

Appendix 4

World Bank Financed Project

Hubei Safe, Sustainable, Smart Agricultural Project

Pest Management Framework

Submitted by: Foreign Cooperation Office of

Hubei Department of Agriculture and Rural Affairs

Prepared by: Central-Southern Safety&Environment
Technology Institute Co., LTD

November 2019

Table of Contents

1. Project Overview	1
2. Project Backgrounds	3
2.1 Project Objectives	3
2.2 Pest Problems of Project Crops	4
2.3 Current Situation of Chemical Pesticide Use	5
2.4 Crop Pest Management and Problems	5
2.5 Possible Environmental Impacts and Risks after Project Implementation	7
2.6 Evaluation of Existing Policies and Systems.....	9
2.7 Institutional Framework for Pest Management	11
3. Integrated Pest Management Plan	18
3.1 Objectives and Priorities.....	18
3.2 Project Activities.....	18
3.3 Integrated Pest Control Technology of Main Crops	20
3.4 Principles for the Use of Pesticides in the Project Area	33
3.5 Pesticide Management	36
3.6 Technical Requirements for the Pesticide-Applying Instruments	37
3.7 Ability to Use and Dispose Pesticides	38
3.8 Environmental Risk	39
3.9 Professional/Health Risks	40
4. Implementation Arrangement of Pest Management Plan.....	41
4.1 Organization Arrangement and Responsibilities	41
4.2 Mechanism and Process of Pest Management.....	41
4.3 Skill Building.....	42
4.4 Supervision and Management.....	44
4.5 PMP Implementation Report	45
4.6 Work Plan and Cost	46
5. Monitoring of Pest Management.....	48
5.1 Monitoring Content	48
5.2 Contents of Supervision.....	48
5.3 Monitoring Plan	48

5.4 Project Report	55
--------------------------	----

1. Project Overview

The Hubei Safe, Sustainable, Smart agriculture Project is led by the Hubei Provincial Government (HPG) and the Provincial Department of Agriculture and Rural Affairs (PDARA) that is to set out from the investigation of the current situation in agricultural industry, to analyze the existing problems and propose solutions. By promoting safe, sustainable and smart agricultural practices and improving product quality and food safety, the project aims at promoting sustainable agricultural development. By establishing demonstration zones as demonstration results that can be replicated, the project can be duplicated in Hubei Province, in the whole country and even in the whole world to improve the quality and safety agricultural products and the smart agriculture level. The project involves 11 counties and cities including Honghu City, Zhongxiang City, Jingshan City, Xiaonan District, Nanzhang County, Xian'an District, Tongcheng County, Tongshan County, Duodao District, Yiling District and Gong'an County. The project has three components, including the agricultural risk assessment, management and communication; the demonstration and extension for safe, sustainable, and smart agricultural practices; and the project management and knowledge management. Among them, the management and communication component, and the demonstration and promotion of safe, sustainable and intelligent agricultural practices component involve rice, tea, fruit and vegetable industries and the aquaculture industry.

This Pest Management Framework (PMF) was prepared following the requirements of the World Bank's business protocol "*Pest Management OP/BP4.09*" and related regulations, with consideration of the current pest conditions in the project area and issues that may emerge in project activities. PMF enhances the quality and safety of agricultural products by encouraging farmers to adopt environmentally friendly good agricultural practices and Integrated Pest Management (IPM) technologies to provide technical assistance, farmer training, equipment procurement, monitoring and evaluation.

The project adopts a framework approach, and the location, scale and owners of specific sub-projects are not yet determined during project preparation. An environmental and social management framework (ESMF) was therefore prepared during project preparation and this Pest Management Plan is an annex to the ESMF report. Based on the principle of "prevention comes first and with comprehensive approach", the PMF adopts the concepts of "public plant protection" and "green plant protection", and summarizes the

prevention and control methods of common pests for major crops and forest fruits related to the project. Under the premise of protecting the ecological environment, this PMF prioritizes the role of natural method by promoting the use of agricultural, physical and biological control methods, coordinates the use of appropriate chemical control measures, and reduces dependence on agro-chemicals. Pest control can bring about the best economic, social and ecological benefits. During project implementation this PMF should be updated based on actual situations including monitoring and training.

The focuses are as follows:

(1) Introduce and promote IPM technology in the project area (cooperatives), develop and implement pest monitoring and management plans, and strengthen the agricultural pest forecast.

(2) Introduce new varieties of microbial pesticides and plant-derived pesticides in the project area as a control method to substitute harmful chemical pesticides, thus reduce the adverse effects of chemical pesticides on the environment and on human health.

(3) Through the farmers' production skills training, on-site training and other learning methods, improve the practical skills of farmers and train farmers with comprehensive pest management skills.

(4) Provide training for technicians, pesticide dealers, community managers and assistants, and county project office managers of the technology promotion station to raise awareness of integrated pest management (IPM).

(5) Strengthen communication with quality supervision departments and strengthen supervision of pesticide sales and use in the project area to ensure compliance with the World Bank's relevant requirements (OP/BP4.09) for this project, and other international conventions and guidelines for pesticide use.

In order to effectively implement the pest management plan, the Hubei Provincial Project Management Office (PMO) and county/city PMOs have arranged designated personnel to be responsible for the implementation and management of the pest management plan.

2. Project Backgrounds

2.1 Project Objectives

The project proposed the target of pesticide reduction and control as: under the guidance of the “Zero Pesticide Use Growth Action Plan by 2020”, with the implementation of this project, the comprehensive prevention and control technology level and practical operation skills of farmers in the project area will be significantly improved. While ensuring the effective pest prevention and control, the pollution and damage of chemical pesticides to the agricultural ecosystem will be reduced. In the demonstration area, the chemical pesticides that the farmers depend on will be replaced by biological pesticides; the frequency of spraying application will be reduced from the five times to two times; the overall dosage will be reduced by more than 60%; the utilization efficiency will be increased from 29% to 45%; the pest damage will be maintained below 4%; and the average application rate of chemical pesticides will be reduced by more than 80% compared with prior-to project status.

Integrated pest management (IPM) is the core of the comprehensive pest control principle, an important measure for pest prevent and control, and the requirements of the World Bank loan project related business policy "*Integrated Management of Animals and Plants and Pests*" (OP 4.09). Since 1975, Chinese government has also adopted Integrated Pest Management (IPM).

When implementing an IPM, not only economic benefits, but also ecological balance and social security should be considered. Based on this theory, principles of pest control should be: Based on agronomic measures, based on the different biological characteristics and habits of pests, make full use of the natural factors controlling the pests and diseases and create conditions that are not conducive to the development of pests and diseases, strengthen the occurrence of forecasting and hazard monitoring, and adapt to local conditions. The use of biological, physical, chemical and other complementary, coordinated, complementary measures to avoid killing natural enemies and polluting the environment, to control pests and diseases at acceptable levels. Give priority to the use of biological and other control measures. When pests and diseases occur seriously and other control methods cannot be effectively controlled, high-efficiency, low-toxic and low-residue chemical pesticides should be used, and safe application methods should be adopted to reduce chemical pesticides in soil or water environment.

2.2 Pest Problems of Project Crops

The crops supported by the project include rice, tea, rapeseed, loquat, citrus, aquatic vegetables, etc. The planting area is scattered. The common problems of major pests and diseases are shown in Table 2.2-1.

Table 2.2-1 Main pests and diseases of the planting industry supported by the project

Project support crops	Main diseases	Major pests
rice	Blast, sheath blight, Ustilagoidea virens and Rice bacterial root rot	Rice planthopper, rice leaf roller, Chilo suppressalis, stem borer, thrips, etc.
Tea	Anthrachnose of tea, tea red scab, Exobasidium vexans	Tea leafhopper, Aleurocanthus spiniferus, tea elephant, tea caterpillar, leaf roller moth, tea Looper, etc.
Rape	sclerotinia sclerotiorum\ rape downy mildew\ Rape virus diseases	Rape aphid, etc.
Loquat	Loquat leaf spot/ anthracnose/ White plumule disease of loquat	Loquat yellow caterpillar, navicular caterpillar, mulberry longicorn
Citrus	Citrus scab\ canker \Phomopsis citri\ anthracnose	Citrus red yellow spider\ phyllocnistis citrella stainton\ Citrus scale insects\ Citrus whitefly\Citrus rust tick

2.3 Current Situation of Chemical Pesticide Use

At present, the chemical pesticides used by farmers in the project area are mainly low-toxic or non-toxic chemical pesticides recommended by the county plant protection stations. See table 2.3-1 for details.

Table 2.3-1 Use of chemical pesticides in main crops

Crop name	Types of pesticides used
Rice	streptomycin sulfate, mancozeb, carbendazim, thiophanate-methyl, acetamiprid, imidachloprid, Abamectin, Deltamethrin, Cyfluthrin, cypermethrin, Deltamethrin
Tea	biphenthrin, Permethrin and emamectin, Tolfenpyrad, diafenthiuron, dinotefuran
Rape	prochloraz, dimetachlone and carbendazim
Loquat	Bordeaux mixture, thiophanate-methyl, carbendazim, Zineb, benomyl, tuzet, Pyrethroid emulsifiable concentrate, Aluminium phosphide
Citrus	tuzet, mancozeb, streptomycin sulfate, thiophanate-methyl; carbendazim, bromothalonil, Propargite, Chlorpyrifos, Abamectin;
Edible fungi	Thiabendazole, Abamectin, Deltamethrin

2.4 Crop Pest Management and Problems

At present, all districts and counties in Hubei Province have established monitoring, forecasting and prevention and control systems for pests and diseases of major plants and epidemic disease, which can be controlled in time for general plant diseases and insect pests and animal diseases, but some epidemic and explosive plant diseases and insect pests are still passive. However, the means of prevention and control are single. The disease prevention and control is not widely covered and the control effect is unstable. Overall, disease prevention and control capacity still need to be improved.

(1) Lack of information on the occurrence and control of animal and plant diseases and insect pests

Farmers have few channels to understand the occurrence of pests and diseases of plants and animals and the use of pesticide control. They often get such knowledge by watching television programs or reading technical books on pesticide use and pesticide manuals. Although the grassroots agricultural authorities have set up some training courses, the technical staff of the county or townships have provided some consulting services, and some technical manuals and textbooks for crop protection provide methods for the occurrence of pests and diseases of plants and animals and the use of pesticides, it is difficult for the

majority of farmers to accurately grasp the relevant information on livestock breeding and plant pest control in a timely way.

(2) Lack of concept of using chemical substitutes and common sense of using chemical pesticides safely

When farmers choose pest control methods, they mainly consider which method will bring them the greatest benefit. Generally, farmers prefer to choose chemical control methods with quick and good effect. Only when chemical pesticide alternative methods can bring them good net income, it is possible to abandon the use of chemical control methods. Therefore, the important work is to let farmers fully understand the advantages and disadvantages of various methods available, and encourage farmers to change their traditional animal and plant protection concepts through the development of high value green food and organic food production.

Under general field production conditions, some farmers seldom wear protective clothing, helmets, masks and gloves when using manual sprayers or advanced automatic sprayers, especially when spraying pesticides. Due to poor personal safety awareness, it is easy to cause acute pesticide poisoning and chronic pesticide residues in the body. In Hubei Province, it is very convenient for farmers to buy pesticides. Almost all villages and towns have agricultural material stores and crop hospitals. Therefore, farmers usually buy and use pesticides as needed. Most of the remaining pesticides are stored at will, which is easy to cause accidental poisoning.

(3) Lack the consciousness of integrated defense of disease

In the prevention and control strategy, if you do not pay attention to prevention, the outbreak of pests and diseases will be taken by surprise; if you do not pay attention to the rule of unified defense, it is difficult to control the epidemic of pests and diseases by local application of one household. The reason is that the concept of integrated pest management has not yet reached the farmers. The pest and disease prediction and forecasting system is relatively lagging behind. The group defense and group management cannot be fully covered. The chemical pesticides are over-reliant, the dosage is gradually increased, and the area of chemical control is expanding year by year, resulting in deterioration of the ecological environment. The resistance of pests and diseases is significantly enhanced. The reason is that chemical pesticides have quick effect and stable drug effect, and it is easier to control the occurrence of pests and diseases. However, pollution-free agricultural products

do not have higher prices even the quality is better, and farmers lack the driving force to use biological pesticides and other alternative chemical pesticides.

