 2
   2.1 Objectives ............................................................................................................. 2
   2.2 General Situation of Crop Plantation, Irrigation and Pest Occurrence in the Project area ......................................................................................................................... 2
   2.3 Administrative and Policy for Pest Management ............................................. 5
   2.4 Main Methods for Pest Management ................................................................. 7
   2.5 Pest Management Ability and Its Evaluation ............................................... 8

3. Components of PMP .............................................................................................. 10
   3.1 Objectives ............................................................................................................. 10
   3.2 Principles ................................................................................................................. 11
   3.3 Activities for Implementing PMP (Activities) .................................................. 12
   3.4 Expected Output/Effects ....................................................................................... 18

4. Arrangements for Implementation of PMP (Implementation strategy) ........... 19
   4.1 Capacity Building ..................................................................................................... 19
   4.2 Setup of Executive Agency and Its Responsibilities ...................................... 26
   4.3 Supervision and Evaluation .................................................................................. 28
   4.4 Reporting System for Pest Management ......................................................... 29

5. Work Plan and Budget .......................................................................................... 31

6. Public Consultation ............................................................................................... 31
1. **Summary of Recommendation**

The Sustainable Agriculture Development Project (SADP) Utilizing the World Bank Loan in Hunan Province is aimed, through adapting global climate change, implementing agricultural emission-reduction measures and improving the agricultural infrastructures and the capacity of disasters prevention and fighting, to realize the sustainable development and efficiency-increasing of the agriculture, gradually increase of farmers’ incomes and continual improvement of eco-environment. It is also aimed to accumulate relevant experiences and provide a demonstration for the sustainable and highly-efficient development of agriculture in Hunan Province.

To establish a high-standard farmland demonstration area, the emphases are placed on the following contents: building the irrigation infrastructure to adapt to the climate change, integrating agricultural measures to adapt to and mitigate the climate change, enhancing the relevant institution and capacity buildup, establishing and improving an agricultural production system to drive the agricultural sustainable development.

The project area in Hunan Province involves the following subproject areas in 6 counties (cities/districts): Ningxiang Subproject Area, Junshan Subproject Area, Datonghu Subproject Area, Jinshi Subproject Area, Zixing Subproject Area and Hengdong Subproject Area. 130 villages in 18 townships are involved in the project. The project construction area is 15,533 hectares.

For the successful execution of the project, Hunan Academy of Agricultural Sciences (HAAS) is contracted as the technology supporter to organize a team of experts to make plans and technical schemes for pest management and to organize the implementation, technical trainings and inspections.

In Hunan SDAP area, we shall introduce the “Green Plant Protection” concept and insist plant protection principals - “Prevention First, Integrated Management”. We shall focus on protecting all crops from pest injury and remaining good
eco-environment simultaneously. We shall apply all kinds of effective technologies in combination, such as agricultural control, Bio-control, physical control, and chemical control, especially non-chemical control, to control crop pests to minimize even or to avoid crop loss from crop pests. Therefore it can be ensured for the security of agricultural production, the safety of agricultural products and the safety of eco-environment in the project area. It can be also ensured for the sustainable and highly-efficient development of agriculture in the project area.

2. Background to Set the Context

2.1 Objectives

In Hunan SDAP area, we shall introduce the “Green Plant Protection” concept and insist plant protection principals - “Prevention First, Integrated Management”. We shall focus on protecting all crops from pest injury and remaining good eco-environment simultaneously. We shall apply all kinds of effective technologies in combination, such as agricultural control, Bio-control, physical control, and chemical control, especially non-chemical control, to control crop pests to minimize even or to avoid crop loss from crop pests. Therefore it can be ensured for the security of agricultural production, the safety of agricultural products and the safety of eco-environment in the project area. It can be also ensured for the sustainable and highly-efficient development of agriculture in the project area.

2.2 General Situation of Crop Plantation, Irrigation and Pest Occurrence in the Project area

In the project area, the total territory area is 70,427.13 hectares; the cultivated land area is 18,935 hectares; the effective irrigation area is 14,690.5 hectares and the water-saving irrigation area is 3,332 hectares.

In the project area, main crops consist of rice, cotton, vegetables, and oranges (which shall not be deemed as the focus in this project) etc., and the winter crops include rapes and vegetables, etc.
For rice, the frequent plant diseases and insect pests include banded sclerotial blight, rice blast, false smut, south rice black streak dwarf (accidentally happened in some years), rice stem borer, cnaphlocrocis medinais, tryporyza incertulas and rice planthopper, etc.

For cotton, the frequent plant diseases and insect pests include cotton seedling diseases (seedling blight, anthracnose, etc.), fusarium wilt, verticillium, boil spoiling disease (redroot, cephalothecium roseum, anthracnose, black fruit, etc.), cotton bollworm, cotton aphid, tetranychus cinnabarinus and cotton plant bug, etc.

For vegetables, the frequent plant diseases and insect pests include vegetable seedling diseases (seedling blight, seedling damping-off etc.), downy mildew, phytophthora disease, anthracnose, fusarium wilt, grey mold, bacterial blight, soft rot, aphid, black cutworm, spodoptera litura, pieris brassicae, plutella xylostella, helicoverpa assulta, diaphania indica, beet armyworm, polyphagotarsonemus latus, etc.

For oranges, the frequent plant diseases and insect pests include citrus scab, canker, anthracnose, panonychus citri, phyllocnistis citrella, phyllocoptura oleivora, coccoidae dialeurodes citri, etc.

For rapes, the frequent plant diseases mainly include sclerotinia rot of colza, powdery mildew, viral disease; and the frequent plant insect pests include rape aphids, plutella xylostella, daiconleafbeetle, etc.

Currently, the pest management level in the project area needs to be improved. What’s more, people excessively rely on chemical pesticide but neglect the important roles of agricultural control, biological control, physical control and other technologies and methods played in the pest management. Specially, due to the shortage of comprehensive pest prevention and control knowledge, farmers rely more on the chemical pesticide for convenience and quick effects, with their pollution to the environment and agricultural product neglected. Though the use of pesticide with high toxicity and residue is prohibited in the project area, problems such as insufficient prevention knowledge, wrong technology selection, improper prevention
method and improper prevention time still exist, which in all will lead to the pesticide overuse and higher costs and intensify the agricultural widespread pollution and waste pollution, thus deteriorating the agricultural sustainable development. These negative effects are mainly presented in following aspects:

1. Increase of crop planting cost:
   Because farmers only rely on the use of chemical pesticide for disease & pest control, the production cost is increased and tends to increase year by year due to the increase of pesticide application frequency and amount.

2. Pests’ resistance to pesticide and pest resurgence
   It has been detected that the rice plant hopper resists to buprofezin and imidacloprid, and that the snout moth’s larva strongly resists to the bisulfate. In a word, the pesticide overuse results in pests’ resistance to the pesticide, as well as resurgence of plant diseases and insect pests. For instance, to control the cnaphalocrocis medinalis, the application of the pyrethroid pesticide, though the pest deterioration can be controlled temporarily, will increase the spawning amount of the cnaphalocrocis medinalis by 50% or more. As a result, the pest will resurge within 7-10 days after the pesticide application. Besides, the pyrethroid pesticide will largely kill the natural enemies of pests in the farmland, which will weaken or lose the natural control to the pests and result in pest resurgence as a result.

3. Hazards from pesticide residue
   With the overuse of chemical pesticide, its pollution to water, soil, air and other ecological factors is intensified increasingly. Being at the very top of food chain, our human beings are damaged by the pesticide residue and biological concentration to the largest extent. Pesticide residue has become one of the major global public hazards, and the residue in food has become one of the most important international food safety matters currently.

4. Hazards to the ecological environment
Long-term and overuse of chemical pesticide has killed large quantities of natural enemies of the pests and insects harmless to the human being, which affects the survival of birds, fish, fogs and other creatures which live on insects. For instance, the use of pyrethroid pesticide in the paddy will directly poison the aquatic organism, which will affect the survival of freshwater fishes, crabs and shrimps and break the ecological balance of farmland.

2.3 Administrative Organization and Existing Policies for Pest Management

2.3.1 Administrative Organization for Pest Management

China has established pest management organization [Plant Protection Phytosanitary Bureau (Station)] at state-level, province-level, city (county) level and town-level with their respectively responsibilities clearly specified, i.e., responsibility for the pest management, pesticide management and agricultural safety production and others corresponding to their own administrative level.

According to the requirements for agriculture, environment conservation and food safety, the Ministry of Agriculture has compiled a list of prohibited or limited chemical pesticides for the plant chemical control in different periods, and strictly implements the “Three Certificates” and pesticide label management for the market available pesticides. Then the Provincial and County (City) Plant Protection Phytosanitary Station and the Agricultural Law Enforcement Departments should implement corresponding management according to relevant regulations.

