SFG2977

World Bank Loan

Project of Utilizing World Bank Loans for Agricultural Nonpoint Pollution Control in Guangdong Province

Pest Management Plan

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Contents

1 Summary

World Bank loan Guangdong agricultural non-point source pollution control projects, aims to introduce international good agricultural practices, improve the conditions of agricultural production, accelerate agricultural transformation and upgrading. In Guangdong Province especially in the Pearl River Delta region selected project demonstration area for environmentally friendly planting and wastes, waste water management practice demonstration. Exploration of the control of agricultural non-point source pollution of new approach, new pattern, realize the agricultural source of pollution reduction goals for the impact of water pollution. Implementation of Guangdong Province "The 12th Five-Year Plan" energy-saving emission reduction task. Innovation of agricultural technology extension model of energy saving and emission reduction, change the mode of production, saving the cost of agricultural production, improve agricultural beneficial result, improve agriculture to develop a condition, agricultural non-point source pollution control to create the experience, realize sustainable development of agriculture. Project selection in Huicheng District, Huiyang District, Boluo County, Enping City, Kaiping City, Taishan City, Longchun County, Lianping County, Zijin County, Mei County, Dapu County, Wuhua County, Xingning City, Jiaoling County, Pingyuan County, Haifeng City, Lufeng City, Leizhou City, Lianjiang City, Gaozhou City, Huazhou City, Xingyi City, Yangshang County, Qingxing County, Lianshan County, Deqing County, Luoding City, Xingxing County and Yunan County is carried out, involving about 28000 hm^2 of cultivated land.

Through the implementation of the project, resource utilization and agricultural production waste, reduce chemical fertilizer, pesticide use and pollution, animal waste to any discharge, realized agriculture to produce low energy consumption, low pollution and low emission, improve production and living conditions of farmers, formation of resources and environment, person and natural harmony production environment, living environment, implementation economy, social and ecological

environment comprehensive sustainable development.

According to the project area agriculture production is actual, the project implementation process, the need to reduce pesticide fertilizer use, carry out IPM, pest control of hazard degree, reduce pesticide pollution, so the project implementation should pay more attention to sustainable agriculture technology application.

According to the world bank "Pest Management Environment Assessment of OP/BP4.09" and "Pest Management " provisions, combined with the project area pest occurrence situation and project activities may cause some new problems, we developed a " Pest Management Plan ".

The PMP program by encouraging farmers to adopt environmental friendly good agricultural practices and integrated pest management (IPM) technology, provide technical assistance, training of farmers, equipment procurement, monitoring and evaluation, improve product quality and safety level, reduce pesticide pollution. The main focus is as follows:

- In the project area introduction and popularization of PMP technology, including the establishment of biodiversity monitoring program, protection and utilization of natural enemies resources, strengthen pair of agriculture pest forecast.
- Introduction and demonstration of biological pesticides, plant source pesticide to replace chemical pesticide, put an end to the highly toxic chemical pesticide use, increase the integrated pest control techniques and biological pesticide usage, thereby reducing chemical pesticides to the environment and human health adversely affected.
- The counselor training, farmer field school, farmer flow training team, participatory training methods, improve farmers' practical skills, training farmers to master and integrated pest management skills. For the project area farmer pesticide storage and use of training, to improve the understanding of pesticide management and use of the provisions.
- As the technology extension station personnel, distribution of pesticides, county project office staff will provide training, improve their management plan (PMP) understanding.

- With the quality supervision departments to strengthen contact, increase pair of pesticide sales and use of supervision, to ensure compliance with the World Bank on the demonstration project requirements (OP/BP4.09) and other international conventions standards.

For the effective implementation of this plan, provincial IPM supervision steering group and the expert advisory group will be set up. Each city and county will establish project office. County and township will arrange special persons to take charge of the project implementation and management.

2 Background

2.1 Contents of PMP preparation

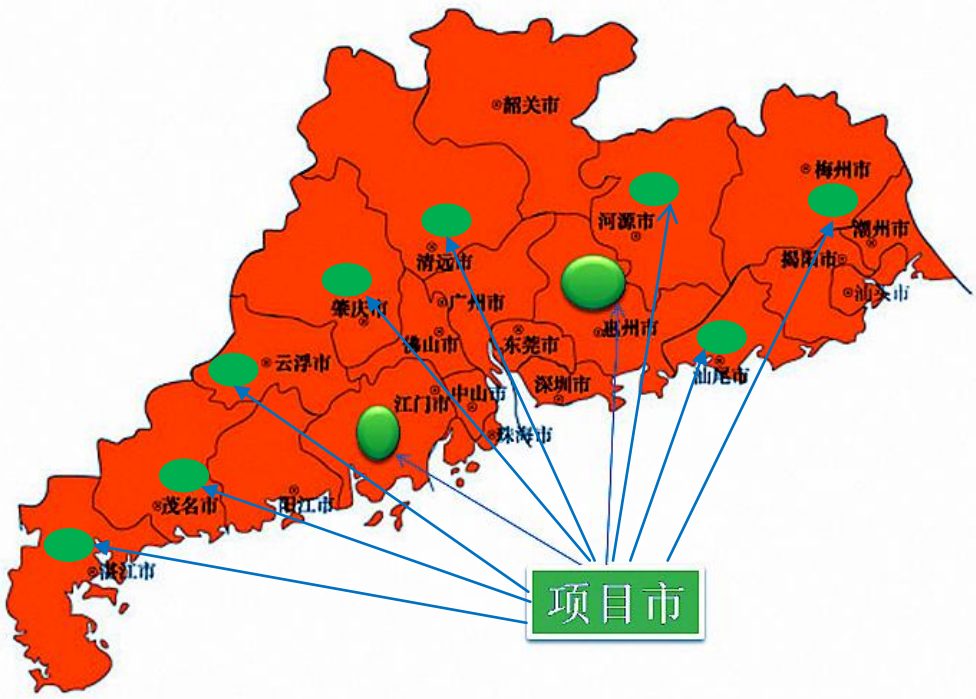
PMP program includes project overview, the background of the project, integrated pest management program, executive plan, work plan etc. PMP program area will be 28000 hm^2.