(4) Prevention and control system need to be improved

In the prevention and control system, the prevention and control funds are limited, the prevention and control system have obvious dead ends, decentralized local prevention and control accounts for the mainstream, and the prevention and control technology are difficult to widely spread. The reason is that the grassroots agricultural technology promotion department lacks working funds and technical personnel. It can only focus on prevention and control of animal and plant diseases and insect pests causing major losses in the year. The prevention and control system and technology need to be improved. At the same time, due to the limited technical personnel of agricultural technology promotion departments at all levels, the research and promotion of physical control and biological control technologies are very slow, and the physical control and biological control methods are single and the effect are not satisfactory. Although the project has completely eliminated the use of high-toxicity and high-residue pesticides, there are still problems of insufficient prevention and understanding, improper technology selection, improper control methods, and inaccurate control timing, resulting in a large number of drug use, higher costs, and increased agricultural source pollution and waste pollution are not conducive to the sustainable development of agriculture.

2.5 Possible Environmental Impacts and Risks after Project

Implementation

The planting industry of this project is mainly based on local economic crops, encouraging and guiding cooperatives to produce safe and sustainable intelligent agricultural products, mainly pollution-free food, green food (Grade A) and organic food (Grade AA). Therefore, the project mostly uses biological and physical means to prevent and control the occurrence of pests and diseases, and the use of commercial organic fertilizer or farmyard manure has less impact on the project area and helps to change the traditional farming practices in the project area, avoiding large-scale use of pesticides or fertilizers. When pesticides or fertilizers have to be used, the dosage will be strictly controlled, and the possible effects are as follows:

2.5.1 Possible Environmental Risks Caused by Pesticides

Once the pesticide enters the environment, it will take chemical reactions, causing pollution to air, water and soil.

The environmental impact and risks that may be caused by chemicals such as pesticides include:

(1) Impact on the air: Under normal circumstances, when the pesticide is sprayed, some pesticides float in the air in the form of particles, and are decomposed by photolysis, thereby affecting air quality;

(2) Impact on the soil: The amount of pesticide residues and derivatives in the soil increases. Pesticides are not easily decomposed by microorganisms and stable to acid and heat. It is not easy to volatilize and are not soluble in water. Therefore, the residual time in the soil is longer, especially for clay and organic soil.

(3) Impact on biology and human body: Most of the pesticides fall into the soil and enter into the environment, which will cause harm to aquatic and terrestrial organisms and humans. Some pesticide components can be accumulated in the food chain.

2.5.2 Possible Environmental Risks Caused by Chemical Fertilizer

The environmental impact and risks that may be caused by fertilizer include:

(1) Eutrophication of rivers and lakes. The cause of eutrophication is mainly due to the increase of nitrogen and phosphorus in the water, causing excessive growth of aquatic plants such as algae;

(2) The soil is polluted and the physical properties of the soil are deteriorated. Long-term excessive application of chemical fertilizers will make the soil acidification. The amount of ammonium ions in organic and inorganic complexes in soil solution and soil micelles increases, and replace Ca^{2+} , Mg^{2+} , etc., so that the soil colloids are dispersed and soil structure is destroyed and the soil plates are formed. It will directly affect the agricultural cost and crop yield and quality;

(3) Increase of nitrogen oxide content in the atmosphere. A considerable amount of nitrogen fertilizer applied to farmland is directly volatilized from the soil surface and enters the atmosphere. There is also a considerable part of organic and inorganic nitrogen get into soil which will transfer from insoluble and adsorbed compounds to water-soluble nitrogen and nitrogen oxides under the action of soil microorganisms and then enter into the

atmosphere.

Therefore, in order to solve the potential problem of pesticide and chemical fertilizer pollution in the project area, IPM strategy must be adopted for pest control. The project has formulated a comprehensive pest control plan, widely applied integrated pest control technology, and combined the promotion of disease-resistant varieties with the application of high-efficiency, low-toxicity, low-residue pesticides and biological pesticides, so that the farmland ecological environment in the project area can be effectively improved.

2.6 Evaluation of Existing Policies and Systems

2.6.1 Current Policies and Systems

The state and local governments have successively promulgated and implemented a series of laws, regulations, standards, methods, procedures and guidelines. Through the implementation of these regulations, the integrated pest management (IMP) has been further promoted and applied.

(1) *“Law of the People's Republic of China on Agricultural Product Quality Safety” (Revised in 2018) (Standing Committee of the National People's Congress, Effective date: Oct 26th, 2018)*

(2) *“Regulation on Pesticide Administration” (State Council, Effective date: June 1st, 2017)*

(3) *“Measures for Implementing the Regulation on Pesticide Administration” (Effective date: Aug 1st, 2008)*

(4) *“Management measures for non-polluting agricultural products” (General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China)*

(5) *“Standard for safety application of pesticides” (GB 4285-1989)*

(6) *“Standard for safety application of pesticides” (GB8321.2-1987)*

(7) *“Green food pesticide application guideline” (NY/T393-2000)*

(8) *“Maximum residue limits for pesticides in food” (GB2763-2005)*

(9) *“Determination of organophosphorus pesticide residues in foods” (GB/T 5009.20-*

2003)

(10) *“Guideline for safety application of pesticides” (GB/TB8321.1-8321.8)*

(11) *“Regulations on plant quarantine” (2017 PKULAW Version) (Effective date: Oct 7th, 2017)*

(12) *“Detailed rules for the implementation of the regulations on Plant Quarantine” (agricultural part)*

(13) *“Antitoxic regulations for storage-transportation, marketing and use of pesticides” (GB 12475-2006)*

Through the implementation of these standards and guidelines, a research, production, application, monitoring and management service system for pesticides has been established in China. In particular, the “Pesticide Management Regulations” promulgated by the State Council on May 8, 1997 is the first administrative regulation of pesticides with legal effects, which indicates that pesticide management has entered the track of standardization, legalization and internationalization. In January 2008, the revised “Measures for the Implementation of Pesticide Management Regulations” played a good role in the smooth implementation of the “Pesticide Management Regulations”. Among the ten safety protection policies of World Bank, this evaluation applies: (Pest Management) (OP/BP4.09). Under the implementation of relevant policies in China, the Integrated Management Pests (IMP) in the project area has been initially promoted.

2.6.2 China's Animal and Plant Protection Policy Principles

The purpose of the Chinese government's agricultural animal and plant pest control policy is to implement the concept of integrated pest management (IMP) and to control the level of pests and diseases of plants and animals to a low level to promote the quality of agriculture and enhance the sustainable use of agricultural resources. Its purpose is to protect agricultural resources and protect the ecological environment. Over the years, the national animal and plant protection policy has emphasized the adoption of the “Protection-based, scientific prevention and control, legal governance, and promotion of health” animal and plant protection policy. Those policies and regulations emphasized on animal and plant quarantine to prevent the invasion and spread of animal and plant diseases and insect pests; application of biological control methods to replace chemical drugs; and the production of pollution-free food, green food (Grade A) and organic food (Grade AA).

The Chinese government has given great attention to the safety of food. According to the animal and plant protection policy of “prevention first, comprehensive prevention”, the prevention and control methods based on biological control will be gradually adopted in the future. The fast-growing green food and organic food markets have begun to reduce or eliminate the use of chemical pesticides through price incentives. In order to promote the production of green safe agricultural products and the certification of green foods and organic foods, the Green Food Development Center of the Ministry of Agriculture of China has published a “Pesticide Use Regulations” to guide the production of Green food (Grade A) and organic food (Grade AA).

The “Pesticide Management Regulations” promulgated by the Chinese government and the “Safety Standards for the Use of Pesticides” issued by the Ministry of Agriculture encourage the use of high-efficiency, low-toxicity and low-residue pesticides. Any pesticide produced by a pesticide manufacturer must comply with the above “Procedures”, “Regulations” and “Standards”. These documents clearly indicate:

- The use of pesticides is strictly controlled on agricultural products (very dangerous and major toxic pesticides such as parathion, monocrotophos and Phorate are prohibited);

- Agricultural products with excessive pesticide residues shall not enter the market for sale.

- Methods of safe use of pesticides include: forms of pesticides, methods of safe and reasonable use, general dosage and maximum dosage, limited use times within the same year, time from the last use to harvest period, etc.

The Pesticide Inspection Institute of the Ministry of Agriculture of China and each province are the monitoring agencies responsible for agricultural products and pesticide residues (especially vegetables, fruit and food crops, as well as poultry, eggs and meat).

2.7 Institutional Framework for Pest Management

PMP pest management agencies include pesticide supervision and management institutions, pest control organizations and pesticide residue detection organizations. Table 6 shows the tasks and responsibilities of different departments in the management of pesticide market and the production of agricultural products after the implementation of the project.

Table 6 Tasks and responsibilities of different departments

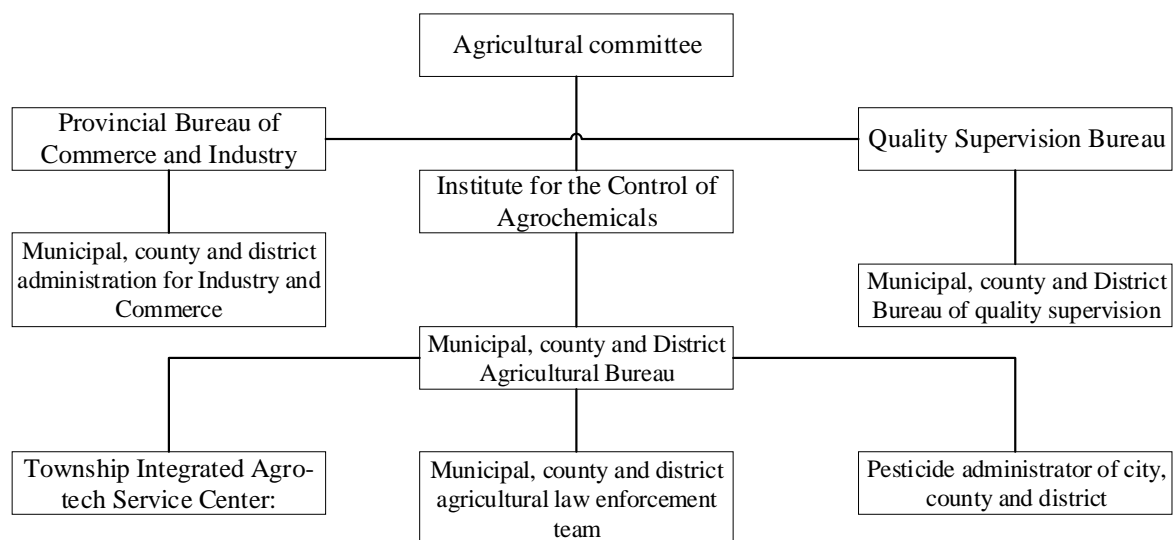
Item	Government	Agricultural Technology Department	Farmer
1. Supervision of pesticide market	Organize the cooperation of industry and commerce, agricultural law enforcement team and other departments to carry out regular inspection of agricultural material market, put an end to the sale of fake drugs, and prohibit the sale of highly toxic pesticides in the production areas of vegetables and fruits.	Assist the government departments to carry out pesticide market survey and investigate the use of pesticide in the fields of farmers.	Purchase pesticides under the guidance of local technicians to reduce high toxic pesticides purchased.
2. Management in the production of agricultural products	According to the standards of World Bank, FAO and the European Union, we will issue, approve and modify the list of banned and prohibited registration of high toxic pesticides; formulate stricter regulations on the use of pesticides, strictly prohibit the use of high toxic pesticides on fruits and vegetables; reduce the registration and approval of high toxic pesticide production enterprises and varieties; strengthen the supervision and testing of cross provincial allocation of trees and crop seeds and seedlings.	Strengthen the training and guidance of farmers in their daily pest control work, and guide them to use low toxic chemical, biological and other control methods to control pests and diseases.	Participate in agricultural technology training, carry out pest control in accordance with the guidance methods provided by agricultural technicians, and resolutely put an end to the application of highly toxic pesticides on crops.
3. Post marketing management of agricultural products	To implement the recall system of agricultural products; to strengthen the market supervision and inspection of pesticide residues in agricultural products; to encourage farmers to produce green food, pollution-free food and IPM food, to establish a sustainable market system of agricultural products with high quality and high price, to stimulate farmers to consciously adopt IPM technology in the field with price advantage; to encourage leading enterprises of agricultural products and farmers to establish an order system.	Encourage farmers to use IPM technology to produce agricultural products, and help farmers apply for registration of green food, pollution-free food and organic food.	Join farmers' associations, production bases of leading enterprises or register green food, pollution-free food and organic food; actively adopt IPM measures to produce agricultural products with higher added value.