The pest management in the Hunan project area is an integral part of the *Emergency Plan for Agricultural Biological Disasters*. The People's Governments of all provinces, prefectures and cities or counties should establish emergency response administration for the agricultural biological disasters to respond and handle the agricultural biological disasters occurred in their respective administration areas.

Hunan Plant Protection Phytosanitary Station, the government agency which leads the crop pest management, has established major pest prediction agency in all plant municipal or prefectural level and county-level protection phytosanitary stations, to
regularly predict the major pest disasters about 7 days in advance, and to distribute the pest information to the affiliated towns for organizing farmers to prevent disasters in time.

Various pesticides are sold by agricultural department of each subproject county or city, the agricultural resource distribution system and private businessmen to the farmers through the dealing outlets in the villages and towns; and the law enforcement brigade and the Industry and Commerce department are responsible for the supervision of pesticide sales and pesticide types.

The agricultural department of each subproject county or city is responsible for instructing the territorial farmers to prevent the major local plant diseases and insect pests and the newly-occurred serious plant diseases and insect pests, and for instructing farmers to apply new technologies, new methods, and new pesticides of pest prevention and control to the farmers though broadcasting, understand-paper and bullet.

2.3.2 Current Policies

The policies implemented in Hunan Project area in respect of plant protection, integrated pest management and pesticide management include:

1. *Administrative Regulations of the People’s Republic of China on Pesticides* (by the State Council in Nov. 2001);
2. *Regulation on safety application of pesticides* (by Ministry Of Agriculture, Animal Industry And Fisheries and Ministry of Health in June 1982);
3. *Measures for Implementing the Regulation on Pesticide Administration* (by Ministry of Agriculture in July 2004);
4. *Administrative Measures on Bio-Safety Agricultural Products* (by Ministry of Agriculture and General Administration of Quality Supervision, Inspection and Quarantine, in April 2002);
5. *Opinions of the Ministry of Agriculture on Promoting Green Prevention and Control of Farm Crops’ Pests and Diseases* (on May 15, 2011);
6. **Standard for safety application of pesticides GB4285-89** (by Ministry of Environment Protection in Sept. 1986);

7. **Standard for safety application of pesticides GB8321.2—1987** (by Ministry of Environment Protection in Sept. 1986);

8. **Pesticide Application Guideline for Green Food Production NY/T393-2000**;

9. **Maximum Residue Limits for Pesticide in Food GB2763-2005**;

10. **Measurements of Organophosphorus Pesticide Residues in Food GB/T 5009.20-2003**;


12. **Plant Protection Regulation of Hunan Province** (on Sept. 30, 2006)


14. **Opinions of the Agriculture Department on Promoting Green Prevention and Control of Farm Crops' Pests and Diseases of Hunan Province** (on Nov. 8, 2011).

### 2.4 Main Methods for Pest Management

#### 2.4.1 Main Methods

Considerably insist on the plant protective policy of “putting prevention first and integrated control; public and green plants protection”, and make the prevention and control of crop pests and diseases go through the whole process of agricultural production. Based on the agricultural prevention & control, apply appropriate disease-resistance and pest-resistance varieties according to local conditions and take effective measures to prompt the crops growth by reducing the basic number of pests and enhancing the pest resistance of crops; strengthening the inspection to eradicate the transportation, transmission and planting of seeds with pests; emphasize the enhancement of pest supervision and prediction to provide ground for prevention and control decisions; apply necessary chemical controls in the
occurrence of serious pests and diseases (Note: the bio-rational pesticide should be selected upon using the chemical pesticide to mitigate the pests’ resistance to pesticide and to prevent environmental pollution.).

2.4.2 Specialized Pest Control Service for Farm Crops

The specialized insect pest control service for farm crops refers to a throughout contracting service for the uniform prevention and control of the crop diseases and insect pests implemented by a service organization consisting of a certain quantity of experts specialized in plant protection, using the advanced plant protection equipments and technologies on the basis of the plant protective policy of putting prevention first and integrated control.

Essentials of this technical service: when the agricultural control, biological control and the physical control are properly implemented, realize the uniformity of prevention time, experts, special equipments and the prescription for pesticide application and prevention in chemical control, so as to prevent and control the pests in time as well as to enhance the prevention effect and efficiency, thus reducing the prevention costs and time consumption and mitigating the environmental pollution with the health of farmers protected. Therefore, the technical service is a good method for the mass production, specialization and standardization of agricultural development.

2.5 Pest Management Ability and Its Evaluation

Since the implementation of the “11th five-year plan”, the governments and agricultural departments at all levels, insisting on the protective policy of “putting prevention first and integrated control”, has firmly established the “public and green plants protection” concepts and continuously optimized the “government leading, territory management, joint protection and control” systems, thus making great progress in plants protection legislation development, organization system construction, technical capacity construction and infrastructures construction. As a result, the Hunan Province has always been in the forefront in the plants protection around the country in respect of followings: implementing “public and green plants
protection” concept, strengthening public service, developing green control and specialized prevention, enhancing the pest prevention and control level, prompting the development of green and low-carbon agriculture, ensuring the growth of agricultural yields and farmers’ incomes and the stability of rural area and confirming the agricultural production and ecological safety, the agricultural product supply and quality safety and the ecological environment safety, etc. Specially, Hunan project area leads the country in the integrated paddy pest management. Its crop pest management capacity mainly represents in: (1) establishing a government-leading public plants protection system; (2) establishing and optimizing the coordination system of territory management and joint prevention & control; (3) probing and accumulating the experiences in the specialized insect pest control; (4) initially establishing the network for pest supervision and control.

The promulgation of Plants Protection Regulation of Hunan Province and the Emergency Plan for Agricultural Biological Disasters of Hunan Province in 2006 drives the legalization and institutionalization of the plants protection in Hunan Province. It also marks that the plants protection in Hunan Province has stepped into the new stage of legal management, and provides strong legal support for the effective prevention and control of plant diseases and insect pests.

Hunan Province has mastered a series of technical achievements through continuous scientific research on the plant protection technology, which provide strong technical supports for the improvement of plants protection technologies and the prevention and control capacity to the plant diseases and insect pests. Those technologies include: “research and promotion of non-polluted management of stem borer in Hunan province”, “research and application of the control on the rice water weevil, lissorhoptrus oryzophilus kuschel in Hunan Province”, “test research and technology integration of prevention and control technologies for “two-migratory” pests”, “technical solution for the major paddy diseases and pests in Hunan Province” and the “test and demonstration of green prevention and control technologies”, etc.
In recent years, Hunan Province has been dedicated to applying green plants protection technology, and establishing 10 provincial demonstration areas for the green control of major pests and diseases of rice, oranges and vegetables as well as 10 provincial demonstration areas for the integrated control of the tetradacus citri and bactrocera dorsalis, which play an important role in popularizing the green plants protection technology.

The establishment of green control demonstration area in Hunan Province facilitates the improvement of the farmers’ awareness to the integrated pest management and the enhancement of the integrated prevention and control to the plant diseases and insect pests. Besides, it boosts the breakthrough in enhancing farmers’ environmental awareness, agricultural safety awareness and health awareness, thus making them realize the importance of the application of agricultural, physical and biological controls and the decrease of the pesticide application amount, and laying a good foundation for the sustainable development of agriculture in Hunan Province.

3. Components of PMP)

3.1 Objectives

By implementing the green prevention and control management against the crop diseases and pests, maintaining and enhancing the agricultural prevention and control, improving the effect of biological control, ecological control and physical trapping technology and continuously improving the scientific pesticide application technology, the Hunan project area has established an domestically advanced green prevention and control technology system for the serious plant diseases and insect pests of major crops and spread it to the whole province for application.

In the latest five years, Hunan Province will establish core demonstration areas of 3,170 hectares for the green control of paddy diseases and pest, core demonstration areas of 100 hectares for the green control of cotton diseases and pest and core demonstration areas of 100 hectares for the green control of vegetable diseases and
pest, which totally add up the total area of integrated prevention and control to 10,820 hectares, accounting for 69.66% of the construction area in this project area. It is required to achieve the following goals in Hunan project area: comprehensive prevention and control effects against plant diseases and insect pests shall be more than 70%; the reduction of chemical pesticides application in the subproject area and core demonstration area for green prevention and control shall be more than 10% and 50% respectively to eradicate the use of high-toxic pesticides and improve the scientific level of pesticides use and comprehensive prevention and control benefits; the overall and single loss rate of harm from insect pests shall be controlled under 5% and under 3% respectively to continuously improve the ecology environment, thus ensuring the safety of people and animals as well as products quality.

3.2 Principles

Green Control: thoroughly implement the “Green Plants Protection” concept in the project area, to prompt the promotion and application of green control technology against the plant diseases and pests.

Technology Integration and Development: continuously improve the advancement, practicability and operability of green prevention and control technology and boost the cost-saving & efficiency-improving and the sustainable development of agriculture, though the integration and innovation of key technologies such as ecological control, biological control, physical control and scientific pesticide application.