Fig 1. The geographical location of the project areas in Guangdong Province

2.2 Natural condition of Guangdong Province and major crop pests and diseases in the project areas

Guangdong belonging to the East Asian monsoon region from north to south, respectively, in the sub-tropical, subtropical and tropical climates, is one of the richest areas in the national light, heat, and water resources. The annual average temperature is about 19℃-24 ℃.

Guangdong is abundant rainfall and the average annual rainfall is between 1300 to 250



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diseases, has caused great difficulties for pest and disease control. The main crop production of Guangdong Province is as fellow:

In 2011, the province pest area was about 2.47 million mu times and rice pests and diseases area was 1.1 million mus. Planthoppers occurrence area was 3278 mus, and that of rice case worm, rice boring snout moth's larva, sheath blight, rice blast and southern rice black streaked dwarf disease was 2695, 1202, 2310, 476 and 105.92 million mu times respectively.

An area of vegetable pest was 5216 million mu times, among them area of Insect was 3912 million mu times. Occurrence of disease area was 1304 million mu times. Diamondback moth, striped flea beetle, whiteflies, melon thrips, aphids occurred heavier.

An area of 5437 million mu times fruit tree pests and diseases, insect pest in an area was 4204 million mu times, the occurrence of disease area was 1233 million mu times. *Panonychus citri* McGregor, *Phyllocoptura oleivora Ashmead, anthracnose, Conopomorpha sinensis Bradley*, *Eriophyes litchii* Keifer, *Peronophythora litchi* Chen ex ko al and *Colletotrichum sp* occurred more serious

The major crops planting area was 49520000 mu, and year consumption was 74090 tons of pesticide formulations, list in the table.

The crops planting area and consumption of pesticide in the project area in 2011

	Crops planting area（mu）	Rice（mu）	Vegetables（mu）	Fruits（mu）	pesticides（ton）
Heyuan	3400000	2040000	430000	510000	3233
Meizhou	5370000	2660000	970000	1120000	5533
Shanwei	2590000	1070000	630000	530000	2659
Zhanjiang	7420000	3280000	1750000	1300000	15893
Maoming	8700000	3080000	1370000	3520000	11891
Zhaoqing	5280000	2510000	1030000	1220000	6807
Qingyuan	5060000	2010000	1450000	920000	7803
Yunfou	3300000	1380000	310000	1200000	8970
Huizhou	4100000	1400000	1300000	900000	5256
Jiangmen	4300000	2300000	1200000	400000	6045

2.3 Guangdong Province pesticide usage

2.3.1 Pesticide usage

Perennial pesticide use quantity was 18000 tons (quantity of pure), herbicide accounted for about 25%, pesticides accounted for 50%. fungicide accounted for 25%. A variety of crop pesticide use types and annual consumption of fruit, vegetable consumption was up to, every hectare was about 3.8-4.0 kilograms, followed by the rice, every hectare was about 3.5 kilograms, sugarcane, groundnut with dosage little, every hectare was 2.5 kilograms.

2.3.2 Use of pesticides

Commonly used pesticide was DDVP, chlorpyrifos, Isocarbophos, Isoprocarb, cypermethrin, dimethoate, fenvalerate, bisultap, carbendazim, tricyclazole, jinggangmycin, butachlor, paraquat and glyphosate. These varieties was the most of the unit area with dosage big, control effect was not enough ideal.

2.3.3 Pesticide use

The province as a result of the use of plant protection mechanization level is low, add farmer spraying technology backward, so that the pesticide utilization rate is low, only 20-30%.

2.4 Crop pest management problems

Pesticide is a kind of indispensable important means of production. Prevention and control of plant diseases and insect pests in crops, raise produce yield, quality plays a very important role. But the unreasonable use of pesticides is also easy to cause some adverse effects, such as lead to person cultivate toxic, kill natural enemies, pollution of agricultural products and environment. Area of project management of

plant diseases and insect pests are the following:

(1) Do not pay attention to the effects of pesticides on Eco environment. Application of pesticides in the environment is getting more and more pesticide residues, and through various channels to ecological environment harm. In addition, plant diseases and insect pests resistance to pesticides and pesticide residues in agricultural products is more problematic. Specific performance: The first one is mainly depend on the chemical control method, excessive, excessive use of pesticides. The second is long single use the same types of pesticides.

(2) The irrational use of pesticides, improper operation. Pesticide application time, application times, application rate and method is not reasonable, not only effect could not be guaranteed, but also pollute the environment. Almost all farmers in the use of herbicides, and dosage was higher than recommended doses of herbicide. Likely to lead to the current crop phytotoxicity, also bring disaster to the next stubble crops. Most farmers do not know of herbicide on soil and groundwater effects, for example, corn field herbicide atrazine, not a very good grasp of pesticide application time, application rate and method.

(3) Spraying equipment is backward. One is the low level of mechanization. At present, the province's crop pest control area above 70% is through manual sprayer to complete. Two models and technology is relatively backward. Current my province common sprayer is mainly Gongnong-16 type, WFB-18 type and Gongnong-36 type sprayer with workers and peasants, models and technology is backward, sprinkler performance is poor, the spraying component is single, the product quality is inferior, leakage is more serious.