The pesticides used in the project area must comply with national standards, industry

standards or enterprise standards. Pesticide packaging, transportation and storage are essential to production and use. Pesticide packaging shall comply with the relevant provisions of GB3796-85 "General Principles for Pesticide Packaging", GB4838-84 "Emulsion Pesticide Packaging" and GB5736-85 "Plastic Plastics for Pesticide" issued by the State Bureau of Technical Supervision. The storage shall comply with the general requirements of Article 3 of the "Regulation on Safe Use of Pesticides".

There are still gaps between the state's laws and regulations on the production, packaging, storage, transportation, sale and use of pesticides and international laws and regulations. In order to cope with the possible risks of pests and diseases after the implementation of the project, it is necessary not only to help farmers effectively control pests and diseases, but also to increase the environmental and agricultural pollution caused by pesticides in the project area. It needs the joint efforts of the government, technicians and farmers.

Pesticide supervision and management organization:



Duties of each Department:

Agricultural committee: Being responsible for the agricultural development planning and related agricultural affairs.

Industrial and Commercial Bureau: being responsible for the management of pesticides in trading.

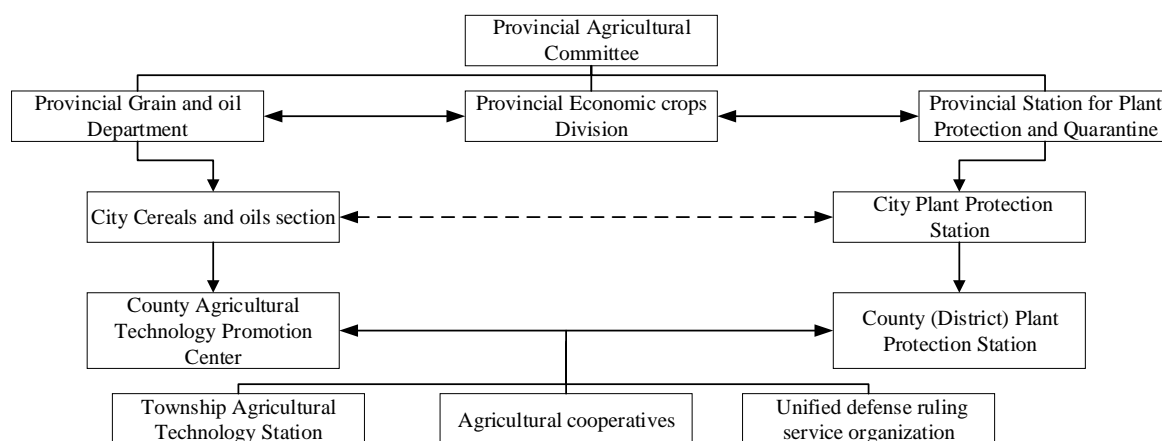
Quality Supervision Bureau: being responsible for the management of pesticides in production.

Institute for the Control of Agrochemicals: being responsible for the application, use, supervision and management of pesticides as well as the formulation or participating in the formulation of pesticide safe use and the industry standard of the pesticide quality and pesticide residue and related affairs.

Institute of Law Enforcement, Pesticide Management Station: being responsible for the market supervision and management of agricultural chemicals.

Township Integrated Agro-tech Service Center: coordinate and assist in related law enforcement and the technical departments in the publicity, training and instruction on pesticide management and comprehensive pest management techniques.

Management organizations for the prevention and treatment of pests and diseases:



Duties of each Department:

Agricultural Committee: being in charge of the agricultural and animal husbandry work of the province, being responsible for the agricultural competent department at various levels in the province, organizing the prevention and treatment work of the crop pests and diseases.

Provincial Station for Plant Protection and Quarantine: conducting plant quarantine, regularly issuing long-term, mid-term and short-term forecast of crop pests and diseases, carrying on emergency prevention and treatment of major crop pests and diseases and the lasting control, publicity of instruments and the safe use of new pesticides; publicizing the pest management technique to peasants and providing related trainings to them.

Provincial Grain and Oil Department: assisting in conducting related management work with the Department of Agriculture and Animal Husbandry, and being responsible for disseminating techniques.

Provincial Division of Economic Crops: being responsible for planting planning, technique promotion and management of pests and diseases of the economic crops, e.g. vegetables, fruit trees, tea of the province.

City and County (District) Argo-tech Extension Center: being responsible for promotion of agricultural technique in its jurisdiction, being responsible for the organization, planning, coordination, supervision, decision-making and the formulation of work management system of the prevention and treatment of crop pests and diseases.

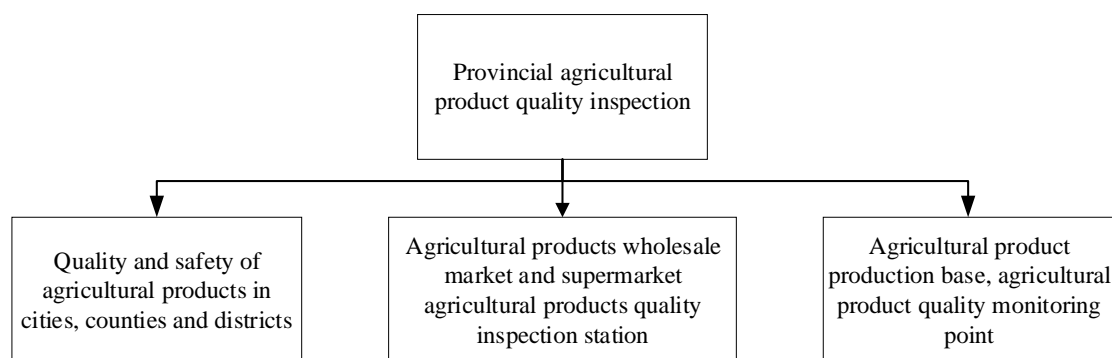
City and County (District) Plant Protection Station: being responsible for the

organization and management, direction and supervision of the prevention and treatment of pests and diseases in its jurisdiction; coordinating, assisting in the technical publicizing, training and guiding the comprehensive management of pests and diseases and pesticide control in local regions with related law enforcement and technical departments.

Township Agricultural Technique Station: being responsible for supervision and forecasts of major pests and diseases in its jurisdiction and directing the prevention and treatment in a timely manner.

Agricultural cooperatives and unified defense ruling service organization: organizing and conducting prevention and treatment of pests and diseases in local regions.

Organization and institutions of pesticide residue detection:



Duties of each Department:

District Detection Centers for Agricultural Product Quality Safety: being responsible for the supervision and management of agricultural product quality safety of the province, and directing the supervision work of agricultural product quality safety of all cities, counties (districts).

Monitoring Centers (stations) of Agricultural Product Quality of the City, County and District: being responsible for the supervision and management work of local agricultural product quality and safety.

Quality detection station for wholesale market and supermarket: being responsible for the quality detection of agricultural product admittance to the market (supermarket).

Agricultural Product Quality Detection Point for Agricultural Product Production Base: being responsible for the quality detection of agricultural product in the production base.

3. Integrated Pest Management Plan

3.1 Objectives and Priorities

The development goal of the project is to pilot development mode in select suitable cooperatives in the selected project area that can be promote to Hubei Province, so as to provide opportunities to increase farmers' income. The component 2 is the demonstration and promotion of safe and sustainable smart agricultural practice. The planting industry is mainly rice, vegetable, tea, rape, citrus, etc. The project encourages to reduce the use of agricultural chemicals and drugs, ensure the quality and safety of primary agricultural products, reduce the negative effects of the environment, pay attention to the rational allocation of resources and balance of ecosystem, and seek sustainable development of agriculture. The main tasks are as follows:

(1) Introduce and promote IPM technology in the project area (community, cooperatives), establish pest and disease monitoring and management plans, and strengthen forecasting of agricultural pests.

(2) In the project area, new varieties of microbial pesticides and plant-derived pesticides were introduced as a control method to replace harmful chemical pesticides, thereby reducing the adverse effects of chemical pesticides on the environment and human health.

(3) Through skills training and on-site learning, improve the practical skills of farmers, and train farmers to master the skills of integrated management of pests and diseases.

(4) Provide training for technicians, pesticide dealers, community managers and assistants, and county PMO staff to raise awareness of integrated pest management (IPM).

(5) Strengthen communication with quality supervision departments and strengthen supervision of pesticide sales and use in the project area to ensure compliance with the World Bank's relevant requirements (OP/BP4.09) for this project, and other international conventions and guidelines for pesticide use.

3.2 Project Activities

The Integrated Pest Management Plan for the Safe, Sustainable and Smart Agricultural Project of Hubei Province will adopt comprehensive measures such as

agricultural, physical, biological and chemical control to treat pests and diseases for specific crops, so as to reduce use of chemical pesticides.

The PMP Integrated Pest Management Plan is to implement integrated pest management. With the goal of controlling pests, improving the safety of agricultural products, protecting the ecological environment and improving the quality of farmers, reducing the dependence on chemical synthetic pesticides and controlling pest activities at economic hazard levels. The core is:

- (1) Control pests, not kill off them
- (2) Use non-chemical measures as much as possible to control the number of pests
- (3) When pesticides have to be used, the selection and application of pesticides must minimize their impact on crops, humans and the environment;
- (4) Establish a standardized IPM technology system that meets regional characteristics, integrate agricultural control, biological control, ecological control, physical avoidance and trapping techniques to maximize avoid and reduce usage of chemical pesticides. Try to avoid killing natural enemies and polluting the environment, and control pests and diseases at acceptable levels.

Based on the different biological characteristics and habits of pests, the use of quarantine methods, physical and mechanical methods, cultivation techniques and biological methods shall be considered first. Highly effective and low toxicity chemical pesticides can only be used if the above methods cannot successfully prevent animal and plant pests and diseases. In the IPM method, priority is given to the use of chemical pesticide substitutes, especially in the application of natural enemies and biopesticides, such as *Trichogramma*. The insect pathogens nematode can be used to control a variety of fruit borers and dry borers in agriculture. Some biocides have also been developed and applied, such as *Bacillus thuringiensis* (BT) insecticide and *Beauveria* preparation. At present, biological insecticides and biological control technology have been applied in some crop production in Hubei Province.

Chemical methods are essential when large plant pests and diseases occur in the project area. The number of pesticide sprays varies with the type of plant pests and diseases and the condition of the crop.

3.3 Integrated Pest Control Technology of Main Crops

The natural conditions of each county in the project area are quite different and the crops planted are also different. However, the prevention and control measures and methods for pests and diseases are generally the same. In summary, there are mainly agricultural control measures, physical and mechanical measures, biological, ecological control and chemical control.