Safety Guarantee: To ensure the agricultural products quality safety, firstly demonstrate and popularize the green prevention and control technology against the plant diseases and pests in the project area; intensify the physical control and biological control; reduce the pesticide application amount through decreasing the dependability on the chemical pesticide.

Demonstration and Promotion: determine the core demonstration area in each subproject area (more than 100 hectare for each county every year) and try to
achieve the target for the demonstration area with all technologies implemented by the farmer technicians and farmers under the instruction of technicians at town level; the specialized farmers cooperative should be responsible for the procurement and installation of plant protection equipments and materials, and responsible for the widespread promotion of technologies.

3.3 Activities for Implementing PMP (Activities)

3.3.1 The following tasks on which the emphases of this project are placed will be implemented:

1. Introduce and promote IPM technologies in the subproject areas (townships and towns), make plans for biodiversity monitoring and control, protect and take advantage of natural enemy resources and enhance the prediction and forecasting of pests harmful to agricultural crops.

2. Introduce microbial pesticides and botanical pesticides to substitute the harmful chemical pesticides in trainings and small-area demonstration to reduce the adverse effect of chemical pesticides on environment and persons’ physical health.

3. Train the farmers in subproject areas to master the skills of integrated pest management through technical trainings and guidance given to them to strengthen their actual ability for integrated pest management.

4. Provide trainings on pesticide storage and application for farmers in demonstration plots to improve farmers’ knowledge on regulations for pesticide management and application.

5. The PMO of each project-located county or city shall provide trainings for technicians of technology extension stations and pesticide distributors to improve the awareness of integrated pest management (IPM)

6. Enhance the communication with quality supervision departments to strengthen the supervision and management of pesticide marketing and application to ensure the conformance to related requirements of the World Bank on this
project (OP/BP4.09) and the specifications for pesticide application of other international conventions and standards.

### 3.3.2 Key Technologies Applied in the Project Area

With the Hunan Academy of Agricultural Sciences as its technical support and taking the advantages of the advanced agricultural technologies, Hunan project area will realize the green prevention and control for the diseases and pests of crops in the project area by comprehensively applying those key technologies such as ecological control, biological control, physical control and scientific pesticide application. The 6 subproject areas affiliated to the Hunan project area will stipulate a detailed pest management plan separately according to the local crop varieties and the pest occurrence situation.

Following technologies will be promoted and applied in the Hunan project area.

1. **Promotion and application of the latest good varieties and technologies researched by Hunan Academy of Agricultural Sciences**
   
   It’s preferential to apply the latest-improved paddy varieties (two-line hybrid paddy, super hybrid paddy and high-quality paddy) and vegetable varieties by the Hunan Academy of Agricultural Sciences, and focus on promoting following technologies: “paddy fertility project technology”, “main pest occurrence characteristics and key prevention and control technologies for the super hybrid paddy”, “integrated pest management technology for super high-yield tri-cropping rice”, “winter crops covering technology in double-crop rice area”, “key techniques in the production of non-pollution vegetable in South”, “full control technologies for pepper calamity diseases”, “system of anti-disease and growth-boosting by trichodermin and the key technologies for its industrialization”, “research and application of photosynthetic bacteria which can effectively degrade the organophosphor and the pyrethroid pesticide residue”.

2. **Popularization of ecological control technology**
Rebuild the pest occurrence source and breeding environment and manually enhance the hazard resistance of nature and the pest resistance of crops, through mainly applying and promoting demonstrative plantation measures such as selecting pest-resistance varieties, optimizing crop distribution, cultivating healthy seedling and improving the water and fertilizer management, as well as by cooperating biodiversity control and natural enemy protection technologies such as farmland ecological project, orchard grass coverage, crop inter-planting and natural enemy trapping zone.

3. Strengthening the biological control technology

Focus on the promotion and application of key biological control measures such as “pest control with pest”, “mites control with mites”, “pest control with bacteria” and “bacteria control with bacteria”; enhance the demonstration and promotion of mature products and technologies such as trichogramma ostriniae, predatory mites, bacillus thuringiensis (BT), bacillus cerens, bacillus subtilis (ehrenberg) cohn, nucleopolyhedrosis virus (NPV), “rice-duck farming system”; and positively develop application technologies for the biological agents such as botanical pesticide, agricultural antibiotics, plant induced-resistance agent.

4. Promoting the physical and chemical trapping and control technology

Focus on promoting the insect pheromones (sex pheromone, acrasin, etc.), insecticidal lamp and pest-attracting plate (yellow plate and blue plate) to prevent and control the insect pests of paddy, cotton, vegetable and other crops; positively develop and promote the physical and chemical trapping and control technologies such as plant trapping and control, bait trapping, pest proof enclosure and silver gray film avoidance.

5. Improving the scientific pesticide application technology

Try the best to mitigate the negative influence of pesticide by rational pesticide application. As a result, following methods should be implemented: promoting the application of environment-friendly pesticide with high-efficiency, low-toxicity and low residue; optimizing and integrating matching technologies including the
shifting application, alternative application, accurate application and safety application of pesticide; enhancing the monitoring and treatment to the pesticide resistance of crops; popularizing and standardizing the pesticide application knowledge; strictly observing the safety interval for pesticide application.

### 3.3.3 Key Green Prevention and Control Technologies Against Major Diseases and Pests of Crops in the Project Area

In Hunan project area, following green prevention and control technologies should be applied for rice, cotton, vegetable, rape and other crops.

1. Green prevention and control technologies for major diseases and pests of paddy.
   1) Select pest-resistance varieties and reasonably arrange them according to local conditions; implement demonstrative plantation (soil testing and formulated fertilization, increase of organic fertilization, scientific irrigation, etc.) and other agricultural control technologies.
   2) Properly reserve the “greenland” or “green channel” around the paddy field; enhance the protection and application of paddy field spider and other natural enemies; during the spawning stage of rice stem borer and cnaphalocrocis medinalis of early/semilate/late paddy, apply biological control technologies, manually release the trichogramma ostriniaie to mitigate the hazards of rice stem borer and delphacidae.
   3) From May to October, trap the rice stem borer, delphacidae, cnaphalocrocis medinalis and other imagoes with solar insecticidal lamp, so as to mitigate their hazards.
   4) During the feather stage of rice stem borer of early paddy and the tryporyza incertulas of late paddy, trap the rice stem borer and cnaphalocrocis medinalis with sex pheromone, to reduce the pest spawning amount and mitigate the pest hazards.
5) Use the bacillus thuringiensis (Bt), Jinggangmycin-Bacillus cereus, bacillus subtilis, Jinggangmycin, isoprothiolane and other chemical agents to prevent rice stem borer, banded sclerotial blight, rice blast, etc.

6) Apply pesticide in a scientifical and rational way: Never apply high-toxicity and high-residue pesticide; strictly conform to the standards for the application concentration and safety application interval of pesticide; (when necessary,) apply the low-toxicity, low-residue and environment-friendly pesticide for once to twice, such as Tebuconazole, Difenoconazole-Propiconazole, Chlorantraniliprole, Chlorine insect double amide-Abamectin, Emamectin benzoate, Abamectin, Profenofos, Pymetrozine, Thiamethoxam and Buprofezin.

2. Green prevention and control technologies for major diseases and pests of cotton

1) Implement the autumn ploughing, site clearing and crop rotation (rice/cotton rotation to mitigate the cotton blight and verticillium) according to local conditions; select disease/pest-resistance varieties and implement agricultural control technologies such as demonstrative plantation;

2) Strictly implement the seed processing and seedling plantation, so as to prevent and control main cotton seedling diseases, such as damping off, anthracnose and aphid;

3) Implement the no-tillage cotton plantation technology with the rape straws spread to the cotton field; in the middle and late period of cotton growth, apply the interval pesticide application technology, so as to effectively protect the natural enemies in the cotton field (for example, ladybird beetle and spider) and to control the hazard of cotton aphid and tetranychus cinnabarinus.

4) From July to October, use the solar insecticidal lamp and the sex pheromone to trap the adult cotton bollworm, etc.
5) Use the bacillus thuringiensis (B.t emulsion) and nuclear polyhedrosis viruses (NPV) to prevent and control the cotton bollworm;

6) From July to September, use the low-toxicity, low-residue and environment-friendly selective insecticide to prevent and control the tetranychus cinnabarinus, cotton bollworm and pectinophora gossypiella (saunders) for twice to three times. Therefore, it is recommended to apply abamectin, propargite, high effect cypermethrin, fenvalerate, chlorfluazuron, malathion, imidacloprid, nitenpyram and acetamiprid, etc.

3. Green prevention and control technologies for major diseases and pests of vegetables

1) Select good disease-resistance varieties and rationally distribute them; implement paddy-upland rotation and rotation of different varieties of vegetables; apply seeds processing and soil disinfection; enhance the scientific field management and implement demonstrative plantation.