(4) Sometimes use highly toxic pesticides (WHO I). According to the provisions of China pesticide use, highly toxic pesticides banned for vegetables, fruit, tea and Chinese herbal medicine. However, the management of pesticide use regulations and farmer production actual gap exists between, there exists different degree of illegal use of highly toxic pesticides phenomenon

(5) Not reasonable storage of pesticides and other agricultural chemicals. Pesticide packaging waste is not harmless treatment. They are arbitrarily discarded fields.

(6) Of resistant varieties and biological control techniques are inadequate attention. Agricultural control measures were inadequate promotion. Comprehensive prevention and control measures were assembled and matched with the propaganda dynamics.

(7) Farmer, personnel of ability of basic level farming and pesticide distributors of integrated pest management understanding degree is low, especially the farmers lack of knowledge of PMP.

(8) Farmers pesticide safety science use of awareness is not strong.

2.5 Implementation of the project may occur after the risk assessment

Since the implementation of the project to reduce the use of chemical pesticides, we will improve farmers' comprehensive ability and philosophy of pest control. The resistance of pest will be controlled and the pest of the hazards be controlled at a reasonable level. Unless there is a serious natural disasters, such as a special drought or floods, or special invasive alien biological disasters, pests should be able to get reasonable control

3 National plant protection and pest management policy

Mainly includes:

(1) Pesticide Management Statute of PRC (Issued by State Department, put in force in May 8, 1997, revised in Nov. 29, 2001) That ordinance was enacted in order to strengthen the supervision and management of pesticide production and use. It could ensure the quality of pesticides and the protection of agricultural and forestry production and ecological environment and safeguard human and animal safety.

(2) Implementation Method of Pesticide Management Statute of PRC (Issued by Ministry of Agriculture in April 27, 1999, put in order and revised in Jan. 8, 2008)

(3) Manage Method without Pollution Agricultural Products (Issued by Ministry of Agriculture, Quality Inspection Quarantine Bureau in 2002)

(4) Pesticide Safety Using Standard of PRC (1982)

(5) Pesticide Restrict Use Management Stipulation issued by Ministry of Agriculture in Aug. 1, 2002. The stipulation established according to Pesticide Management Statute of PRC.

(6) Pesticide Safety Use Standard GB4285-84 and Pesticide Use in Reason Rule (GB/T8321.1-GB/T8321.7). Make regulation for use quantity, use times, safety space period, mix remain limit and use notice items of crops.

Through the enforcement of these standard and norm, in our country have established pesticide research, produce, application, inspection and management service system. Especially State Department issued Pesticide Management Statute of PRC in may 8, 1997, it is the first have law effectiveness pesticide management administrative law, it marked Chinese management of pesticide have steped into standardize, legal system and internationalization orbit, also marked Chinese management regulations of pesticide have formed.In jan. 2008, castigatory Implementation Method of Pesticide Management Statute of PRC have taken good guarantee role for Pesticide Management Statute of PRC implemention enforcement smoothly.

4 Chemical Supervision Organizations of Guangdong Province and Current situation

All levels of agricultural administrative departments in Guangdong Province, are responsible for the supervision of the pesticide production, management and use. **Responsibility of Each Division:**

Pesticide Inspection Institute of Guangdong Province is Responsible for pesticide registration of first Instance, and supervision and management.

Chemical management department of Guangdong Province is responsible for pesticide production planning, supervision and management of pesticide production, and specifically responsible for awarding the pesticide production license and approval documents of the production.

Technical Supervision, Industrial and Commercial Administration Bureau, and the Agricultural sector of Guangdong Province are responsible for supervision and management of the product quality, operating and market transaction of pesticide,in accordance with the national and local relevant laws and provisions.

Agricultural law enforcement organization is responsible for Supervision and management of the agricultural chemicals quality and market.

Township Integrated Agricultural Technical Service Center is responsible for Assist and coordinate with agricultural law enforcement and technical organizations to carry out technical promotion, training and guidance on pesticide management and integrated pest and disease control.

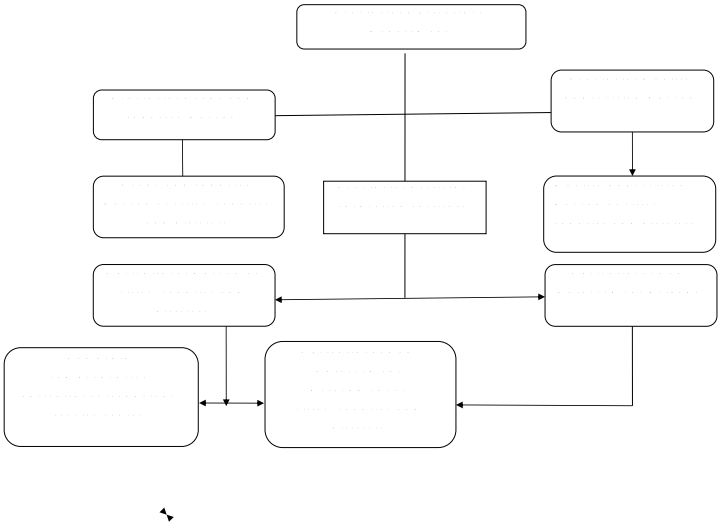

Figure 5 Diagram of regulatory agencies of pesticides in Guangdong Province

Qualified operating departments for pesticide:

1) Agricultural substance business department of supply and marketing cooperatives

2) Plant Protection Station

3) Soil and Fertilizer Station

4) Promotion agencies of Agriculture and Forestry

5) Control agencies for Forest pest

6) Pesticide manufacturers

7) Other operating departments allowed by State council

Pesticides used in the project areas must meet the national standards, industry standards or enterprise standards. The pesticide packaging should comply with the relevant provisions of GB3796-85 " General Principles of pesticides packaging" issued by the State Bureau of Technical Supervision, GB4838-84 " EC pesticide packaging", GB5736-85 "Pesticide used Calcification plastic corrugated boxes". Pesticide transport implementing the relevant provisions of national standards "Anti-toxicity Rules on pesticide storage, sale and use ". Storage shall comply with the the third general requirements in " Safety regulation of Pesticide use".