3.3.1. Agricultural Prevention and Treatment Method

(1) Selecting pest-tolerant and resistant varieties; publicizing formulated fertilization techniques and rational irrigation, increasing use of organic fertilizer, practicing healthy cultivation techniques and increasing the pest tolerance of the crops.

(2) Conducting the rotation and succession of crops, field and orchid cleaning and conduct dry farming with autumn sowing and winter irrigation so as to prevent the propagation of soil-borne diseases, ploughing of paddy field to kill pupa, control the habitat of pests and reduce the population of the pests over winters and summers.

(3) Trimming fruit trees in appropriate ways to eliminate excessive buds and sprouts, and improving the ventilation among trees and light penetration through the crown by cutting off lower leaves;

(4) Timely cleaning up weeds in the growth period, creating environmental conditions that are not conducive to pest breeding.

(5) Promote the cultivation of soybean, sesame, vetiver and other crops to protect the natural enemies of pests, trap the *Chilo suppressalis* and increase the biodiversity in the double-season rice area, double-season rice and one-season rice mixed area.

3.3.2 Physical and Mechanical Methods

This method is commonly used in the control of agricultural animal and plant pests and diseases, the reasons are:

(1) cheap- farmers do not need to buy pesticides, labor force is cheap in China;

(2) effective - physical and mechanical methods are very effective in controlling some animal and plant pests and diseases;

(3) safety – no pollution, and natural enemies are safe.

The physical prevention and treatment method are to use light, color, odor and the special response to physical factors such as heat, radiation, high-frequency current, ultrasound to prevent and control pest. It mainly includes the following measures:

1. Using the photoaxis of pests to trap pests. Using the lamp of frequency vibration and black light lamp to trap rice planthopper, rice leaf roller, striped rice borer, pink rice borer, etc.;
2. Using the heat energy, such as hot water to kill the pathogenic bacteria in the seed.
3. Cutting off and burning the diseased branches and leaves.
4. Clear the pests and diseases of the orangery and reduce the pest population overwintering

In the project area, pests such as longicorn, moth, caterpillar, scarab on rice, rape, citrus, tea, edible fungi and other crop can be effectively reduced through physical and mechanical and manual methods.

3.3.3 Biological Prevention and Control Method

The biological prevention and control method are to use beneficial insects and bacteria to control the pests, such as parasites, predators and pathogenic microorganisms. It mainly includes:

(1) Protection and utilization of natural enemies. The control of predatory natural enemies, such as ladybug, *Chrysopa perla*, syrphid and Reduviid hunting on aphid, leaf mite, whitefly and thrips; The predation of *Tetranychus Cucurbita* on red spider and tampan; The control of *Trichogramma parasitica* to rice leaf roller, *Chilo suppressalis*, yellow rice borer and pink rice borer.

(2) Use of biological agents and products. At present, the most widely used bacterial products, such as *Bacillus thuringiensis* (III), *Bacillus subtilis* (U); Fungal products, *Beauveria* (U), *Trichoderma* (III), otomycosis (U); Viral products, such as cotton bollworm nuclear polyhedrosis virus (III), cabbage armyworm nuclear polyhedrosis virus (III); Antibiotics, such as agricultural streptomycin (U), Jinggangmycin (U) And so on. Sex pheromone has sex inducing core (agent) and botanical pesticide, such as 0.2% matrine (U) solution, 0.5% veraconine (U) solution, 0.5% Azadirachtin (III) emulsifiable oil, 2.5%

rotenone (U) emulsifiable oil, etc.

(3) Create the environment suitable for the natural enemy, increase the number of natural enemies.

3.3.4 Chemical Prevention and Control

Chemical prevention and control method are to use chemical pesticides to control diseases, pests and weeds and other harmful organisms. The chemical pesticide has the advantage of being easy to use, effective to wide range of pests, high efficiency, being able to rapidly control the spread of pests, especially for the outburst pests, so it can be used as an emergency measure. However, simply using large amount of chemical pesticide will not only kill the natural enemy of pests, but also damage the field ecosystem, which will lead to the outburst of secondary pests, bring environment pollution and generate a series of side effects of poisoning human and livestock. In addition, using one type of pesticide in long-term will increase the pesticide resistance of the target pest. Therefore, how to control the use of chemical pesticides so as to reduce its impact on environment pollution and human health is a key point in this project.

The following principles shall be followed in the project regions:

1) Educate the farmers that rationally using agricultural, physical and biological methods with necessary chemical methods can also effectively control pests;

2) When the pest prevention and control index is reached, timely using efficient, low toxic pesticide to play its best effect and keep the pests and diseases in an economically allowable scope;

3) When a major pest disaster occurs, a plant protection professional team for prevention and treatment is formed and dispatched to undertake joint prevention and treatment;

4) Non-pollution techniques of prevention and treatment shall be disseminated and used:

① Efficient, low toxic and low residual pesticide shall be used.

② Promotion of pesticide spray aids to reduce pesticide dosage effectively. The use of pesticides (insecticides, fungicides, herbicides, plant growth regulators, except for living biopesticides) is reduced by 20-40% comparing with the conventional dosage. Use polyol

nonionic surfactant (U) 15 ml per acre with pesticide spray. At the same time, additives such as monosilicic acid (U), gibberellin, indole acetic acid, brassinolide (U), and other additives are added to improve the resistance of crops and alleviate the toxicity of heavy metals to crops.

③ For the pest source area and the occurrence center with large pest population, low dosage pesticide with high efficiency shall be used in the young larva stage of pests to optimize the effects of pesticide, and the pesticide that will kill the natural enemy of pests is strictly prohibited at the late stage of pest outbreaks;

④ the interval of pesticide application shall be observed;

⑤ Continuous use of one single pesticide for long-term is prohibited. The pesticides shall be used in turns with different types;

⑥ the safe pesticide applying instruments and methods shall be used to improve the effectiveness of pesticide;

⑦ the dissemination, education and training on safe and proper use of pesticide shall be strengthened, including properly wearing protective clothes, mastering the general knowledge on emergency treatment of pesticide poisoning, etc.;

⑧ Safe storage shall be ensured for the agricultural chemicals (e.g. away from children access and food, etc.).

⑨ Properly handle discarded pesticide bottles and packing, do not clean pesticide applying instruments in natural waters.

3.3.5 IPM Measures for Crops under this Project

(1) IPM measures for rice

The main pests and diseases of concern include rice sheath blight, rice blast, rice smut, southern black streaked dwarf disease, stem borer, rice planthopper, and rice leaf roller. The measures include to introduce and utilize species with resistance; to adopt balanced fertilization and cultivation techniques to reduce the occurrence and prevalence of these diseases; to use means of deep-water inundation and vetiver trap stem borer; to mix with 10% imidacloprid (III) before planting to reduce damage from rice planthopper and southern black streaked dwarf disease; to use propichlor (U), penoxsulam (U), cyhalofop-butyl (U)

to control weeds in paddy fields; During the rice growing season, Jinggaangmycin (U), 30% benzo propiconazole (III), propylthiazole (U), 40% pyrimethamine (III) to control rice sheath blight, rice blast, rice curved Planthopper and rice leaf roller; to use Chlorobenzamide (U), tetrachloroamide (U), Flubendiamide (U) and Bacillus thuringiensis (III) to control Chilo suppressalis, rice planthopper and rice leaf roller. The dosage of above chemicals will be reduced by 20-40% when applying, and additions and conditioners including polyol (U), monosilicic acid (U), gibberellin, indoleacetic acid and Brassinolide (U) are used. High toxic pesticides such as organophosphorus are forbidden to be used.

(2) IPM measures for tea

1) Tea caterpillars, tea geometrid, tea leaf roller moth

The measures include to use lighting, frequency vibration type insecticidal lamp in the tea garden, and the large face value is effective. It has a good effect on pests such as tea caterpillars, tea stalks, and tea leaf moths. Pesticide use can be reduced by once or twice.

2) Camellia

Adult camellia has a pseudo-death stage. In the mid-June, shake the trees with dustpan or plastic film under can eliminate the adult camellia. Another possible option is to remove the more severe diseased leaves manually by crushing the moths in the leaf of the tea caterpillar egg, and then scraping the scorpion of the tea moth on the branch, and using a bamboo knife to scrape off the mossy pests on the damaged branches.

3) Tea anthracnose

The measures are to strengthen the daily management of tea garden and ensure that the tea trees are not short of water or fertilizer; to apply organic fertilizer based on actual situation of tea trees. Nitrogen fertilizer should not be over-applied. Drainage should be conducted for the tea trees. For tea trees already infected with this type of disease, apply 75% Zineb 1200g/hm², 20% prochloraz 1300 g/hm², and 60% thiophanate methyl 1300 g/hm². Mix the chemicals with 800 kg/hm² water and spray on the infected tea plants.

4) Brown spot disease

The measures include to loosen the soil and water the tea garden in the summer, and apply 70% chlorothalonil (1500g / hm²), 50% carbendazim (2000g / hm²) in 600kg / hm² for watering.

3) Tea cake disease

The measures include to apply 20% triketone diluted by 3000 times with dosage 350 g / hm² and to apply 70% chlorothalonil diluted by 600 times with dosage of 1300g / hm² , and to mix with 1000 kg / hm² of water before applying.

(3) IPM measures for cole

The main pests and diseases of concern include *Sclerotinia sclerotiorum*, downy mildew and aphid. The measures include to select *Brassica napus* species with strong resistance; to adopt rotation planting for cole and rice; to strengthen field management and timely clean-up of ditches and drains to improving venting; to remove diseased, aged and yellow leaves, and to take them off the field for centralized treatment; and to apply P-K fertilizer before and after flowering to enhance the damage resistance. Apply pesticide when the rate of *Sclerotinia* leaf disease is 8% - 10% or the rate of stem disease is 1%. If there is rain in the flowering period, apply the pesticide for another round. For aphid apply 10% or 20% imidacloprid (III), Pymetrozine (U) and other chemicals; for downy mildew apply Metalaxyl, manganese zinc (U), etc.; for *Sclerotinia* apply 43% tebuconazole (U), 10% hexazol (U), 30% benzo, propiconazole (III), 20% prochlorazine (U) etc.; Before sowing (before transplanting), apply glyphosate (U) and trifluralin (U) for soil treatment and weed control. After sowing, apply acetochlor (III) and 33% dimethyl pentylamine (III) for soil treatment and weed control. The dosage of above chemical pesticides should be reduced by 20-40%. Other additives and regulators such as polyol (U), monosilicic acid (U), gibberellin, indoleacetic acid and Brassinolide (U) will also be added.

(4) IPM measures for Citrus

The priority is the plant quarantine. Strengthen the quarantine of introduced seedlings, and strictly prevent Citrus Yellow Dragon disease and canker disease.

① Strengthen the basic positioning of agricultural measures: **a.** Strengthen the management of fertilizer and water, and enhance the disease and insect resistance. In particular, the application of high-quality organic fertilizer and phosphorus fertilizer can significantly reduce the occurrence of anthrax, scab and other diseases, and worsen the nutritional conditions of the mites, aphids and scale insects. **b.** Adopt fine pruning, flower thinning and fruit thinning to balance reasonable burden and strengthen tree growth. **c.** Adopt fruit bagging. Improve the quality of fruit, prevent damage from canker, scale insect,

rust tick, citrus fruit fly and other diseases and pests, and prevent pesticide pollution. **d.** Enhance the orchard cleaning. Combined with pruning, removing of diseased and insect occupied branches, removal of fallen fruits for centralized burning or deep burying, the numbers of disease and insect will be controlled.

② Actively adopt biological control technology. First, protect and utilize their natural enemies. Citrus garden is rich in natural enemies for pest and disease, especially for mite as they have a large number of predators that can be effectively used for pest control. Second, promote the planting of legumes and green manure in the orchard, so as to provide a good breeding place for natural enemies thus control pests effectively. Third, increase the amount of natural enemies artificially in the orchard. Such as the adding *Trichogramma* for the control of the citrus leaf miner; adding Muggle mite for the control the citrus mites, etc.