2) Promote the trapping technology of solar insecticidal lamp to trap the adult noctuid, plutella xylostella and cabbage caterpillar, etc.

3) Use the sex pheromone trapping technology to trap prodenia litura, plutella xylostella, beet armyworm, helicoverpa assulta and other vegetable pests.

4) Use the yellow and blue pest-attracting plates to trap vegetables aphids and whitefly, etc;

5) Use pest proof enclosure and shade net to prevent pests and diseases;

6) Apply the pesticide in a scientific and rational way: Never use high-toxicity, high-residue pesticide; strictly conform to the standards for the application concentration and safety application intervals of general pesticide for the vegetables. Therefore, it is recommended to apply high-efficiency, low-toxicity pesticide and biological pesticide such as Bt emulsion, rotenone, pleocidin, chlorfluazuron, flufenoxuron, tebufenozide, chlorfenapyr, emamectin benzoate and abamectin.
4. Green prevention and control technologies for major diseases and pests of rapes

1) Agricultural control technology: Selecting anti-disease and disease-resistance varieties; clearing and processing seeds; implementing paddy-rape rotation; clearing fields by grass removal; deeply ploughing and rationally fertilizing; rationally arranging the sowing time and avoiding the infection period.

2) Physical control technology: Using the yellow pest-attracting plate and the silver grey film to respectively trap and prevent the aphid; applying the light to trap plutella xylostella and prodenia litura; using the high-fat membrane to prevent powdery mildew and other leaf spots.

3) Biological control technology: Applying the agricultural antibiotics to preventing diseases and pests, for example, the agricultural antibiotic 120 is used for powdery mildew and the wuyiencin for anthracnose; controlling the pests with bacteria; for example, controlling the larva of pieris rapae with insecticidal bacteria and beauveria bassiana.

4) Chemical control technology: Preventing and controlling the pests with insecticides such as pymetrozine, thiamethoxam, B.t emulsion, abamectin, chlorantraniliprole and lubendiamide; and preventing and controlling the diseases with anti-bacterial agents such as bromothalonil, carbendazim and dimethachlon.

3.4 Expected Output/Effects

In the latest five years, Hunan Province will establish core demonstration areas of 3,170 hectares for the green control of paddy diseases and pest, core demonstration areas of 100 hectares for the green control of cotton diseases and pest and core demonstration areas of 100 hectares for the green control of vegetable diseases and pest, which totally add up the total area of integrated prevention and control to 10,820 hectares, accounting for 69.66% of the construction area in this project area.
It is required to achieve the following goals in Hunan project area: comprehensive prevention and control effects against plant diseases and insect pests shall be more than 70%; the reduction of chemical pesticides application in the subproject area and core demonstration area for green prevention and control shall be more than 10% and 50% respectively to eradicate the use of high-toxic pesticides and improve the scientific level of pesticides use and comprehensive prevention and control benefits; the overall and single loss rate of harm from insect pests shall be controlled under 5% and under 3% respectively to continuously improve the ecology environment, thus ensuring the safety of people and animals as well as products quality.

4. Arrangements for Implementation of PMP (Implementation strategy )

4.1 Capacity Building

In Hunan project area, it is planned to comprehensively popularize the application of green prevention and control technology against insect pests from paddy, cotton, vegetables and rape and build core demonstration areas for green prevention and control against insect pests from different crops in relevant subproject areas. On the basis of universal implementation of demonstrative plantation and enhancement of agricultural prevention and control, it is planned to reasonably select fine varieties with disease resistance, invest for the set-up and improvement of facilities and conditions on physical and biological prevention and control to replace chemical prevention and control, thus substantially reducing the application of chemical pesticides.

For Hunan project area, it is planned to invest RMB 20.3525 million yuan within 5 years in order to purchase and install 4,686 (sets) solar insecticidal lamps, popularize the application of sex pheromone trap technology as well as biological prevention and control technology such as releasing trichogramma in 7500 hectares of farmland, lay stress on establishment of 3,170 hectares of core demonstration areas for green prevention and control against paddy diseases and insect pests and
110 hectares of core demonstration areas for green prevention and control against cotton diseases and insect pests and 100 hectares of core demonstration areas for green prevention and control against vegetable diseases and insect pests so as to make the comprehensive prevention and control dimensions against plant diseases and insect pests in Hunan project area reach up to 10,820 hectares, accounting for 69.66% of the construction area in the project area.

1. Pest management scheme for Ningxiang subproject area

As the major production area of commercial grain in Hunan Province, Ningxiang, taking double-cropping paddy as the main part, is one of the key areas popularizing two-line hybrid paddy, super hybrid rice and high-quality paddy. In Ningxiang subproject area, it is planned to carry out the green prevention and control technology scheme against double cropping paddy (hybrid paddy and high quality paddy) from hilly area, establishing core demonstration areas of 500 hectares (100 hectares per year) in 4 towns, where it is planned to adopt regularly varietal rotation cropping mode, popularize high yield, high quality varieties with high resistance such as Xiangzaoxian 45, Xiangzaoxian 17, Liangyou 287, Liangyoupeijiu, Y Liangyou 2, Yueyou 9113, Jinyou 207, Jinyou 284, Xiangwanxian 12, take various agricultural prevention and control measures such as balanced fertilization technology and fitness cultivation; reinforce the popularization and application of biological and physical prevention and control to scientifically apply biological and chemical pesticides of low toxicity, realizing substantial reduction in chemical pesticides application, thereby guaranteeing the safe and quality production objective for paddy.

For Ningxiang subproject area, it is planned to invest RMB 2.869 million yuan within 5 years to strengthen the biological, physical and chemical prevention and control measures and make the comprehensive prevention and control dimensions against plant diseases and insect pests reach up to 1,320 hectares, including: investment of RMB 0.66 million yuan for releasing trichogramma japonicum ashmead and application of sex lure technology in paddy field for
application of biological prevention and control area of over 1,320 hectares; investment of RMB 2.209 million yuan for procuring 631 solar insect trap lamps for prevention and control areas of over 1,320 hectares.

2. Pest management scheme for Hengdong subproject area

As an important nationwide production base county for commercial grain, Hengdong, locating in the midstream of Xiangjiang River, boasts a terrain characteristic of the combination of both fluvial small plain and hill, and takes double cropping paddy as main part, therefore becoming one of the key popularization areas for hybrid paddy and high quality paddy.

Similar to Ningxiang subproject area, it is planned to carry out the green prevention and control technology scheme against double cropping paddy (hybrid paddy and high quality paddy) from hilly area in Hengdong subproject area, establishing core demonstration areas of 500 hectares (100 hectares per year) in 3 towns, where it is planned to universally popularize fine varieties with high yield such as Xiangzaoxian 24, Jinyou 207, adopt various agricultural prevention and control measures such as balanced fertilization technology and fitness cultivation; reinforce the popularization and application of biological and physical prevention and control technology to scientifically apply biological and chemical pesticides of low toxicity, realizing a substantial reduction in chemical pesticides application, thereby guaranteeing the safe and quality production objective for paddy.

For Hengdong subproject area, it is planned to invest RMB 3.2475 million yuan within 5 years to emphatically popularize the biological, physical and chemical prevention and control technologies in order to improve the conditions and technologies for prevention and control against plant diseases and insect pests in the subproject area and make the comprehensive prevention and control dimensions for plant diseases and insect pests reach up to 1,700 hectares, including: ① investment of RMB 0.850 million yuan for popularizing biological prevention and control technologies and the sex lure technology against
trichogramma over 1,700 hectares; investment of RMB 2.3975 million yuan for installing 685 solar insecticidal lamps over 1,700 hectares.

3. Pest management scheme for Jinshi subproject area

Jinshi subproject area is the paddy and cotton cultivation area in Dongting Lake region with double cropping system, where the paddy-rape or cotton-rape rotation production mode is adopted.

In Jinshi subproject area, it is planned to carry out the green prevention and control technology scheme against paddy and cotton diseases and insect pests in Dongtong Lake region, establishing core paddy demonstration areas covering 370 hectares and core cotton demonstration areas covering 110 hectares in 2 towns, where it is planned to popularize fine paddy varieties with high yield such as Xiangzaoxian 24, Xiangzaoxian 17, Luliangyou 996, Luliangyou 819, Xiangwanxian 12, New Xiangyou 80, Jinyou 207, Yueyou 9113, Weiyou 227, select fine cotton varieties with insect-and-disease-resistance such as Nankang 3, Zhongmian 41, Kemian 4, adopt various agricultural prevention and control measures such as balanced fertilization technology and fitness cultivation, reinforce the popularization and application of biological and physical prevention and control technologies to scientifically apply biological and chemical pesticides of low toxicity, realizing a substantial reduction in chemical pesticides application, thereby guaranteeing the safe and quality production objective for paddy and cotton.