The laws and regulations of pesticide production, packaging, storage, transportation, sale and use in China are defective, comparing with the international laws and regulations. For instance, the related works in China has been starting in recent years, and there is a lot of work to be done. China are constantly revising and improving the existing ordinances to enhance the full supervision on pesticides to accord with the international standards gradually, including down-regulation of the limits of pesticide residues, etc.

There are similar situation of pesticides management between Guangdong Province and other province in China, majorly including inadequate regulatory, and illegal use of highly toxic pesticides, excessive use of pesticides, violation of the provisions of the pesticide safety interval by the farmers in many places.

The project aims to improve the systems, to enhance the supervision and management, to promote the use of PMP technics and controlling toxicity technology by pesticide reduction, to reduce agricultural pollution by pesticide inputs reduction, and to guarantee the safety of the environment of demonstration bases and the quality of agricultural products.

5 Present pest management situation in Guangdong Province

5.1 Pest and disease monitoring and early warning

Guangdong Province has complete pest monitoring and early warning system in all

the provincial, municipal and county levels, monitoring more than 50 kinds of plant disease and insect pests on major crops of food, vegetable and fruit. At present, there are 15 National Center for pest monitoring , 50 provincial pest monitoring points, 21 municipal pest monitoring points, and more than 130 county-level pest monitoring points. Monitoring points have established a long-term pest observations garden, pests forecasting lights, and implete weekly reporting system after investigation. According to the Pest monitoring data, the monitoring points at all levels have published the long, medium and short-term pest forecast or warning, the accuracy rate of which were more than 85%, 90%, 95%, respectively.

In 2005, Guangdong Province established the provincial biological disaster monitoring and early warning system for crops, helping to exchange Information, share resources, and improve transfer speed of pest information . Monitoring points around whole province reported the pest information through the system, plant protection agencies at all levels could also through understand the dynamic of pest. Provincial pest remote video surveillance system was established in Huizhou, Maoming City, etc, in 2008, functioning as real-time pest monitoring.

At present, pest information transferring still mainly count on the issuance of worms. However, pest television forecasts and mobile messages of pest situation are still not applied in the project area, requiring the construction funding.

The current pest monitoring and warning methods, still mainly rely on the traditional methods, be short of advanced scientific monitoring equipment, methods and methods, as lead to fail to meet the needs of the development of agricultural production.

5.2 Breeding and usage of resistant varieties

Using resistant varieties is one of the most effective, economy and convenient way to control crop pests. Especially, some stubborn diseases are difficult to be controlled by different agricultural measures and existed pesticides or biocontrol agents, for instance, soil-borne diseases, viral diseases, air-borne diseases, breeding and usage of

resistant varieties is particularly important. In the other hand, the non-toxic way is also effective to reduce the harm of rice blast, rice bacterial blight, pepper virus diseases, potato virus diseases, vegetables viral diseases, rice planthoppers, and rice gall midge, etc.

Usage of disease resistance varieties: promoting the horizontal resistance and durable resistance varieties, multi-line varieties or mixed resistant varieties. Multi-line varieties is a mixed group of rice lines with identical agronomic traits and heterogeneous resistance genes, helping to slow down the change of pathogen species composition.

Rational distribution of varieties: genetic diversity of resistant varieties is an effective way to conthol the popular diseases in large scale, for example, rice blast and corn size blotch. Specific methods are as follows, adapting the varieties of different resistance genes in different disease endemic areas, and rotation to use resistant varieties with different genes in the same endemic areas.

Application of resistant varieties has made a great progress in controlling rice blast and bacterial blight in Guangdong Province. Over the years,a veto policy is used in the rice varieties validation process, that is the varieties susceptible to blast or bacterial blight are not audited. Therefore, bacterial blight could be control completely without pharmaceutical, and the control of rice blast is also relied on resistant varieties. The veto policy is expected to be promoted to the validation of other crops during the implementation of the project.

5.3 Agriculture and physical control methods

Agriculture and physical methods for pest control are as follows:

1) Selection and using of non-pest seeds, seedlings and vegetative propagation materials;

2) Rational crop rotation;

3) Opportune sowing;

4) Timely farming;

5) Attention to rural health;

6) Enhance water and fertilizer management;

7) Manual removal of the eggs and capturing larvae in the harm peak of pests and diseases;

8) Trapping and killing the pests by yellow board and insecticidal light;

9) Bagging of fruits.

Farmers in the project area have been profited greatly in the rotation of rice and potatoes, rice and melon crop rotation, rice and vegetables rotation, the models could be promoted further.

For controlling Vegetable pest, some vegetable farms use yellow sticky and insecticidal lamps to trap pests.Fruit bagging has been used in prevent pest on bitter melon, carambola, guava,etc,but their application area is extremely limited.

5.4 Biological control methods

Biological control methods used in large production area are as follows:

1) Release of Trichogramma against Corn borer.

2) Usage of Bassiana against Corn borer.

3) Usage of Bt, Avermectin, Emamectin benzoate against Diamondback moth, Borers, Spodoptera litura, Beet armyworm and Cabbage caterpillar.

4) Usage of Jinggangmycin and Waxy Bacillus against Rice sheath blight.

5) Usage of Kasugamycin against rice blast.

6) Predatory mite or other biological control methods against Starscream.

7) Application of rice-duck model to relief the harm of rice paddy pests and weeds, and reduce medication.