③ Rational use of chemicals: **a.** apply the chemicals based on the economic threshold. Based on the monitoring of diseases and insect pests, adopt the economic threshold to avoid random use of pesticide by reducing dosage and frequency. **b.** apply chemical pesticides based on science. First, rational selection of pesticide. Select the pesticide that is safe for human being and animals, harmless to natural enemies, has no pollution to the environment, and has high-efficiency. The commonly used pesticides in orchards include insect growth regulators such as diflubenzuron (U), diflubenzuron (U); biological agents such as *Bacillus thuringiensis* (III), Liuyangmycin (U); selective acaricides such as tetraacariazine (U), thioacaridone (U); selective aphids and scale killing agents such as 25%, 10% or 20% imidacloprid (III), etc.; Second, rational application of chemical pesticides. Before the germination of fruit trees in spring, and before the time when the natural enemies of the orchard come out, spray broad-spectrum insecticides to kill the aphid eggs, mite eggs and adults overwintering on the trees; and spray the eradicated fungicides such as peracetic acid (U) to eliminate the scab and anthrax on the trees. In the growing season, selective insecticides and acaricides are mainly used, such as the diflubenzurons (U) for the control of leafminer moth, the thiazinone (U) and 10% or 20% imidacloprid (III) for the control of aphid, and the spiroadinyl ester (U) for the control of leafminer mite. In addition, application methods should be selected based on the habits of pests, such as the ground application, trunk application, etc., to reduce the damage to other organisms; adopt rotate application of pesticides, reasonably mix pesticides to postpone insect resistance to the dosages. The application above chemical pesticides should be reduced by 20-40%, and additives and

regulators such as polyol (U), monosilicic acid (U), gibberellin, indoleacetic acid and Brassinolide (U) will be used. The following measures can be taken to prevent common diseases and insect pests.

1. For the main fungal diseases, select from 80% mancozeb WP 600-800 times, 25% azoxystrobin suspension 1500 times, or 10% Difenoconazole non dispersing agent 2000-2500 times, etc.

2. For canker, select from 47% chunleimycin Wangtong wettable powder 1000 times solution, 20% Thiobacillus copper emulsion 500 times solution, copper master, and Kocide, etc.

3. For the ground killing of flies, select from 48% chlorpyrifos emulsion 800-1000 times, or other chemicals.

4. For the spider, select from 4000-5000 times of mite danger, 2000-2500 times of pyridaben 20%, 5000-7000 times of ethacazole 11%, avermectin, etc.

5. For scale insects and whiteflies, select from 800-1000 times of 48% chlorpyrifos emulsion, or 1000 times of 25% thiazinone wettable powder, etc.

6. For stem borers, select from 48% chlorpyrifos emulsifiable oil 50-100 times or other pharmaceutical mud to dry and block the adults out of the hole.

(5) IPM measures for Loquat

1) Leaf spot

① Select species with pest resistance. By adopt deep furrow with high border planting, and strengthened pruning to improve venting in the crowns, disease rate can be reduced. Strengthen fertilizer application can promote the growth of healthy tree and improve disease resistance. Strengthen drainage in rainy seasons can reduce the groundwater level and improve the orchard environment. ② In winters, remove fallen leaves and the diseased leaves for burning to reduce the sources of overwintering bacteria. ③ For the nursery or orchard, with new leave sprouts emerge, spray 1:1:160-200 times Bordeaux solution; 70% methyltobuzin WP 800-1000 times solution; 50% carbendazim WP 800-1000 times solution; 65% Daisen WP 500-600 times solution or 50% Brett WP 1500 times solution. Generally, spraying starts from late April to early May. Spray for 2-3 times with internals of 10-15 days.

2) Anthracnose

① Strengthen cultivation management by winter pruning and removal the diseased fruits for burying or burning. ② Early detection of diseased fruit. Once detected, immediate remove them to prevent break-out. ③ Pay attention to the timely control of orchard pests. ④ In combination with the control of leaf spot disease, spray 0.5% Bordeaux solution to protect the fruit, or spray 1000 times of 50% abacteria wettable powder, or 600 times of 65% mancozeb wettable powder, or 700 times of 70% methiltobuzin. Apply once or twice with internal of 10-15 days.

3) White plumule disease

① The white striated feather disease has a broad spectrum in hosts, therefore it is better not to build an orchard in newly-cut forest lands. If an orchard is to be built in a newly-cut forest, the rotten roots must be picked up and removed.

② Diseased tree needs to be identified and removed, and quarantined with ditches to avoid spread-out.

③ Cultivation management should be strengthened by enhanced organic fertilizer application, strengthened cultivation and drainage to promote the development of root system and to improve the disease resistance of plants

④ The roots of trees with light damage can be drenched with 50% tobujin wettable powder with 300-500 times dilution.

4) Yellow caterpillar

① In winter, wipe the trunk or main branch with straw or cloth to eliminate the overwintering pupae on the branches. This is an effective method to control loquat yellow caterpillar.

② When the early larvae cluster on new leaves, artificial capturing needs to be used. Capture and kill them as they tend to stay on the trunk.

③ Adopt the lamp seduction. Set up lamps in the orchard to trap and kill the adults.

④ In sprout stage of loquat and larva hatching period, spray pesticide to protect the sprout. Use 90% trichlorfon crystal or 80% dichlorvos emulsion 1000 times or 20% fenpropathrin emulsion 5000-6000 times; 50% fenitrothion emulsion or 50% thiophosphate emulsion 800 times; 2.5% rotenone 500 times, or spray directly with 25% and 40%

trichlorfon powder.

⑤ Protect and utilize natural enemies by increase natural parasitism rate to control damage.

5) navicular caterpillars

① Capture larvae artificial. Take advantage of the habit of colony damage and the larva silk spinning when frightened to and falling down at low age, shake the trees and catch the larvae.

② Spray control. Apply 90% trichlorfon 1000 times or 80% dichlorvos 1000-1500 times; 20% fenprothrin 3000-4000 times; 2.5% deltamethrin 3000 times

③ For adults, use black light lamp to trap and kill.

④ In winter use deep-digging to kill or frozen the pests.

6) Mulberry Longicorn

① In the adult stage, artificial habits are captured by using the habit of flying at 9 o'clock in the morning and after the rain, and biting the skin of the branches. You can also tap the branches with a stick to stun them to the ground and collect them.

② Do not plant mulberry trees around the orchard, or mix with mulberry trees.

③ In the initial stage of adult larvae, spray 50% phoxim emulsifiable concentrate or 50% chlorpyrifos EC 1000 times on the trunk and branches, and spray again after 12 to 15 days to eliminate adult worms before laying eggs.

④ In the adult stage, the wound of oviposition and defecation should be checked frequently. If found, the eggs can be killed by piercing into the oviposition groove with a sharp tool such as a knife tip.

⑤ Larva damage period. According to the position of fresh feces on the ground, find out the wormhole of larvae, inject 50% dichlorvos 50 times solution into the wormhole at the bottom with syringe, then block the hole with clay, or dip the cotton ball with solution, use thick wire to plug the hole below, and then use clay to plug the hole

⑥ The larvae were killed by aluminum phosphide. Use 52% aluminum phosphide tablets (3 g per tablet), according to the dosage of 1 / 6 of each wormhole, use tweezers to

insert the tablet into the wormhole, and immediately seal it with mud. To connect piece of wormhole, usable plastic film is wrapped tightly. Put aluminum phosphide in the film, 4-5 pieces per cubic meter. But pay special attention to safety when using this medicine.

(6) IPM measures for main diseases and insect pests of edible fungi

1) Brown rot

Before the covering soil is put into bed, it should be strictly disinfected. If the covering soil is polluted by verruca, pasteurization method (60 °C) can be used for one hour to reduce the initial infection source. Pay attention to the environmental sanitation inside and outside the mushroom room, and thoroughly remove the sick and disabled tissues. In the early stage of the disease, we should stop spraying water immediately and increase the ventilation of the mushroom room. We can spray 1:1:50 Bordeaux solution (quicklime: copper sulfate: water) on the mushroom bed to protect the healthy mushroom from damage. When the disease is serious, it is necessary to remove the original covering soil and replace it with a new one; and destroy the sick mushroom and soak all the tools in the formaldehyde solution with a concentration of 4%.

2) Bacterial rust

Cultivation management and prevention. Disinfect the mushroom farm and purify the water quality; strengthen the ventilation of the mushroom farm, cool down the heat and avoid spraying with large water; sow timely to avoid the mushroom season with high temperature and humidity. In addition to timely control, high resistant varieties should also be selected in the mushroom farms with high incidence of bacterial rust. an antidote against the disease. In the early stage of bacterial rust, ventilate and disperse dampness, spray 1% lime solution or 0.2% bleaching powder solution. If the disease is serious, the mushroom should be removed first, the yellowing surface mycelium should be scraped off, and 5% lime liquid should be sprayed, or a piece of strong chlorine disinfectant tablet should be added with 4 kg water to dissolve and then sprayed for 2-3 times.

3) Bacterial canker

Use clean water mixture, properly control the moisture content of the culture material at the germinating stage, properly reduce the relative humidity of the air in the mushroom room at the germinating stage, strengthen the ventilation, and prevent the water from accumulating in the mushroom bag when spraying water. Once the sick mushroom is found

on the mushroom bag or the mushroom bed, immediately remove it, stop spraying water, and strictly prevent the spread of bacteria. Chemical control can refer to the control measures of bacterial rust.

4) damping-off disease

Sterilization of soil cover is the main method to control the disease. Generally, 1:500 carbendazim or tobuin solution is used to spray for disinfection and sterilization.

5) blight

When the fruiting body withers, we should first find out the cause of the disease and take corresponding measures. Do not spray medicine in the mushroom room after the mushroom is produced, otherwise it is easy to cause harm. Especially for oyster mushroom and pleurotus sajor-caju, it is absolutely not allowed to spray pesticides during the mushroom growing period.

6) Edible fungus mite

Fumigation to kill mites: dip the cotton ball in dichlorvos, put it on the bed frame bottom material surface, and then cover the bed surface with plastic film to make the medicine evaporate and fumigate to kill mites. **Rapeseed cake entrapment:** lay a number of wet cloth on the material surface harmed by mushroom and mite, and sprinkle the newly fried rapeseed cake on the wet cloth. When the mite gathers on the rapeseed cake powder of the wet cloth, remove the wet cloth and put it in boiling water for a moment to kill the mite. **Sugar and vinegar solution entrapment:** Take 1 part of acetic acid, 1 part of clear water, 0.1 part of white sugar, mix well, then drop 1-2 drops of dichlorvos, that is to say, prepare the sugar and vinegar solution. Soak the liquid medicine with gauze or cotton and put it on the material surface. When mites gather on it, remove the scalded insect. Repeat until there is no mite. **Trapping and killing of fresh bone:** put the fresh pig bone on the bed surface infested by mushroom and mite, and discharge them alternately. When the mites gather on it, put the bone in the water for a moment to kill the mites. Repeat several times until there is no mite on the bed. **Spray killing mites:** use 50% Omethoate 1000 times liquid, chrysanthemum ester 1500 times liquid or kite 500 times spray to kill mite. Spray 400 times with detergent powder for 2~3 times. It also has a good acaric effect.

7) Gall midge, eyebug, flea fly

Adopt standard mushroom house or plastic shed, and install gauze net. The mushroom house shall be thoroughly cleaned before use, and then 800 times of trichlorfon or dichlorvos shall be used for extermination. For outdoor cultivation, weeds around the cultivation site shall be removed and 200-300 times of trichlorfon solution shall be used to spray the soil. Lure and kill adults. We can use the phototaxis of adults of gall midge, ocular fungus mosquito and flea fly, and use black light lamp or fluorescent lamp to trap and kill. Hang dichlorvos cotton ball or place dichlorvos medicine basin around the lamp. A small amount of dichlorvos can also be added to honey, molasses, etc. for trapping. Chemical control: fumigation in mushroom house: under closed conditions, 2-3 pieces of aluminum phosphide are fumigated per cubic meter of space to kill pests. Spray 500 times solution of trichlorfon or 500-800 times solution of dichlorvos, kill 1000 times solution of dichlorvos, etc. to kill pests; when pests occur in the mushroom stage, first collect all mushrooms, and then spray the above pesticides to kill pests.