For Jinshi subproject area, it is planned to invest RMB 3.740 million yuan within 5 years to enhance and improve the technologies and equipment on biological, physical and chemical prevention and control against paddy and cotton diseases and insect pests, thus guaranteeing the effective control for the harm from paddy and cotton diseases and insect pests as well as the continuous agriculture development in the subproject area, including: ① investment of RMB 0.240 million for popularizing the application of insect sex pheromone to prevent and control paddy snout moth's larva and cotton bollworm over 480 hectares; ②
investment of RMB 3.5 million yuan for procuring 1,000 solar insecticidal lamps and widely installing them in the subproject area to lure and kill paddy snout moth's larva, plant hopper, cicadellidae as well as cotton bollworm and pectinophora gossypiella adults over 2,000 hectares.

4. Pest management scheme for Zixing subproject area

Locating in the mountainous area in the south of Hunan province, Zixing subproject area takes single-cropping paddy as main part, which is a frequent and heavy issue area of rice blast because of foggy and wet climate as well as heavy shading in the morning and evening of mountainous area. Therefore, prevention and control technology scheme against hilly single-cropping paddy diseases and insect pests will be carried out in Zixing subproject area, setting up core demonstration areas of 800 hectares (100 hectares respectively in the first and fifth year, 200 hectares respectively in the second, third and fourth year) in 5 towns where it is planned to select medium paddy from two-line hybrid or supper hybrid with rice blast resistance such as Zhunliangyou 608, Zhunliangyou 527, Y Liangyou 1, Y Liangyou 2, Tianyou 3301, popularize the balanced fertilization technology, reinforce various agricultural prevention and control measures such as fitness cultivation, emphatically popularize the solar insecticidal lamp trapping technology and sex pheromone trapping technology to reduce the harm induced by paddy rice stem borer, cnaphalocrocis medinalis, rice planthopper, and apply the biological and chemical pesticides of low toxicity such as jinggangmycin, tebuconazole and isoprothiolane to prevent and control banded sclerotial blight and rice blast, thereby guaranteeing the safe production with high quality for paddy.

For Zixing subproject area, it is planned to invest RMB 3.546 million yuan within 5 years to purchase solar insecticidal lamps, sex pheromone and yellow sticky traps and make the comprehensive prevention and control dimensions reach up to 2,000 hectares, including investment of RMB 2.546 million yuan for installing 670 solar insecticidal lamps over 1,340 hectares so as to adapt to the
scattering characteristic of paddy field in mountainous area and prevent and control insect pests such as paddy snout moth’s larva, plant hopper, pachydiplosis oryzae wood-mason and thrips oryzae williams; ② investment of RMB 1.000 million yuan for popularizing the application of yellow sticky traps and sex pheromone to prevent and control insect pests such as paddy snout moth’s larva and plant hopper over 2,000 hectares.

5. Pest management scheme for Datonghu subproject area

Datonghu subproject area is a typical major production area of commercial grain where paddy is the main cultivation crop and cotton, rape and vegetables are secondary ones. Paddy-paddy-green manure, paddy-rape, cotton-rape and cotton-rape-paddy rotation cropping systems are adopted here, forming multiple cropping patterns such as double cropping, triple cropping and three harvests in two years.

Green prevention and control technology scheme against plant diseases and insect pests for paddy (hybrid paddy and supper hybrid paddy) from Datonghu region will be implemented in Datonghu subproject area, where 500 hectares (100 hectares every year) of core demonstration areas will be set up in 3 towns in order to popularize fine paddy varieties with high yield such as Xiangzaoxian 24, Xiangzaoxian 17, Luliangyou 996, Jinyou 207, Jinyou 299 and Xiangwanxian 12; adopt various agricultural prevention and control measures such as balanced fertilization technology and fitness cultivation; reinforce the popularization and application of biological and physical prevention and control technologies to scientifically apply biological and chemical pesticides of low toxicity, realizing a substantial reduction in chemical pesticides application, thereby guaranteeing the safe and high yield production of high quality paddy.

For Datonghu subproject area, it is planned to invest RMB 3.550 million yuan within 5 years to emphatically popularize insect sex pheromone trap technology and solar insecticidal lamp trap technology in order to intensify physical and chemical prevention and control technologies and reduce the chemical
pesticides application on the basis of comprehensive prevention and control, thereby raising the paddy quality level and environment safety level, including:

① investment of RMB 0.750 million yuan for popularizing the application of sex pheromone to lure and kill insect pests such as paddy rice stem borer, tryporyza incertulas, cnaphalocrocis medinalis, plant hopper and cicadellidae over 1,500 hectares within 5 years; ② investment of RMB 2.80 million yuan for procuring and installing 8,000 solar insecticidal lamps over 1,600 hectares.

6. Pest management scheme for Junshan subproject area

Junshan subproject area is the paddy and vegetables cultivation area in Dongting Lake region, where green prevention and control technology scheme against paddy and vegetable diseases and insect pests is to be carried out, establishing core paddy demonstration area of 500 hectares (100 hectares every year) and core vegetable demonstration area of 100 hectares in 3 towns in order to popularize fine paddy varieties with high yield such as Luliangyou 996, Y Liangyou 1, Fengyuanyou 299, Yueyou 9113, Jinyou 207; select good vegetable varieties; strictly carry out various agricultural prevention and control measures such as balanced fertilization technology and fitness cultivation; popularize as far as possible the application of biological and physical prevention and control technologies to scientifically apply biological and chemical pesticides of low toxicity, realizing a substantial reduction in chemical pesticides application, thereby guaranteeing the safe and high yield production of high quality paddy and vegetable.

For Junshan subproject area, it is planned to invest RMB 3.400 million yuan within 5 years to enhance the measures such as biological, physical prevention and control as well as bio-pesticide application against paddy and vegetable diseases and insect pests and make the comprehensive prevention and control dimensions reach up to 1,800 hectares, including: ① investment of RMB 0.250 million yuan for releasing trichograma on the paddy to prevent and control paddy rice stem borer and cnaphalocrocis medinalis, applying sex pheromone
on the paddy and vegetables to lure and kill paddy snout moth's larva and cnaphalocrocis medinalis as well as insect pests on the vegetables such as armyworm, pieris rapae and plutella xylostella and applying bio-pesticides such as jinggangmycin and isoprothiolane on paddy as well as bacillus thuringiensis and agricultural antibiotic 120 on vegetables over 500 hectares; ② investment of RMB 3.15 million yuan for procuring and installing 900 solar insecticidal lamps over 1,800 hectares.

4.2 Setup of Executive Agency and Its Responsibilities

4.2.1 Setup of Executive Agency

1. Establishing a project expert group on diseases and insect pests management in Hunan Province

With the support of Hunan Academy of Agricultural Sciences, the project leading team in Hunan province (with respect to the comprehensive agriculture development, loans from World Bank are used for the sustainable agriculture) set up a management expert group against plant diseases and insect pests in Hunan project, which includes 12 experts (including Luo Herong, a researcher of Hunan Academy of Agricultural Sciences, holding the position of group leader) (Attachment 1) who take charge of the plan, technology guidance and training, inspection and result assessment on management against plant diseases and insect pests for the whole project.

Hunan Academy of Agricultural Sciences shall sign a technical assistance agreement on management against plant diseases and insect pests with the 6 subproject areas at county level every year to make definite the technical assistance content and specify responsibilities and obligations and provide paid services.

2. Establishing a technology implementation group on management against plant diseases and insect pests for subproject areas

The 6 subproject areas shall establish technology implementation teams on management against plant diseases and insect pests at county level
respectively (Attachment 2) to charge the management and implementation of management work against plant diseases and insect pests, the construction and operation of core demonstration areas for green prevention and control against plant diseases and insect pests, working report and summary as well as farmers training, local issues reporting and experiences conclusion in the subproject area of each county.

4.2.2 Technical Training Plan for Pest Management (Attachment 3)

1. General trainings
Organizing trainings for the plant protection and cultivation technicians at town or higher level of technology implementation teams on management against plant diseases and insect pests in the 6 subproject areas in order to guide and determine the management plan and objective (technical objective) against plant diseases and insect pests of each subproject area as well as specific technology proposals on trainings (investigation and forecast, technology implementation and so on), and determine the reporting procedure of forecast information on plant diseases and insect pests and the technology implementation results.

2. Annual trainings
Organizing the technicians of the 6 subproject areas at the beginning of every year to explicit the management plan against plant diseases and insect pests, technical proposals and measures of the current year, conclude and analyze the working conditions of last year, and finally put forward an improved plan.