At present, some farms in Huizhou City apply the rice-duck model to relief the harm of rice paddy pests and weeds. Most of areas in Guandong Province use Jinggangmycin and Waxy Bacillus against Rice sheath blight, and employ Bt, Avermectin, Emamectin benzoate against Diamondback moth, Borers, Spodoptera litura, Beet armyworm and Cabbage caterpillar. Some areas also release

Trichogramma against Corn borer to educe medication. The practical and mature technologies of biological control have been promoted in the project area. Thus, it is not difficult to further promote the technologies.

5.5 Chemical control methods

The chemical control methods for crop pest is the most effective and widely used way, and has the advantages of quick, favorable control effect, and convenient usage. In another hand, there are several disadvantages if misconduct, such as Environmental pollution, endangering human and animal safety, and phytotoxicity. Nevertheless,the farmers in the project area don't realize PMP concept, and try to adopt a human-friendly and environment-friendly pesticides and usage methods in order to reduce the chemical pesticides pollution in the agricultural environment.

5.5.1 Non-chemical synthetic pesticide control methods

1) Usage of non-chemical synthetic pesticides against certain crop pests.
2) Usage of diluted oil emulsion against mites of fruit trees.
3) Smearing the lime on the trunks of fruit trees to control the disease, and spraying the copper oxychloride to control citrus canker and other bacterial diseases.
4) Usage of sex hormones and insect nutrition agent to trap crop pest.

5.5.2 Chemical synthetic pesticide control methods

1) Seeds coating with insecticides and fungicide coating agents.
2) Seed soaking and dressing with insecticides and fungicides.
3) Soil treating with insecticide and fungicide.
4) Direct spraying plants to control the diseases, insects and weeds.

6 Status quo of integrated pest management

Plant protection organizations at Provincial, municipal and county levels are responsible for the promotion of integrated pest management, but the agricultural technology promotion agencies and plant protection organizations at all levels are limited by enough technicians to train the farmers in the progress of Pest Management Plan (PMP) field extension. The county agencies could not widely acquire training materials for PMP, and fail to train the farmers effectively. Limited personnel activity funds of township agricultural stations cannot support fully the PMP project for the extension staff to train farmers. Meanwhile, lack of incentives on the integrated pest management promotion works by county and township agencies, leads to depressed initiative and effectiveness for Promoting PMP.

Works need to be done corresponding to the above-mentioned problems:

1) Priority to support the promotion of PMP applied technologies for crop pests and diseases control. Developing incentives on the integrated pest management promotion works for county and township agencies.

2) Providing training courses of integrated pest management and PMP advanced methods, for plant protection experts and agricultural extension agents of county and township agencies. The farmers are trained with more field operations to satisfy their actual needs, and PMP training textbook and audiovisual materials in local concise language are distributed to farmers.

7 PMP integrated pest management project

7.1 Operating scope, measures and aims

PMP integrated pest management project is implemented in Huizhou City (Huiyang, Boluo, Huicheng), Jiangmeng City (Taishan, Kaiping, Enping), Heyuan City, Meizhou City, Qingyuan City, Shanwei City, Yunfou City, Zhaoqing City, Maoming City and Zhanjiang City.

The plan will focus on the following tasks:

Introduce and popularize PMP technology in project area, including practice of biological diversity inspection, Protecting to use the resource of natural enemy, extending effective control technologies, as resistant varieties, agricultural, physical and biological pesticides, in order to relief the adverse affection of chemical pesticides on environment and human being.

Improve farmers' practical skills and training farmers to master the skills of the integrated management of pests and diseases, through participatory learning types of field schools, etc. Technical training of scientific useage of pesticide for the farmers in project areas, to raise farmers' awareness of pesticide management and usage regulations. Providing training to technical staff in agricultural extension agencies, pesticide marketers and city (county) project office, to improve their awareness of integrated pest management (PMP) for crops.

The project aims to improve the awareness of pest and disease PMP concept and practical skills of the farmers in the project area, to improve the level of pest management by using the pesticides efficiently and safely, to control the environmental pollution and play great roles in agricultural production simultaneously, increasing pesticide utilization by 10% or more in the project area. Reasonable handling pesticide packaging raise the waste recovery rate up to more than 95%, and 100% of harmless treatment rate. The project also aims to reduce the damaging effects of chemical pesticides pollution to a minimum on agricultural ecosystem, and vigorously promote the efficient and low residue pesticides, reducing the

contamination of pesticides on the environment. Through the implementation of the PMP, the anti-pesticides of main pest can be depressed markedly leading to biodiversity improvement, and the the losses caused by pests are limited under 10%. Abiding by the requirements of World Bank (OP4.09 and BP 4.01) and pesticide usage specification of other international conventions and guidelines, including "The international pesticide sales and use of the Code of Conduct" by FAO and "Pesticide Management Regulations for implementation" by Ministry of Agriculture, agricultural integrated Pest Management can be standardized in the project area. By the demonstration effect in the two cities, PMP implementation in the whole province is driven to reduce pesticide contamination on agricultural environment overall.

7.2 Implementation of content

The controlling pests technology with pesticide reduction will apply agricultural, physical, biological, and chemical integrated measures to control pests and diseases against specific crops, in order to reduce the reliance on chemical pesticides and the pollution on agricultural environment, to develop appropriate field operation behavior, and to recycle and recover the pesticide packaging waste.

7.2.1 Integrated pest management measures

Priority to conduct the pest forecasting and popularize and apply anti-pest varieties. For controlling the disease and pest, agricultural measures should be adopted firstly, second is the physical and biological control, and final is chemical prevention.

7.2.1.1 Enhance the forecast of plant diseases and insect pests

Every municipal and county plant protection organization should timely offer the forecasting information of Prevention and control of diseases and insect pests to farmers 7-10 days before controlling the pest, including control objects, control periods, control techniques, drug varieties for prevention and treatment. Timely pest treatments can improve control effect and reduce pesticide usage.