(7) IPM measures for main diseases and insect pests of vegetables

First, agricultural control technology. Select resistant varieties, cultivate disease-free, insect free and strong seedlings, clean the fields, remove the sick remains, remove the sick old leaves, apply fertilizer reasonably, adjust acid and calcium, and apply organic fertilizer. **Second, physical control technology.** The techniques of trapping moths with insecticidal lamp and yellow (blue) plate were used. **Third, the prevention and control technology of sex inducer.** To popularize and use the special lure killing technology of *Plutella xylostella*, *Spodoptera litura* and *Spodoptera exigua*. **Fourth, biological control technology.** To promote the application of biological agents such as *Bacillus brevis*, *Metarhizium anisopliae* 421, *Beauveria bassiana*, natural pyrethrum, rotenone, BT and NPV to control vegetable pests, the technology of ningnanmycin to control virus diseases, the technology of ethyl polychloride to control *Plutella xylostella*, *Spodoptera litura* and *Spodoptera exigua*, and the application of amino oligosaccharide and brassinolide to improve disease resistance, stress resistance and yield Immune inducers and growth regulators. Fifthly, scientific and rational use of high-efficiency and low toxicity chemicals and application of precise application technology.

3.4 Principles for the Use of Pesticides in the Project Area

3.4.1 Pesticide Types Recommended

In the process of project implementation, the use of pesticides and agricultural measures, physical measures and biological measures shall be integrated to make the use complying with the economical, safe and effective principles. According to related laws and regulations of China, the IPM methods and the principles of integrated treatment

(1) Pesticide types prohibited in China

List of the pesticide prohibited in production, sales and use

BHC (II), DDT (II), toxaphene (II), dibromochloropropane (II), Chlordimeform (II), dibromoethane (II), herbicidal ether (III), aldrin (II), dieldrin (I b), mercury preparation, arsenic (I b), lead (I b), diquatil (II), fluoroacetamide (I b), Ganfu (II), tetramine (I a), sodium fluoroacetate (I a), tetrathione (I a), methamidophos (I b), methyl parathion (I b), parathion (I b), monocrotophos (I b), phosphamine (I b), benzenolphos (I b), dinoflagellate parathion (I b), methylthiocyclophosphate (I b), calcium phosphide (I B), magnesium phosphide (I b), zinc phosphide (I b), parathion (I b), fly poison phosphorus (I b), Chilo borer control phosphorus (I b), terbuthion (IA), formis (II), formis (II), Chlorsulfuron (U), methasulfuron (U) and tamesulfuron (U), Baicao low water agent (II). Since July 1, 2017, it is prohibited to sell and use the original medicine and compound preparation of Metsulfuron (U) and tamsulfuron (U).

List of pesticides prohibited in vegetables, fruit trees, tea tress and Chinese medicinal plants, etc

It is forbidden to use phorate (IA), isosalix methyl (IB), endosorbent (IA), carbofuran (IB), aldicarb (IA), methomyl (II), thiocyclophosphate (IB) and chlorzofos (IB) in vegetables, fruit trees, tea and Chinese herbal medicines. It is forbidden to use dicofol (II) and fenvalerate (II) on tea plants. It is forbidden to use succinylhydrazide (U) on peanut. The use of fipronil (II) in other aspects is prohibited except for some seed coating agents used for hygiene and corn in dry land. The use of Isocarbophos (IB) on citrus trees is prohibited. Methomyl (IB) is prohibited to be used on citrus, apple, tea and cruciferous vegetables. Endosulfan (II) is forbidden to be used on apple trees and tea trees. It is

forbidden to use bromomethane (IB) on strawberries and cucumbers. It is forbidden to use Omethoate (IB) on cabbage and citrus trees. Chlorpyrifos (II) and Triazophos (II) are forbidden to be used on vegetables since December 31, 2016.

All pesticide products can only be used in the scope approved in the pesticide registration, and the use out of the scope is prohibited.

3.4.2 Pesticides Recommended by the World Health Organization

The grading standards for pesticide hazards recommended by the World Health Organization were adopted at the 28th World Health Legislative Assembly in 1975. In order to meet the environmental requirements of the new situation, the WHO revised the pesticide grading standards in 2009 (Table 3). The classification of pesticide toxicity is mainly based on acute oral and dermal toxicity in rats, which has become a standard method for determining toxicity classification in toxicology.

WHO's pesticide hazard grading standards are detailed in the table below.

Table 3.4-1 WHO's pesticide hazard grading standards (2009)

Grade classification	Level sign language	LD50 (mg/kg)	Median Lethal Dose (mg/kg)
Ia	Very toxic	<5	<50
Ib	High toxicity	5-50	50-200
II	Moderate poison	50-2000	200-2000
III	Low toxicity	>2000	>2000
IV	Non-toxic	≥5000	≥5000

According to the lethal dose LD50 (mg/kg body weight) of oral and transdermal feeding in rats, the World Health Organization (WHO) and China have respectively established the acute toxicity classification standards for pesticides. World Health Organization (WHO) pesticide toxicity is divided into IA: extreme hazard, IB: high hazard, II: moderate hazard, III: mild hazard and IV: no hazard, highly toxic and high corresponding to the Chinese pesticide acute toxicity grading standards Five levels of poisonous, moderately poisonous, low toxicity and non-toxic.

In the prevention and control of pests and diseases, strict implementation of the WHO Guidelines for the Classification of Pesticides (2009), the use of Class I is prohibited, and

Class III and Class IV are preferred.

The recommended pesticides are shown in Table 3.4-2.

Table 3.4-2 list of recommended biopesticides

Crop name	Types of pesticides used	Pesticide classification (WHO)
Rice	streptomycin sulfate, mancozeb, carbendazim, thiophanate-methyl, acetamiprid, imidachloprid, Abamectin, Deltamethrin, Cyfluthrin, cypermethrin	III and IV
Tea	biphenthrin, cyhalothrin and emamectin, Zolamide, diafenthiuron, dinotefuran	III and IV
Rape	prochloraz, dimetachlone and carbendazim	IV
Loquat	bordeaux mixture, thiophanate-methyl, Carbendazim, Zineb, benomyl, tuzet, fenvalerate, Aluminium phosphide	III and IV
Citrus	tuzet, mancozeb, streptomycin sulfate, thiophanate-methyl, carbendazim, bromothalonil, Propargite, Chlorpyrifos, Abamectin;	III
Edible fungi	Thiabendazole, Abamectin, Deltamethrin	III, IV, III

The list of recommended pesticides listed in the above table is completely consistent with the World Health Organization (WHO) pesticide toxicity classification list and China Pesticide acute toxicity classification standard list. The pesticides in the list of recommended pesticides in Table 3 belong to two levels, i.e. III: low toxicity and IV: non toxicity, among which the ones with "*" are biological pesticides, which belong to the non-toxic category. The above-mentioned recommended pesticides fully meet the requirements of the World Bank and relevant national documents and policies. Pesticides listed in the World Health Organization (WHO) IA and IB levels and those listed in China's latest banned list shall not be purchased and used in this project.

This project will give priority to agriculture, physics (such as trapping), biological control measures or biological pesticides (such as Bt) that are equivalent to synthetic pesticides. This project mainly supports pest control measures. These measures have the least impact on the environment and humans and animals. In addition, the same pesticide will be discontinued and reused for similar crops to avoid drug resistance. All applicable pesticides shall be products registered by the state. They shall be used correctly in accordance with the guidelines for the rational use of pesticides (national standards). They shall be safe for people and target crops. They shall be used correctly in accordance with the labels and instructions of pesticide products (formulated in accordance with the

administrative measures for pesticide labels and instructions). They shall be safe for the environment. The regulations of the people's Republic of China on the administration of pesticides stipulates that those who produce, manage and use pesticides within the territory of the people's Republic of China shall abide by these regulations. The regulation has made detailed regulations on pesticide registration, production, operation and use.

3.5 Pesticide Management

3.5.1 Pesticide Use Management

1. Local agricultural departments should strengthen guidance on the safe and rational use of pesticides. According to the occurrence of agricultural diseases and insect pests in the region, a plan for the use of insecticides in rotation shall be formulated, and insecticides shall be used in rotation in a planned way to slow down the resistance of diseases and insect pests and improve the control effect.

2. When using insecticides, farmers shall abide by the safe operation rules for pesticide application, make correct dispensing and application, do a good job in waste disposal and safety protection, and prevent pesticide pollution and pesticide poisoning accidents.

3. When using insecticides, farmers shall abide by the regulations of the state on the safe and rational use of insecticides, and apply them according to the prescribed dosage, frequency, method and safety interval to prevent pollution of agricultural and sideline products.

4. Farmers should pay attention to protecting the environment, beneficial organisms and rare species when using pesticides. It is strictly prohibited to poison fish, shrimp, birds, animals, etc. with insecticides.

5. Agricultural technology departments shall strengthen guidance on the safe and rational use of pesticides for forestry, grain storage and health.

6. The plant protection personnel of the local plant protection station shall timely and accurately register the use of insecticides in the county, and make a good record of the use of insecticides.

7. Before spraying in the field, the farmer should report the type and name of the insecticide to the plant protection personnel. During spraying, the plant protection personnel should go to the site to check the use of the insecticide and guide the farmer to spray in time.

8. The packages of pesticides used by farmers shall not be littered at will

9. Establish and improve the responsibility system for pesticides to prevent any phytotoxic accidents. The preparation and spraying methods of pesticides should be correct. The dosage of pesticides must be accurate to prevent any wrong spray, heavy spray, leaking spray, and dosing in the ground. the wind direction should be selected when spraying, pay attention to avoid the harm of pesticide drift to adjacent crops.

10. The local agricultural department needs to establish a sound pesticide management system, establish a warehouse storage file, indicate the name of the drug, and manage it separately according to the characteristics, and implement strict procedures for entering and leaving the warehouse. The pesticides must be signed by the agricultural technicians before they can be used.

3.5.2 Insecticide Use Accident Rescue Measures

1. In the event of an accident (such as a fire, poisoning, etc.), you should call 110 or 120 emergency number immediately. Personnel are quickly evacuated to the safe area to prevent casualties;

2. Immediately organize the rescue of victims, organize evacuation or take other measures to protect other personnel in the hazardous area;

3. Quickly control the source of danger, detect and monitor the damage caused by pesticides, determine the hazardous area of the accident, the nature of the pesticide and the degree of damage;

4. In view of the actual hazards and possible hazards caused by accidents to human bodies, animals and plants, soil, water, and air, measures such as closure, isolation, and decontamination should be taken quickly.

3.6 Technical Requirements for the Pesticide-Appling Instruments

Pesticide is an indispensable means of agricultural production, and there must be good pesticide-applying instruments to enable scientific, rational and safe pesticide applying. Generally, the following aspects shall be taken into consideration in the selection of pesticide applying instruments or for the technical requirements.

1) The types of the pesticide-applying instruments are determined by comprehensively

considering the prevention and treatment targets and sites, crop varieties and growth status, pesticide formulations, applying methods and prevention and treatment scale. For fruit trees, it shall also consider the fruit tree size, height, tree-to-tree inter-space as well as the adaptation of the instrument to be operated in the field and the tree-to-tree pass-through.

- Hand sprayer shall be used for pesticide spraying in a small area;
- Backpack motorized sprayer shall be used for pesticide spraying in large area, and the air-assisted mist sprayer shall be used in orchards;
- Ultra long-range spray gun sprayer shall be used in pesticide spraying in large area.