3. Technology trainings
The technical trainings shall be conducted in two levels.
Level 1 trainings shall be conducted by the management expert group of the PPMO against plant diseases and insect pests, for the technicians from the technology implementation team on management against plant diseases and insect pests in the 6 subproject areas concerning various technical trainings in order to unify the standards and requirements, such as the investigation
methods and standards of occurrence situation on plant diseases and insect pests in the field, the technology of artificial release of trichogramma to prevent and control *cnaphalocrocis medinalis* and rice stem borer, the application technology of trap lamps and sex pheromone for prevention and control of lepidoptera pests from paddy, cotton, vegetables as well as the technology of application on bio-pesticide and safe chemical pesticide of low toxicity. Level 2 trainings shall be conducted by technicians of subproject areas who shall organize the trainings for farmer technicians and farmers by towns. Before the appropriate prevention and control period against paddy, cotton, vegetable or rape diseases and insect pests, they shall offer trainings and publicity in advance via various ways, such as television, broadcast, newspaper, mobile phone message, voice phone, rural power network, understand-paper, on-the spot meeting for prevention and control as well as farmer field school, in order to vigorously publicize and popularize the prevention and control technologies against serious plant diseases and insect pests, truly making the insect pests situation and prevention and control technology available to all the people.

### 4.3 Supervision and Evaluation

Management expert group against plant diseases and insect pests in Hunan project area shall regularly and irregularly examine the work of the 6 subproject areas at county level (Attachment 4) with respect to the plan and technology implementation conditions as well as offer half-yearly, yearly phased evaluation and evaluation on implementation conditions of the technology project. Inviting the technician experts from the Hunan Plants Protection and Quarantine Station and the Plants Protection and Quarantine Station at city, county (district) level where the project is to be conducted to offer technical evaluation and comprehensive assessment for the management effects against plant diseases and insect pests in the project area.
The Hunan project area is waiting for the investigation and assessment of relevant departments from State Agriculture Comprehensive Development Office and World Bank at any time.

The supervision content and indexes are as follows:

1. Area of farmland on which the integrated pest management is applied (hectares);
2. The number of farmers trained on integrated pest management (persons-month);
3. The numbers of physical control equipment purchased and applied (corresponding to the number of insecticidal lamps used in the project);
4. Area of farmland on which biological control measures are purchased and applied (hectares) (corresponding to the amount of subsidy for biological control in the project);
5. Changes in pesticide application rate (sourced from the data of investigation on typical farmers);
6. Changes in pesticide residue (sourced from the data in environment quality monitoring report).

4.4 Reporting System for Pest Management

Farmer technicians of each village shall report the occurrence situation on plant diseases and insect pests as well as prevention and control action to the technicians at town level regularly three times every month (on the 8th, 18th and 28th days of each month) through mobile phone short message.

Technicians at town level shall summarize the occurrence situation on plant diseases and insect pests as well as prevention and control actions in the local town and report them to the technology implementation teams on management against plant diseases and insect pests at city, county and district level regularly three times every month (on the 9th, 19th and 29th days of each month) through e-mail and QQ Group.
Technology implementation teams on management against plant diseases and insect pests from the 6 subproject areas shall report the occurrence situation on plant diseases and insect pests as well as prevention and control actions in local area to the management expert group against plant diseases and insect pests for PPMO regularly three times every month (on the 10th, 20th and 30th days of each month) through e-mail or QQ Group.
5. Work Plan and Budget

**Budget of Pest Management Plan**

<table>
<thead>
<tr>
<th></th>
<th>Physical control equipment</th>
<th>Biological control subsidy</th>
<th>Farmers’ training</th>
<th>Demonstration &amp; promotion of disease-resistant cultivars</th>
<th>Technical assistance from experts</th>
<th>Monitorin g &amp; evaluation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provincial level</td>
<td></td>
<td></td>
<td></td>
<td>4.32</td>
<td>15</td>
<td></td>
<td>19.32</td>
</tr>
<tr>
<td>Ningxiang County</td>
<td>220.9</td>
<td>66</td>
<td>24</td>
<td>138</td>
<td>30.48</td>
<td></td>
<td>479.38</td>
</tr>
<tr>
<td>Hengdong County</td>
<td>239.75</td>
<td>85</td>
<td>33.3</td>
<td>187.5</td>
<td>30.48</td>
<td></td>
<td>576.03</td>
</tr>
<tr>
<td>Jinshi City</td>
<td>350</td>
<td>24</td>
<td>60</td>
<td>303.3</td>
<td>30.48</td>
<td></td>
<td>767.78</td>
</tr>
<tr>
<td>Zixing City</td>
<td>254.6</td>
<td>100</td>
<td>27</td>
<td>147</td>
<td>30.24</td>
<td></td>
<td>558.84</td>
</tr>
<tr>
<td>Datonghu District</td>
<td>280</td>
<td>75</td>
<td>10.5</td>
<td>256.5</td>
<td>30.24</td>
<td></td>
<td>652.24</td>
</tr>
<tr>
<td>Junshan District</td>
<td>315</td>
<td>25</td>
<td>40.8</td>
<td>337.5</td>
<td>30.24</td>
<td></td>
<td>748.54</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1660.25</strong></td>
<td><strong>375</strong></td>
<td><strong>195.6</strong></td>
<td><strong>1369.8</strong></td>
<td><strong>186.48</strong></td>
<td><strong>15</strong></td>
<td><strong>3802.13</strong></td>
</tr>
</tbody>
</table>

6. Public Consultation

To prepare the context of PMP for Hunan project area, experts from the Plant Protection and Quarantine Station of Hunan Province, the College of Biosafety Science and Technology of Hunan Agricultural University and Hunan Plant Protection Institute are repeatedly consulted to propose suggestions for PMP of the whole project so as to ensure the advanced nature, applicability and demonstration
significance of the PMP and its conformance to the management concepts of the World Bank’ PMO.

**Matrix for Public Consultation**

<table>
<thead>
<tr>
<th>Time</th>
<th>Place</th>
<th>Materials provided</th>
<th>Participants</th>
<th>Problems proposed</th>
<th>Responses</th>
</tr>
</thead>
</table>
| March to April, 2011 | 6 subproject counties | Basic materials of subproject counties as required by the World Bank                | Comprehensive Agricultural Development Offices of 6 subproject counties, related technical departments and the agency entrusted to prepare the PMP | 1. Project and implementation scope of project  
2. Document of PMP framework and format | 1. As required by the World Bank  
2. Making an outline by reference to the existing PMP document |
| May to June, 2011   | Changsha City    | Content of 6 subproject counties relevant to PMP, and draft of PMP framework       | Comprehensive Agricultural Development Office of Hunan Province and Hunan Agricultural Information and Engineering Institute | 1. The participatory concept is not sufficiently reflected in the preparation of PMP  
2. The implementation scheme of PMP is too rough. | 1. Personnel who prepare the PMP shall make an investigation and survey according to the participatory concept.  
2. Make detailed implementation scheme for each crop. |
| July to August, 2011 | Changsha City Subproject counties | Questionnaire for pesticide application                                             | Plant protection units, agro-technology extension agencies and farmers from 6 subproject | 1. Blind use of pesticide by farmers  
2. Bio-pesticides are seldom | Emphasize in PMP management plan, particularly the trainings. |
<table>
<thead>
<tr>
<th>Time Period</th>
<th>Location</th>
<th>Context of PMP</th>
<th>World Bank’s PMO (experts)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>April to May, 2012</td>
<td>Changsha City</td>
<td>Modified context of PMP</td>
<td>1. The project does not include the pesticide procurement and subsidy for farmers</td>
<td>1. Contents related to pesticide procurement and budget of the subsidy have been cancelled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Check the toxicity of pesticide (WHO).</td>
<td>2. The toxicity of the pesticides given in the context has been checked according to the World Bank’s standard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Need to add content related to pest control of agroforestry.</td>
<td>3. PMPs of farmland and road protection forests have been added.</td>
</tr>
<tr>
<td>June to July, 2012</td>
<td>Changsha City</td>
<td>Re-modified context of PMP</td>
<td>The tables of mitigation measures, monitoring, setup of executive agency, trainings, implementation and reporting are explicit.</td>
<td>Tables have been completed according to the format recommended by the World Bank.</td>
</tr>
</tbody>
</table>

From 2013 to 2017, we can (1) continuously consult the department of plant protection technologies in each subproject area for plant diseases and pests, provisions on pesticide application and technical guidance to evaluate the effects of pest management and influence on environment and product quality; (2) be subject to the inspections and evaluations by organizations and departments entrusted by the World Bank, the State and the PPMO.
## Attachment 1. Table of Pest Management Plan