7.2.1.2 Agricultural control

According to the specific situation of project area, the following agricultural control measures are made in local conditions:

1) **Selection of resistant varieties:** selecting excellent resistant varieties is one of the most important measures to improve crop resistance, and reduce chemical pesticide usage.

2) Crop rotation: crop rotation, especially the flood and drought rotation, can avoid the disease and insect pests aggravating because of years of continuous cropping, and reduce pest cardinality to prevent effectively diseases and pests.

3) **Reasonable intercropping**: corn and pepper intercropping can reduce the migration of winged aphids and the occurrence of *Phytophthora capsici.*

4) **Sowing dates adjudication**: earlier or delayed crop sowing period can make the crops escape the peak period of pests and diseases in their susceptible stage to disease or vulnerable period stagger, avoiding or reducing the incidence of pests and diseases.

5) Farming measures: burying the stubble and the weeds into soild after deep plowing, can avoid the eggs breeding; plowing stubble immediately after the rice harvest, can reduce the incidence of rice stem borer and weeds.

6) Disease-free strong seedling cultivation: seed and soil disinfection can remove ill seedling and retain nurturing seedlings.

7) Intertilling and weeding: intertillage and weeding can reduce pests and diseases.

8) Deep plowing farming and high ridge cultivation: rooting timely by appropriate 26-33cm after dryland crops harvest, can turn the pests and diseases on surface into the ground, but expose deep overwintering pests and diseases onto the ground to suffocate or freeze them dead.

9) Rational fertilization, timely irrigation and drainage: Using enough basic compost, controlling nitrogen fertilizer, and economizing P fertilizer while increasing potassium fertilizer, can enhance the resistant ability of crops to insect pests. Implementation of scientific water management practices, can also play a certain role in pest control.

10) Cleaning the garden: Clearing worm-infected leaves, dead branches or crop residues, can reduce pest sources

7.2.1.3 Physical control

1) **Erection insect nets:** apply them in the cultivation of vegetables and fruit trees, can play great roles in pest control, rain, wind, shading and moisturizing.

2) **Trapping and killing:** yellow viscose boards are used for killing whiteflies, aphids and others. Insecticidal lamps are used for trapping adult moths, beetles, *Orthoptera* insect pests. Insects nutritional agents can trap moths and fruit flies.

3) **Bagging of fruits**: bagging fruits can reduce hazards by pest.

7.2.1.4 Biological Control

1) **Using biological agents**: use Bt, Nuclear polyhedrosis virus, *Beauveria bassiana*, Kasugamycin, Jinggangmycin, Avermectin, Emamectin benzoate, and agricultural antibiotic 120 to prevent crop diseases.

2) **Natural enemies**: use pest natural enemies, such as *Trichogramma.*

7.2.1.5 Chemical control

The combined application of chemical control and other control measures, can improve the prevention and treatment effectiveness, and guarantee the harvest. Pesticides used for crop safety is required to be high quality, effective, and low toxicity to humans and animals, timely and appropriate usage, and advanced medical device and precise target application technique, are the other correct control methods.

The main chemical control measures include:

1) Strict prohibition of the use of extreme toxic, high toxic, high residual pesticides (WHO I class).

2) Usage of different types of pesticides responding to different pests, and prescribing the right medicine.

3) Timely medication of pesticides according to the pest occurrence.

4) Appropriate usage, and advanced medical device and precise target application technique for using pesticides.

5) Reasonable mixing and alternating the use of pesticides.

6) Strictly enforcement on safe harvest intervals.

7.2.2 Disposal of pesticide packaging waste

Recycle glass bottles, metal cans, metal drums, plastic containers, and paper packaging, for centralized harmless.

7.3 Comprehensive management of major crop pests

7.3.1 Rice

Guangdong is a major hardest hit of rice pest, including planthoppers, leaf roller, yellow rice borer, rice stem borer, rice blast, sheath blight, southern rice black-streaked dwarf disease, etc. Frequent outbreaks of major rice diseases and insect pests in large scare make great damage, and seriously threaten to rice production safety.

7.3.1.1 Aims of prevention and control

Raise control effect up to over 85%, control the loss rate of pest damage below 10%, reduce the use of chemical pesticides and pollution to agro-ecological environment. The rice pesticide residues are controlled within the scope of state regulations, to meet the purpose of high-quality rice and harmless to environment.

7.3.1.2 Control strategy

Adhering to the working principles of plant protection "prevention first, comprehensive prevention and control," and mainly targeting major diseases and insects, the prevention and control of pests in main damaging generation and disease epidemics critical period should be paid close attention to, leading to improve the effect of prevention and treatment, protect the environment of paddy fields, and strive to achieve the sustainable governance of rice pests.

7.3.1.3 Technical measures for prevention and control

1) **Agricultural control.** Promotion of resistant varieties, timely plowing and raking, reducing pests source base, rational close planting, and timely sowing. Using insect nets, non-woven covering protection or centralized seedling protection, and pest-free seedling cultivation. Scientific management of fertilizer and water, avoiding repeated

or unbalanced discharge of nitrogen fertilizer, to improve plant resistance and create a bad paddy ecological environment for pests and diseases. For the measures in rice stem borer hardest hits, vigorously promoting suitable planting period to avoid spawning peak borers, or taking irrigation for eliminating pupae.

2) **Physical control. Light trapping**, an insecticidal lamps is installed by every 30 acres from rice tillering stage to harvest days (except rainy days), and turn on at evening and off in the morning. **Sex pheromone trapping**, leafroller and borer specific traps are hung in the rice fields during the early adult insects outbreak period, and their height are regulated along with the growth of rice plants to keep the traps about 10 cm above the rice's plantsheight. The lures of traps are replaced every 30 days, and cleaned the trapped pests regularly. Controlling snails in water resource, harmful snails and their egg masses in the inlet of irrigation water are filtered using fine mesh filters, which should be replaced regularly.