2) Proper spray-head shall be selected according to the prevention and treatment requirements of pests, diseases, weeds and other harmful organisms and the type of the pesticide applying instruments, the worn spray-head shall be replaced regularly.

- The fan-shaped sprayer shall be used in spraying herbicides and plant growth regulators, which is characterized by the fan-shaped plane of the mist sprayed, even mist drop of less drifting;

- The hollow conic spray-head shall be used in spraying pesticides and bactericides, which is characterized by thin mist drop that drifts easily and contacts the leaf blades from different directions;

- Different types of spray-heads shall not be used on the same spray lever.

3) The pesticide-applying instruments that are manufactured by formal producers and have quality certificates shall be used. In purchasing, the completeness of the packing conditions and the completeness of the random technical documents and accessories and fittings shall be checked according to the packing list.

4) The pesticide-applying instruments shall not be applied to multiple uses. Generally, the sprayer used for spraying pesticides or bactericides shall be cleaned first before being applied for spraying other pesticides or bactericides; the sprayer used for spraying herbicides generally shall not be used in applying other kinds of agricultural pesticides.

3.7 Ability to Use and Dispose Pesticides

At present the pesticide dealers and peasants varied in the pesticide product treatment ability in the acceptable risk scope (e.g. safe storage, using safe instruments, possessing

protective clothes, safe treatment of discarded pesticides and their packages). The trainings plan is recommended for the peasants and chemical dealers to resolve this problem. Nevertheless, the local supervision and evaluation plan will regularly supervise the chemical safe use and treatment ability of the peasants and chemical dealers. Further trainings will be provided in the regions of unsafe chemical operation measures.

3.8 Environmental Risk

(1) Main environmental risks in the use of pesticide in the project regions:

① the pesticide residue causes the deterioration of water quality, the potential risks reduce the number of aquatic organisms (e.g. fishes and aquatic insects);

② spraying pesticide and chemical spilling around drinking water source cause the pollution of water supply;

③ the use of highly toxic pesticides impacts the non-target species (especially bees, birds, livestock and natural enemy of pests);

④ long-term over-amount use of certain pesticide causes the pesticide resistance of pests, diseases and rats;

⑤ soil pesticide residue causes pollution of soil;

⑥ Most pesticides are organic compounds, a few are organic-inorganic compounds or pure minerals, and individual pesticides contain heavy metals such as Hg, As, Cu, and Zn in their composition. Fungicides often contain Cu and Zn. For example, they are widely used in fruit trees and greenhouse crops, often causing Cu and Zn accumulation in soil to reach toxic concentrations.

⑦ Non-point source pollution caused by pesticide packaging waste

(2) Measures reducing the above risks include:

① providing trainings to the peasants and chemical retailers concerning the possible impact of specific pesticides on environment, recommending better spraying instruments and methods;

② Cooperating with the area town government and agricultural technical department, standardizing , supervising and monitoring the spraying operation to ensure the clean of

water source;

③ Recommending the safe spraying instruments with national certification in the project regions;

④ Using efficient, low toxic and low residue pesticides;

⑤ Publicizing and applying biological prevention and treatment measures, reducing the usage amount of chemical pesticides as far as possible

⑥ The application times of Cu and Zn containing pesticides such as mancozeb (U) and Bordeaux solution (III) were controlled to reduce soil accumulation.

⑦ Set up a centralized recycling station for pesticide packaging waste to collect.

3.9 Professional/Health Risks

(1) The professional/health risks generated in pesticide application mainly include:

① The gas emitted in pesticide formulation and spraying with no protective measures causes harm to human body;

② When not wearing protective clothes, the pesticides sprayed and spilled cause skin burn injury;

③ The location for pesticide spraying is close to the drinking water source, causing pollution to drinking water, or there occurred chemical spilling near the drinking water source.

(2) Measures reducing the above risks include:

① Provide trainings on the knowledge of pesticide safe use, delivery, storage and waste handling to the peasants and pesticide dealers. The main training contents include: the professional/health impact possibly incurred by certain pesticides; recommended operation and spray methods; approved spray instruments and use method; wearing safe clothes (long sleeve clothes, muffles, caps, gloves, length pants and shoes); what weathers to spray pesticides; how to safely store agricultural chemicals; how to safely dispose pesticide wastes and packages, etc.

② Supervise and investigate into the implementation of above measures; when the measures are poorly implemented, publicizing and trainings shall be strengthened;

4. Implementation Arrangement of Pest Management Plan

4.1 Organization Arrangement and Responsibilities

The project relies on the existing monitoring, prediction, prevention and control system and plant protection station of plant diseases and insect pests and epidemic diseases in 11 project counties (cities) involved in the project of Hubei Province. The project office of Hubei Province, city and county is responsible for the management of animal and plant diseases and insect pests.

The provincial project office is responsible for formulating the general pest management plan of the project and guiding and supervising the pest control of the leading industries of each project.

The municipal project office shall be responsible for guiding and supervising the implementation of the project county pest management plan.

The county project office shall be responsible for guiding the project owner to supplement and implement the comprehensive plant pest management plan in combination with the specific needs of the project, training agricultural technicians at all levels and farmers on the comprehensive plant pest management method, monitoring the implementation of the pest management plan, proposing solutions to the problems found in time and reporting to the municipal and provincial project offices.

The plant protection station where the project is located shall participate in the implementation and training of the integrated management of animal and plant pests and diseases, and is responsible for the monitoring of pest management in the county.

4.2 Mechanism and Process of Pest Management.

The purchase, storage, transportation and use of pesticides in this project will strictly follow the relevant national laws and regulations. The county project office shall guide the project owner to control and manage according to the following process.

4.2.1 Pest Management Planner management

Each project office shall assign special personnel to be responsible for the management of diseases and insect pests, and make clear its annual tasks, objectives and responsibilities.

4.2.2 Cost Management

The purchase of pesticides shall be in strict accordance with the requirements of the operation manual of the project. The project owner shall keep the purchase, distribution and use records in detail so as to audit the purchase cost.

4.2.3 Implementation and Management of Pest Management Plan

Each county shall regularly hold joint conference on disease and pest management plan composed of county-level project office, plant protection station, animal husbandry and veterinary station and other relevant departments, cooperative leaders, representatives of farmers, etc. to summarize and report the implementation of disease and pest management plan, and timely solve and adjust the problems.

4.2.4 Pesticide Supply and Use Management

(1) According to the actual and possible occurrence of animal and plant diseases and insect pests in the industrial development process of the project area, the recommended purchase list of pesticides (see table 2.3-1, 3.4-1, 3.4-2) shall be prepared; the pesticides in the purchase list must have the product registration certificate and production license approved by the state; under the same conditions, the priority shall be given to the purchase of biological agents and products with small toxicity; the relevant Pesticides not in the recommended purchase list shall not be purchased, used and reported; due to the actual situation, if it is necessary to purchase products not in the list, it is necessary to organize experts to demonstrate in time and get approval from the provincial project office.

(2) According to the actual occurrence of plant pests and diseases, such as the actual occurrence of plant pests and diseases, the project owner lists the names and dosages of pesticides to be purchased in the annual work plan, and purchases and uses them according to the requirements of the operation manual of this project.

(3) The project's owner mainly keeps records of purchases, issuances, and usage in detail for project monitoring and auditing.

4.3 Skill Building

4.3.1 Training

The training content should mainly include the following aspects:

- National and local laws and regulations

- Project integrated pest management plan and implementation
- Methods of pesticide procurement and safe use.
- Identification, prevention and integrated management techniques for major pests and diseases of the project

Training on safe use of pesticides:

- Special training was given to village cadres, farmers and pesticide sales personnel on the possible environmental impacts of pesticides, recommended application methods and equipment.
- Training and demonstration of village cadres, farmers and pesticide sales personnel to raise their awareness of the following issues.
 - Occupational/health effects of various pesticides
 - Recommended treatment and application methods
 - Approved equipment (e.g. sprayer, nozzle size, etc.) and how to use it
 - Wear safety clothing (long-sleeved shirts, masks, hats, gloves, trousers, shoes)
 - Applying medicine in calm weather
 - Store pesticides safely and keep them out of the reach of children in locked cabinets
 - Safely dispose pesticide packages and wastes, and bury or burn them as deep as possible
- The implementation of the above operations is monitored. If it is not implemented correctly, retrain it.
- Implement the listed project management measures

Purchasing pest and disease physics and biological control tools in the project, using a variety of pest control techniques (agriculture / physics, biology, chemistry) to ensure that pests and diseases do not become resistant to pesticides.

4.3.2 Policy Implementation

Through the implementation of the project, the awareness of implementing integrated pest management has been strengthened, as follows:

- Strictly implement the pesticide management regulations.
- Unregistered pesticides are prohibited from being used in project activities.
- The use of WHO Class I pesticides is prohibited in project activities.
- Strictly observe the following regulations:
 - FAO code of Practice for the management, sale and use of pesticides (or corresponding legal documents in China).
 - FAO pesticide packaging and storage guidelines (or corresponding legal documents in China).
 - FAO Guide to correct labeling of pesticides (or corresponding legal documents in China).
 - FAO Waste pesticide and pesticide container treatment guide (or corresponding legal documents in China).
- The implementation of the environmental standards of the Ministry of Environmental Protection on agricultural chemicals, including pesticides, and the ecological demonstration counties should also implement the environmental standards of the ecological demonstration counties.
- County and township governments are encouraged to promote and support the IMP approach by discussing and providing success stories of the IMP program and its benefits (especially long-term benefits).
- Farmers who are required to participate in the construction of the demonstration base are required to purchase permitted and registered pesticides.
- Give priority to funding the IMP research and promotion of this project.

4.4 Supervision and Management

Through the implementation of the project, the awareness of implementing integrated pest management has been strengthened, as follows:

- Strictly implement the pesticide management regulations.
- Unregistered pesticides are prohibited from being used in project activities.

- The use of WHO Class I pesticides is prohibited in project activities.
- Strictly observe the following regulations:
 - FAO code of Practice for the management, sale and use of pesticides (or corresponding legal documents in China).
 - FAO pesticide packaging and storage guidelines (or corresponding legal documents in China).
 - FAO Guide to correct labeling of pesticides (or corresponding legal documents in China).
 - FAO Waste pesticide and pesticide container treatment guide (or corresponding legal documents in China).
- The implementation of the environmental standards of the Ministry of Environmental Protection on agricultural chemicals, including pesticides, and the ecological demonstration counties should also implement the environmental standards of the ecological demonstration counties.
- County and township governments are encouraged to promote and support the PMP approach by discussing and providing success stories of the PMP program and its benefits (especially long-term benefits).
- Farmers who are required to participate in the construction of the demonstration base are required to purchase permitted and registered pesticides.
- Give priority to funding the PMP research and promotion of this project.

4.5 PMP Implementation Report

- The project undertaker is obliged to submit the project progress report in time, submit the project mid-term performance report in the middle of the project implementation, and submit the project performance report at the end of the project.

The project annual report and interim report include project implementation period, project fund usage, project progress, project implementation effect, different between project implementation effect and expected effect, problems and solutions in project execution.

The report submitted at the end of the project shall include the project implementation period, project fund usage, project progress, project implementation effect and evaluation, differences between project implementation effects and expected effects, problems and solutions in project implementation. Project implementation effect evaluation refers to the adoption of standardized promotion technology in the project, the increase of farmers' income, the improvement of living standards due to the use of new technologies, the quality and safety of agricultural products, the impact on ecological environment, project sustainability, project organization and management, etc. Through the effect evaluation of the completed project to analyze the overall results of project implementation.

4.6 Work Plan and Cost

During the implementation of the project, each project county shall formulate an annual training plan and budget for pest management, which may be implemented after being examined and approved by the provincial project office. The annual training plan includes: training times, number of participants, training place, training plan, training materials and other details. The basis for payment of training activities is: (1) training materials prepared; (2) evidence of training courses held that can be monitored (records of number of participants, educators and duration).