### A Mitigation Measures

<table>
<thead>
<tr>
<th>Project Activity</th>
<th>Potential Environmental and Health Impacts</th>
<th>Proposed Mitigation Measure(s) (incl. legislation &amp; regulations)</th>
<th>Institutional Responsibilities (incl. enforcement &amp; coordination)</th>
<th>Cost Estimates</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Propagandizing the concept of IPM</td>
<td>1. Farmers rely on chemical pesticides to control pests, overuse pesticides, use high-toxicity &amp; high-residue pesticides and are lack of the ability to properly apply, store and dispose of pesticides; 2. Farmers are lack of knowledge/skills on integrated pest management. 3. Farmers may be lack of recognition to disease-resistant cultivars, which results in spreading of diseases and increase of pesticide application. 4. Improper varieties of trees or cultivars infected with diseases which easily cause the biological invasion; and the problems of pest management may exist in the agroforestry on west bank.</td>
<td>1. Enhancing the pest monitoring/forecasting and pesticide supervision. 2. Implementing the integrated pest management in subproject area: using agricultural measures and insecticidal lamps, introducing and promoting biological/botanical pesticides; reducing the application of chemical pesticides. 3. Forbidding the high-toxicity &amp; high-residue pesticides/implementing the existing prohibition 4. Training (farmers, departments of agricultural technology, pesticide dealers, pesticide management departments, etc.) 5. Demonstrating and promoting disease-resistant cultivars 6. For the agroforestry, local varieties of trees shall be planted as far as possible and invasive foreign varieties shall not be introduced. Properly arrange the varieties of trees to avoid the large-area planting of a single variety of trees.</td>
<td>1. County-level plant protection station (disease &amp; pest monitoring &amp; forecasting station), agricultural technicians in towns and townships 2. The PMOs shall select the procurement unit, the cooperatives purchase insecticidal lamps, blocks of Trichogramma eggs and biological/botanical pesticides for farmers. 3. The PPMO shall make a list of pesticides prohibited and farmers shall promise not to purchase and apply these pesticides. 4. Agricultural technicians in towns and townships shall be responsible for instructing and supervising the application of pesticides and reporting the infringement of the prohibition. 5. The PPMO shall organize plant protection experts to train the technicians in subproject counties, towns and townships; the agricultural technicians in towns and townships shall organize trainings for farmers.</td>
<td>RMB 38.0213 million yuan</td>
<td></td>
</tr>
<tr>
<td>Proposed Mitigation Measures</td>
<td>Parameters to be Monitored</td>
<td>Location</td>
<td>Data and/or Measurements (incl. methods &amp; equipment)</td>
<td>Frequency of Measurement</td>
<td>Responsibilities (incl. review and reporting)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Taking agricultural measures: installing insecticidal lamps; applying biological pesticides and sex lures; releasing Trichogramma.</td>
<td>1. Areas of farmland on which the integrated pest management is applied (hectares)</td>
<td>18 towns and townships in 6 subproject counties</td>
<td>Make statistics of the newly increased areas;</td>
<td>Once a year</td>
<td>PMO of each subproject county</td>
</tr>
<tr>
<td>Training (farmers, technicians, pesticide dealers, etc.)</td>
<td>2. The number of farms trained on integrated disease &amp; pest control (persons-month)</td>
<td>18 towns and townships in 6 subproject counties</td>
<td>Make statistics of the number of trainees and trainings according to the signatures of trainees after each training and the roster of trainees;</td>
<td>Once a year</td>
<td>PMO of each subproject county</td>
</tr>
<tr>
<td>Installing insecticidal lamps</td>
<td>3. The numbers of physical control equipment purchased and applied (corresponding to the number of insecticidal lamps used in the project)</td>
<td>18 towns and townships in 6 subproject counties</td>
<td>Make statistics of the newly added insecticidal lamps;</td>
<td>Once a year</td>
<td>PMO of each subproject county</td>
</tr>
<tr>
<td>Applying biological pesticides and sex lures; releasing Trichogramma</td>
<td>4. The areas of farmland on which biological control measures are purchased and applied (corresponding to the amount of subsidy for biological control in the project)</td>
<td>18 towns and townships in 6 subproject counties</td>
<td>Make statistics for the application rate of biological pesticides;</td>
<td>Once a year</td>
<td>PMO of each subproject county</td>
</tr>
<tr>
<td>Reducing the pesticide application through applying biological pesticides and sex lures, installing insecticidal lamps and releasing Trichogramma.</td>
<td>5. Changes in pesticide application rate (based on the data of investigation on typical farmers)</td>
<td>18 towns and townships in 6 subproject counties</td>
<td>Select 2 typical farmer households in each town and township as the monitoring points and make statistics for the reduced quantity of chemical pesticides according to the application rate in the reference year;</td>
<td>Once a year</td>
<td>PMO of each subproject county</td>
</tr>
<tr>
<td></td>
<td>6. Changes in pesticide residue (based on the data in environment quality monitoring report)</td>
<td>18 towns and townships in 6 subproject counties</td>
<td>Collect plant samples after the harvest of crops and make analysis according to the national standard laboratory.</td>
<td>Once a year</td>
<td>PMO of each subproject county</td>
</tr>
</tbody>
</table>
### C Institutional Strengthening and Training for Implementation

<table>
<thead>
<tr>
<th>Institutional Strengthening Activity</th>
<th>Position(s) (Institutions, PIUs, contractors, construction supervision consultants)</th>
<th>Scheduling</th>
<th>Responsibility(ies)</th>
<th>Cost Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrangements for implementation of mitigation measures</td>
<td>1. Promotion agency of agricultural technologies and agency of pest control of subproject city and county 2. Agricultural Business cooperatives 3. Growers in subproject town and township. 4. Provincial agricultural scientific research institutions and promotion agencies 5. Project supervision group and expert consultant</td>
<td>1. Implementation of mitigation measures: from January, 2013 to December, 2017 2. Expert consulting: April and December of each year 3. Inspection of the implementation of measures: June and October of each year</td>
<td>1. The supervision group and PMO release the plan and the city- and county-level agencies are responsible for implementation of mitigation measures of IPM; 2. Growers and cooperatives are responsible for the field implementation of mitigation measures 3. The expert group is responsible for consultation and providing suggestions.</td>
<td>TBD</td>
</tr>
<tr>
<td>Arrangements for implementation supervision and monitoring:</td>
<td>1. Law-enforcing team, plant protection station and pesticide verification station of subproject district and county 2. Agricultural technology station and agricultural society in town and township 3. Hunan Academy of Agricultural Sciences and other related testing and analysis agencies</td>
<td>1. Pesticide supervision: March – April of each year 2. Residue testing: after harvest of crops in each cropping season</td>
<td>Law-enforcing agency is responsible for quality supervision and management of agricultural chemicals; plant protection plant, for the propaganda, training and guidance of technologies; testing agency, for the pesticide residue and hazard testing and evaluation</td>
<td>TBD</td>
</tr>
</tbody>
</table>

### II Training Activity

<table>
<thead>
<tr>
<th>Participants</th>
<th>Types of Training</th>
<th>Content (modules, etc.)</th>
<th>Scheduling</th>
<th>Cost Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trainings on implementation of PMP 2. Trainings on IPM (farmers, department of agricultural technology and government departments, etc.)</td>
<td>Farmers and cooperatives, pesticide salespersons, technicians of promotion station and plant protection station in each demonstration plot, technicians from provincial scientific research institutions and managers from PMOs of subproject cities and counties</td>
<td>Mobile training Participatory training Didactic training</td>
<td>Pest management plan, IPM technologies, application and management of pesticides</td>
<td>2013-2017 RMB 1.956 million yuan</td>
</tr>
<tr>
<td>Relevant policies, guidelines and standards.</td>
<td>Managers and technicians at all level, farmers and cooperatives</td>
<td>Concentrated training and discussion and on-site participatory interpretation</td>
<td>The World Bank's policies on the project, guideline preparation, and meanings of indexes and standards.</td>
<td>2013-2017 TBD</td>
</tr>
</tbody>
</table>
## D Scheduling and Reporting

<table>
<thead>
<tr>
<th>Activity Arrangements</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>Mitigation Measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Propaganda of IPM concept</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. Implementation of IPM technologies</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3. Application of disease-resistant cultivars</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4. Implementation of training plan of PMP</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5. Construction of forest network for farmland and road</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Areas of farmland on which the integrated pest management is applied (hectares)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. The number of farms trained on integrated disease &amp; pest control (persons-month)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3. The numbers of physical control equipment purchased and applied</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4. The areas of farmland on which biological control measures purchased and applied (hectares)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5. Changes in pesticide application rate</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6. Changes in pesticide residue</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Institutional Arrangements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Arrangements for implementation of mitigation measures</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. Arrangements for supervision and monitoring of the implementation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Implementation of training plan of PMP</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. Trainings on IPM (farmers, department of agricultural technology and government departments, etc.)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3. Relevant policies, guidelines and standards.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### Mitigation Measures

- **1. Propaganda of IPM concept**

### Monitoring

- **1. Areas of farmland on which the integrated pest management is applied (hectares)**
- **2. The number of farms trained on integrated disease & pest control (persons-month)**
- **3. The numbers of physical control equipment purchased and applied**
- **4. The areas of farmland on which biological control measures purchased and applied (hectares)**
- **5. Changes in pesticide application rate**
- **6. Changes in pesticide residue**