3) **Biological control.** Completing molluscicidal works before transplanting, 3-5 smash kilograms of tea bran are put on per acre paddy field in the evening. Pesticides are not allowed to applied 30 days after seedling transplanting or throwing, to protect and use natural enemies. BT are used to control rice stem borer and leaf roller, Bacillus subtilis is used to prevent the rice blast, and Jinggangmysin for sheath blight. In the Rice-duck farming model for pest and weed control, 12 to15 of 15-day-old ducks are stocked per acre paddy field in the tillering stage, and raised until early flowering.

4) **Chemical control.** When the occurrence of rice pests reaches the combating indicators or the levels needed to be controlled, safe and efficient counterparts chemicals are chose to handle with them, and several principles should be followed to delay pest drug-resistance, as timely and appropriate medication, alternate medication, mixed medication, . Moreover, using pesticides should be assisted by advanced plant protection equipments, in accordance with the specification of using pesticides.

Planthoppers: Focus on the planthoppers control in the late growth of rice. Natural enemies should play great roles in controlling pests before rice booting, to reduce medication. In order to achieve the control index of more than 1000 worms in booting

stage, pesticide prevention is scheduled in young nymph peak, security pesticide agents varieties on the natural enemies are selected priorly, such as insect growth regulating agents, etc, and high level single-agents is also promoted to avoid using low level mixtures.

Leafroller: adopt the strategies of random control in the second and fifth generations and priority to control in the third and sixth generations. Bt and other biological pesticides are preferred from the hatching peak period of eggs to the peak of young larvae, to achieve the prevention goal of more than 10,000 per insects acre.

Borers: Preventing dry-heart in tillering stage,and preventing white head in breaking to heading stage. In spring of pupating period of overwintering borers, the fields should be plowed and waterlogged, to decrease the insect cardinality. Adult moths of generations are trapped and killed using insect sex pheromone, while using Bt in larval stage. When the number of egg masses of yellow rice borer and striped rice borer per mu reaches 40, the rice fields should be sprayed at early breaking or heading stage.

Rice blast: preventing the leaf and neck blast from the tillering stage to heading stage. The accompany medicine is laid in early rice seedling, chemical control will be implemented in occurrence of acute lesions or incidence centers in tillering time, and to prevention spike blast in the heading stage.Moreover,high level single-agents is recommended, avoiding the use of low level mixtures.

Sheath blight: priority to control in the period between late tilling and booting or heading stage. Following such measures: to strengthening fertilizer and water management, to improve fitness cultivation, to dry fields in final tillering stage, and to implement chemical control when the rate of diseased plants reaches 20% in the fields.

Southern rice black-streaked dwarf virus disease: Taking the prevention strategy of "pay attention to seedling fields and guaranty later fields, pay attention to earlier stages and guaranty later stages", white-backed planthoppers in seedling fields of later season and earlier original fields should be prevented well, and implementation of dressing or soaking seeds with pesticides before transplanting as well. When infected

white-backed planthoppers migrate into the seedling fields and earlier original fields, fast-acting and long-acting agents are selected and coordinated with antiviral agents. The seedling fields should be far away from the susceptible eaily rice fields and cornfields, using insect nets or non-woven covering protection, or centralized seedling protection and abandoning susceptible seedlings.

False smut: priority to prevent in late booting, spraying should be operated 7-10 days before heading, and need second spraying in case of suitable weather of the incidence after 7 days.

7.3.2 Sweet corn

The major pest of sweet corn: downy mildew, sheath blight, leaf spot, rust, cutworms, grubs, corn borer, armyworms, aphids, etc.

7.3.2.1 Aims of prevention and control

Raise control effect up to over 85%, control the loss rate of pest damage below 10%, and reduce the use of chemical pesticides and pollution to agro-ecological environment. The corn pesticide residues are controlled within the scope of state regulations, to meet the purpose of high-quality corn and harmless to environment.

7.3.2.2 Control strategy

Adhering to the working principles of plant protection "prevention first, comprehensive prevention and control," and mainly targeting major diseases and insects, the prevention and control of pests in main damaging generation and disease epidemics critical period should be paid close attention to, leading to improve the effect of prevention and treatment, protect the environment of potato fields, and strive to achieve the sustainable governance of corn pests.

7.3.2.3 Technical measures for prevention and control

1) **Agricultural control**. Selecting resistant varieties, the existing resistant varieties are as follows: Chaotian 711, Jinyinli-1, Nongtian-2, CHaotian-28, Taiwang Chaotian-612, Jinshuai, etc. Reasonable crop rotation and planting density, increase the permeability of the fields to reduce pests and diseases, and the planting density per

acre should not be more than 3500. The scientific fertilization and timely irrigation, require fertilizer quantification and supplement during the growth period, and excessive nitrogen fertilizer will cause plant resistance decreased and even susceptible to diseases. To improve the quality of fruit ears, To phosphorus and potash should be supplemented to nitrogen fertilization. Since sweet corn is impatience to water logging throughout the growing season, drainage should be performed timely after raining, reducing the spread and infection of germs.

2) Physical control. Applying the complementary field technology of the light induced control and traps, insecticidal lamps and traps are installed to trap and kill the corn borer cooperatively.

3) Biological Control. Selection of bassiana, Bt and other biological agents against corn.

4) Chemical control. Corn borer is prior to be controlled, and concurrently the other pests. Corn borer is available by Avermectin or Bt in the 7-8 leaf bell stage and 10-13 leaves tasseling period. The armyworms can be prevented by Avermectin in the end of pollination. Aphids can be prevented with Imidacloprid, sheath blight can be treated optionally by 300 times of Jinggangmycin, while large and small leaf spot can be controlled optionally by 500-700 times of 73% Chlorothalonil.