Table 4.6-1 training plan and budget

Training content	Organizer	Training object	Annual training number* day	Total number of trains *	Time schedule (annual)	Estimated cost (RMB million)	Remarks
1. Provincial							
(1)Laws and regulations, Pest Management Plan	PMO	Cm, Ct	22	110	Per year	4.4	400 yuan / person per day
(2)Forest pest control technology	PMO	Cm, Ct					
(3)Pesticide procurement, management and safe use	PMO	Cm, Ct					
total			24	72		4.4	
2. City, county							
(1)Identification,	CPM	Tt, Ft,					400

Training content	Organizer	Training object	Annual training number* day	Total number of trains *	Time schedule (annual)	Estimated cost (RMB million)	Remarks
prevention and integrated management techniques for pests and diseases	O	Fm	90	450	Per year	18	yuan / person per day
(2)Safe use of pesticides	CPM O	Tt, Ft, Fm					400 yuan / person per day
total			100	210		18	
Total funding				560		22.4	

Notes: PMO: Provincial Management Office; CPMO: City Project management office; Cm: county management; Ct: County technicians; Tt: Township technicians; Ft: County and township technicians; Fm: Project village cadres, heads of cooperatives or representatives of key farmers.

5. Monitoring of Pest Management

5.1 Monitoring Content

During the implementation of the project, it is necessary to conduct on-site monitoring on the implementation of the integrated pest management plan, the use mode of pesticides, the quality and yield of crops, the dynamics of major pests and natural enemy populations and the impact on the environment after the implementation of the project. The specific monitoring contents are as shown in the figure:

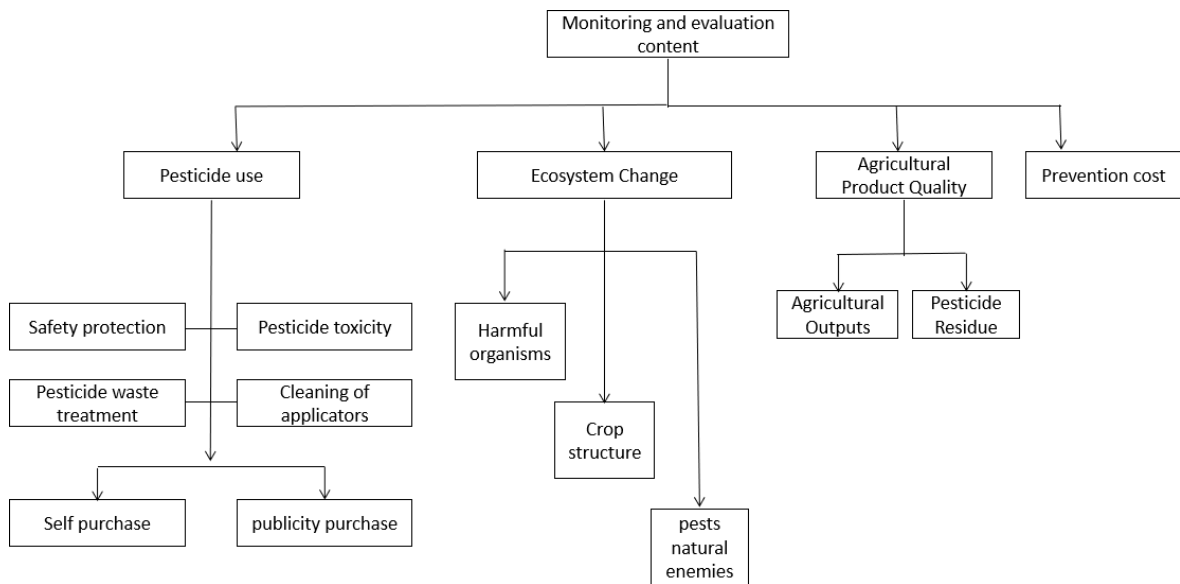


Figure 5.1-1 Schematic diagram of project monitoring content

5.2 Contents of Supervision

On-site monitoring is required when the following work is carried out during the project implementation period:

- Pesticide registration
- Policy release
- Implementation of local monitoring procedures and result analysis assistance

5.3 Monitoring Plan

5.3.1 Monitoring Plan

- (1) Implementation of monitoring plan

The monitoring work shall be carried out by the agricultural technology promotion service center at the municipal and district (county) levels, the project office and the owner in each township of the project implementation area. Once diseases and insect pests are found, they must be reported and dealt with in a timely manner. The bank's dispatched personnel should help establish appropriate monitoring system and sampling procedures as early as possible, and provide training in the implementation and analysis of monitoring system.

(2) Setting of monitoring points and monitoring crops

(2) According to the crop planting structure of the project demonstration township and the planting of the characteristic superior crops, the following monitoring points should be established at least in this project:

①Zhongxiang City, the key monitoring crops are rice, rapeseed, edible fungi

②Yiling District, the key monitoring crops are citrus, tea

③NanZhang County, the key monitoring crops are vegetables, rice, tea

④Duodao area, focus on monitoring crops for rapeseed

⑤In Jingshan District, rice is the key monitoring crop;

⑥Xiaonan District, focusing on monitoring crops for tea

⑦Gong an county, the key monitoring corps is rice

⑧In Honghu City, the key monitoring crops are rice and aquatic vegetables;

⑨Tongcheng County, the key monitoring crops are rice and tea

⑩Tongshan County, the key monitoring crops are loquat

(3) Data collection and sampling methods

According to the monitoring content, the data collection and sampling methods for key monitoring are shown in table 5-3-1.

Figure 5.3-1 List of monitoring and assessment of diseases and insect pests of main crops in the project area

Monitoring name	Focus on monitoring crops	Pesticide use				Status of farmland ecosystem				Output and quality status				Monitoring funds (Ten thousand yuan)
		type	Times	dosage (kg)	Monitoring times	Morbidity	Number of pests	Number of natural enemies	Monitoring times	yield	value of output	pesticide residue	Monitoring times	
Zhongxiang City	Rice				1				4				1	2.4
	rape				1				4				1	2.4
	Edible fungi				1				4				1	2.4
Yiling District	Citrus				1				4				1	2.4
	Tea				1				4				1	2.4
NanZhang County	Vegetables				1				4				1	2.4
	Tea				1				4				1	2.4
	Rice				1				4				1	2.4
Yongshun County	Corn				1				4				1	2.4
Duodao District	Rape				1				4				1	2.4
Jingshan District	Rice				1				4				1	2.4
Xiaonan District	Tea				1				4				1	2.4
Gongan country	Rice				1				4				1	2.4
Honghu	Rice				1				4				1	2.4

Monitoring name	Focus on monitoring crops	Pesticide use				Status of farmland ecosystem				Output and quality status				Monitoring funds (Ten thousand yuan)
		type	Times	dosage (kg)	Monitoring times	Morbidity	Number of pests	Number of natural enemies	Monitoring times	yield	value of output	pesticide residue	Monitoring times	
City	Vegetables				1				4				1	2.4
Tongcheng County	Rice				1				4				1	2.4
	Tea				1				4				1	2.4
Tongshan County	Rice				1				4				1	2.4

Remarks:

1. "Pesticide use" monitoring method: Two villages are selected for each monitoring point. During the harvest period of monitoring crops, the data of pesticide types, dosage, frequency of use and disposal of waste pesticides and packaging materials used for pest control of the crops are collected through questionnaires, surveys and other methods, and statistical summary is carried out;
2. "Farmland ecosystem status" monitoring method: select one demonstration village at each monitoring point, and investigate the types of diseases and insect pests, the occurrence of each kind of diseases and insect pests, as well as the types and quantity of natural enemies at the seedling stage, the adult stage, the fruit stage and the harvest and picking stage of the monitored crops. Each crop was investigated 4 times a year;
3. "Yield and quality status" monitoring method: select a representative village at each monitoring point, select three representative sample fields for yield measurement when monitoring crop harvest, and investigate crop quality and output value; at the same time, collect agricultural product samples for pesticide residue determination.
4. During the implementation of the project, it has been monitored for 5 years. As the specific implementation location (township, Village) of the project has not been finalized, the above monitoring crops may change.

(4) Monitoring and evaluation system

(1) Degree of adoption of integrated pest management control measures

- The number of farmers participating in the demonstration of integrated pest management and control measures;
- The area of crops with integrated pest management and control measures;
- Number of farmers able to identify major pests / natural enemies;
- Number of farmers participating in the training of integrated pest management plan;
- The control effect of integrated pest management and control measures on major pests and diseases.

(2) Safe use of pesticides

- The number of pesticides used per year on major crops or fruit trees;
- The types and quantities of pesticides used in each mu of main crops every year;
- The cost of pesticides used for the control of diseases and insect pests of main crops per mu per year;
- Number of farmers (safe storage, use of labor protection appliances, etc.) who implement safe use and disposal of pesticides;
- Rejection times of agricultural products due to high pesticide residues;
- Human and animal poisoning incidents caused by the use of pesticides.

(3) Agricultural product yield and quality

- The output of the main crops after the project implements the integrated pest management plan;
- Quality status of major crops (including quality, pesticide residues) after implementation of the Integrated Pest Management Plan
- The output and profit status of major crops after the implementation of the Integrated Pest Management Plan.

(4) Degree of impact on agro-ecosystems

- The area of major pests and diseases of major crops in different demonstration areas, and the degree of damage;
- The variety and quantity change of beneficial organisms (including predatory insects, parasitic insects, etc.) in each unit of quadrat of crops implemented in the integrated pest management plan;
- The degree of influence on wild animals, bees, water, soil, etc. after the integrated pest management control measures.

(5) Other indicators

- Number of times agrochemical product sales personnel visit the project area
- The number of times agrochemical products were advertised in the media (television, radio, newspaper);
- The number of times a pesticide product brand appears in the project area through retail channels;
- The number of acceptable pesticide product exhibitions;

5.3.2 Supervision Plan

1. Supervise the implementation of the plan

The project offices at all levels shall be responsible for ensuring the normal conduct of regular supervision activities. The project offices and agricultural technology promotion centers at all levels shall supervise and inspect the implementation of the pest management plan at the peak of the occurrence of pests and diseases, and cooperate with the World Bank supervision team to supervise and inspect the project. The World Bank supervision team should be composed of experienced pest control experts. The supervision inspection can be carried out 1-2 times a year, generally in the high incidence of pests and diseases every year.

2. Specific content of supervision and inspection

(1) Use of pesticides

- Check whether the pesticides used in the project demonstration area and the pesticides used by the farmers are the pesticides recommended by the registration and pest management plan;

- Check if Class I pesticides are sold/used in the project area;
- Check the pesticide registration list to verify the registration of new pesticides;
- Check whether farmers take protective measures in the use of pesticides;
- Check the disposal of discarded pesticides and packaging materials by farmers.

(2) Policy aspect

- Government subsidies (if any) for pesticide use;
- Implementation of policies and regulations on the use of pesticides and the integrated management of pest management by local governments.

(3) Implementation of the on-site monitoring plan

- Evaluate the implementation of the on-site monitoring plan of the counties inspected by the World Bank Monitoring Team;
- Help the relevant personnel of the project county to solve any problems arising from the implementation of the on-site monitoring plan;
- Relevant personnel in the project county will provide timely training on the on-site monitoring process, data analysis, and interpretation of results, and adjust the areas where pest and disease management still needs improvement.

5.3.3 Duties

The county-level plant protection department shall be responsible for providing the technology for integrated pest management, and shall be responsible for guiding, supervising, monitoring and training. Project managers at all levels and stakeholders sharing risk sharing have the responsibility to timely discover and report on the occurrence of pests and diseases, and fulfill the requirements consistent with the pest management plan.

5.4 Project Report

Project offices at all levels and county-level plant protection departments shall report to the relevant departments of the World Bank on the implementation of the project, one report per year, and two reports throughout the year. The contents of the report should include the main crops and areas in the project area, the occurrence and control of pests and diseases, pesticide use, ecosystem changes, agricultural product quality, cost of prevention

and control, and use of project funds.