### Institutional Arrangements

- **1. Arrangements for implementation of mitigation measures**
- **2. Arrangements for supervision and monitoring of the implementation**

### Training

- **1. Implementation of training plan of PMP**
- **2. Trainings on IPM (farmers, department of agricultural technology and government departments, etc.)**
- **3. Relevant policies, guidelines and standards.**
## Attachment 2. Personnel List of Management Expert Group against Plant Diseases and Insect Pests in Hunan Project Area

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Institution/Position</th>
<th>Title</th>
<th>Education Background</th>
<th>Specialty</th>
<th>Responsible Items</th>
<th>Contact Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luo Herong</td>
<td>Male</td>
<td>Vice-president from Hunan Academy of Agricultural Sciences</td>
<td>Researcher</td>
<td>Doctor</td>
<td>Plant protection</td>
<td>Management chief against plant diseases and insect pests in charge of item management and coordination.</td>
<td>13908463428</td>
</tr>
<tr>
<td>Liu Jianhua</td>
<td>Male</td>
<td>Hunan Agricultural Information and Engineering Institute</td>
<td>Researcher</td>
<td>Master</td>
<td>Plant protection and facility agriculture</td>
<td>Technology supervisor in charge of plan and scheme preparation as well as organization for implementation.</td>
<td>18974992799</td>
</tr>
<tr>
<td>Gong Qingwei</td>
<td>Male</td>
<td>Hunan Plant Protection Institute</td>
<td>Researcher</td>
<td>Bachelor</td>
<td>Pesticides and weeds</td>
<td>Guiding and training with respect to the technology of pesticides application.</td>
<td>13907318251</td>
</tr>
<tr>
<td>Chen Zhangfa</td>
<td>Male</td>
<td>Hunan Plant Protection Institute</td>
<td>Associate Researcher</td>
<td>Master</td>
<td>Agricultural entomology</td>
<td>Guiding, training and assessing the prevention and control technology against agricultural insect pests.</td>
<td>13973163100</td>
</tr>
<tr>
<td>Huang Zhinong</td>
<td>Male</td>
<td>Hunan Plant Protection Institute</td>
<td>Researcher</td>
<td>Bachelor</td>
<td>Plant protection</td>
<td>Guiding, training and assessing the comprehensive prevention and control technology against paddy diseases and insect pests.</td>
<td>13077305524</td>
</tr>
<tr>
<td>Liu Erming</td>
<td>Male</td>
<td>Biosafety Science and Technology of Hunan Agricultural University</td>
<td>Professor &amp; Doctoral Advisor</td>
<td>Doctor</td>
<td>Plant pathology</td>
<td>Guiding, training and assessing the prevention and control technology against plant diseases.</td>
<td>13607431942</td>
</tr>
<tr>
<td>Tan Xiaoping</td>
<td>Male</td>
<td>Vice station master of Plant Protection and Quarantine Station of Hunan Province</td>
<td>Researcher</td>
<td>Bachelor</td>
<td>Plant protection</td>
<td>Guiding, training and assessing the prevention and control technology against paddy diseases and insect pests.</td>
<td>13873118162</td>
</tr>
<tr>
<td>Liang Zhuhuai</td>
<td>Male</td>
<td>Director of Hunan Institute of Watermelon and Muskmelon</td>
<td>Associate Researcher</td>
<td>Doctor</td>
<td>Plant protection</td>
<td>Guiding, training and assessing the prevention and control technology against vegetable diseases and insect pests.</td>
<td>13507483586</td>
</tr>
<tr>
<td>Wei Lin</td>
<td>Female</td>
<td>Hunan Plant Protection Institute</td>
<td>Associate Researcher</td>
<td>Doctor</td>
<td>Plant pathology</td>
<td>Guiding, training and assessing the prevention and control technology against plant diseases.</td>
<td>13975856351</td>
</tr>
<tr>
<td>Zhang Zhiyou</td>
<td>Male</td>
<td>Hunan Agricultural Information and Engineering Institute</td>
<td>Researcher</td>
<td>Master</td>
<td>Crop cultivation</td>
<td>Formally implementing the agricultural prevention and control technology.</td>
<td>13974833752</td>
</tr>
<tr>
<td>Li Rui</td>
<td>Male</td>
<td>Hunan Agricultural Information and Engineering Institute</td>
<td>Research Assistant</td>
<td>Master</td>
<td>Information engineering</td>
<td>Applying agricultural information technology.</td>
<td></td>
</tr>
<tr>
<td>Luo Zeyu</td>
<td>Male</td>
<td>Hunan Hybrid Rice Research Center</td>
<td>Research Assistant</td>
<td>Doctor</td>
<td>Genetics and breeding</td>
<td>Selecting and distributing the paddy varieties.</td>
<td></td>
</tr>
</tbody>
</table>
Attachment 3. Setup Requirements Table for Management Executive Agency against Plants Diseases and Insect Pests in 6 Subproject Areas

<table>
<thead>
<tr>
<th>Project-located County</th>
<th>Involved Town (Township)</th>
<th>Involved Administrative Village (Township)</th>
<th>Leader at City, County and District Level (person)</th>
<th>Expert at City, County and District Level (person)</th>
<th>Technician at Town Level (person)</th>
<th>Farmer Technician at Village Level (person)</th>
<th>Farmer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ningxiang County</td>
<td>4</td>
<td>19</td>
<td>1</td>
<td>2-3</td>
<td>8</td>
<td>19</td>
<td>?</td>
</tr>
<tr>
<td>Hengdong County</td>
<td>3</td>
<td>38</td>
<td>1</td>
<td>2-3</td>
<td>6-9</td>
<td>38</td>
<td>?</td>
</tr>
<tr>
<td>Jinshi City</td>
<td>2</td>
<td>22</td>
<td>1</td>
<td>2-3</td>
<td>6-8</td>
<td>22</td>
<td>?</td>
</tr>
<tr>
<td>Zixing City</td>
<td>5</td>
<td>38</td>
<td>1</td>
<td>2-3</td>
<td>10</td>
<td>12</td>
<td>?</td>
</tr>
<tr>
<td>Datonghu District</td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>?</td>
</tr>
<tr>
<td>Junshan District</td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>?</td>
</tr>
</tbody>
</table>

Note: 1) Each county must be provided with 2 or more experts, including 1 plant protection expert and 1 cultivation expert.

2) Each rural town must be provided with 2 or more professional technicians, including 1 plant protection technician and 1 cultivation technician.
## Attachment 4. Training Plan

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
<th>Target</th>
<th>Frequency</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall training</td>
<td>Integrated pest management plan; organization, division and cooperation; work requirement and standard</td>
<td>Technicians at county and town level</td>
<td>Once</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
</tr>
<tr>
<td>Annual training</td>
<td>Annual integrated pest management plan; work summary of last year and work improvement requirement of the current year</td>
<td>Technicians at county and town level</td>
<td>Five times (once a year)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
</tr>
<tr>
<td>Technical training</td>
<td>Method of investigation on plant diseases and insect pests</td>
<td>Technicians at county and town level</td>
<td>Five times (once a year)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
</tr>
<tr>
<td>Green prevention and control technologies against paddy diseases and insect pests</td>
<td>Technician experts at county level</td>
<td>Ten times (twice a year: for early–paddy and late-paddy)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
<td></td>
</tr>
<tr>
<td>Green prevention and control technologies against cotton diseases and insect pests</td>
<td>Technicians at county and town level</td>
<td>Five times (once a year)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
<td></td>
</tr>
<tr>
<td>Green prevention and control technologies against vegetable diseases and insect pests</td>
<td>Technicians at county and town level</td>
<td>Five times (once a year)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
<td></td>
</tr>
<tr>
<td>Technology in release of trichogramma to prevent and control insect pests</td>
<td>Technician experts at county level</td>
<td>Ten times (twice a year: for early–paddy and late-paddy)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
<td></td>
</tr>
<tr>
<td>Application technology of insect sex pheromone</td>
<td>Technician experts at county level</td>
<td>Ten times (twice a year: for early–paddy and late-paddy)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
<td></td>
</tr>
<tr>
<td>Application technology of solar insecticidal lamp</td>
<td>Technicians at county and town level</td>
<td>Five times (once a year)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
<td></td>
</tr>
<tr>
<td>Basic level training</td>
<td>Technology in scientific usage of biological and chemical pesticides</td>
<td>Technicians at county and town level</td>
<td>Ten times (twice a year: for early–paddy and late-paddy)</td>
<td>Conducted by management expert group against plant diseases and insect pests of PPMO</td>
</tr>
<tr>
<td>Farmer training</td>
<td>Disease &amp; pest identification of main crops, safe application technologies of pesticides, biological control technologies, physical and chemical control technologies…</td>
<td>Farmer technicians</td>
<td>A couple of times</td>
<td>Conducted by county and town</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Farmers</td>
<td>A couple of times</td>
<td>Conducted by county and town</td>
</tr>
</tbody>
</table>