7.3.3 Potato

The major pest of potato: late blight, early blight, virus disease, bacterial wilt, stem rot, scab, aphids, wireworms, etc.

7.3.3.1 Aims of prevention and control

Raise control effect up to over 85%, control the loss rate of pest damage below 10%, reduce the use of chemical pesticides and pollution to agro-ecological environment. The potato pesticide residues are controlled within the scope of state regulations, to meet the purpose of high-quality potato and harmless to environment.

7.3.3.2 Control strategy

Adhering to the working principles of plant protection "prevention first,

comprehensive prevention and control," and mainly targeting major diseases and insects, the prevention and control of pests in main damaging generation and disease epidemics critical period should be paid close attention to, leading to improve the effect of prevention and treatment, protect the environment of potato fields, and strive to achieve the sustainable governance of potato pests.

7.3.3.3 Technical measures for prevention and control

1) **Agricultural control**. Selecting local high resistance varieties with high-quality high-yield, and selecting of disease and insect resistance, disease endured, and pest damage-free potato species. By strict implementation of quarantine system, the propagating tubes could not be transferred from the affected areas. Selecting virus-free, bacteria-free, insects-free excellent tubes to plant, through detoxification. Crop rotation with rice. Take high ridge cultivation, timely earthing up and strengthened ventilation are used to prevent flood irrigation. Promotion of formula fertilization can enhance plants' disease resistance. Plants affected bacterial wilt, late blight should be removed immediately when found in fields, and the affected holes should be disinfected with lime.

2) **Physical control**. an insecticidal lamps is installed by every 30 acres, to trap scarab, cotton bollworm, and armyworm, etc. Yellow card is placed to trap aphids, and sex pheromone can kill *Spodoptera litura* and other pests.

3) **Biological control**. Biological pesticides are selected to control pests and diseases, and the protection and utilization of natural enemies plays their naturally controlling action.

4) **Chemical control**. Later blight is prior to be controlled, and concurrently the other pests. 800 times of 80% WP Mancozeb is used to control late blight, aphids can be killed by Imidacloprid in seedling to prevent the spreading of viral diseases, and 4000 times of 72% streptomycin sulfate soluble powder is used to control bacterial wilt.

7.3.4 Vegetable

The major pest of vegetable: soft rot, downy mildew, viral disease, anthrax, cabbage caterpillar, diamondback moth, asparagus caterpillar, *Prodenia litura*, cabbage aphid, spider mites, flea beetle, etc.

7.3.4.1 Aims of prevention and control

Raise control effect up to over 85%, control the loss rate of pest damage below 10%, reduce the use of chemical pesticides and pollution to agro-ecological environment. The vegetable pesticide residues are controlled within the scope of state regulations, to meet the purpose of high-quality vegetable and harmless to environment.

7.3.4.2 Control strategy

Adhering to the working principles of plant protection "prevention first, comprehensive prevention and control," and mainly targeting major diseases and insects, the prevention and control of pests in main damaging generation and disease epidemics critical period should be paid close attention to, leading to improve the effect of prevention and treatment, protect the environment of vegetable fields, and strive to achieve the sustainable governance of vegetable pests.

7.3.4.3 Technical measures for prevention and control

1) Agricultural control. Selecting resistant varieties, seed treatment and seedbed disinfection should be performed before planting. Deep plowing the land, and discharge enough maturity basal fertilizer. Rational crop rotation and intercropping can change the physical and chemical properties of the soil, improving the soil fertility and reducing pests source. Strengthen field management, timely cleaning up diseased leaves, stubble and weeds in fields, can disrupt the spreading ways of worms, preventing the infestation of pests expansion.

2) **Physical control**. Using aversion of the Pests, insecticidal lamps and the yellow plate and so on are used to trap *Prodenia litura*, asparagus caterpillar, diamondback moth, *Phyllotreta striolata*, aphids, *Bemisia tabaci*, leafminers and other pests.An insecticidal lamps is installed by every 15-30 acres, used for light trap. For sex pheromone trapping, one or two traps are hung by per acre vegetable plot, and transparent collecting bottle of eight cm caliber is appropriate for traps. A sexual lure is fixed with lead wire at the center about 1cm above the mouth of the bottle, and the bottle is filled with soapy water to the point 2cm below the mouth of bottle. The sexual lure needs to be replaced every 15 days, and the period should be appropriately

shorten in high temperature and drought. Soapy water should be replaced frequently, and kept enough water inside. For attracting insects onto yellow plate, the yellow boards are placed according to the amount of insects in vegetable growing areas, generally 10-15 plates per acre, and 20-30cm higher than the crops.

3) **Biological control**. For using natural enemies or biological pesticides to control vegetable pests, application of insect control pest, bacteria or fungus governance bacteria or fungus, and bacteria or fungus control pest, etc, can reduce the usage of chemical pesticides and create good ecological environment for protecting natural enemies, helping natural enemies play great roles of controlling pests. According to the actual occurrence of pests and diseases, the following biological pesticides can be rationally used, as Bt, Pyrethrins, Azadirachtin, Metarhizium, Avermectin, Emamectin benzoate, Spinosad, agricultural Streptomycin, multi-Antimycin, agricultural Antibioticsthe, dodecyl sodium sulphate, Moroxydine, Octicin Solution, etc.

4) **Chemical control**. Efficient, low toxicity and low residue pesticides should be used priorly, and extremely toxic, highly toxic, and highly residual pesticides are prohibited to be used. Additionally, the safe use of pesticides should strictly comply with the following standards to delay pest drug-resistance: mastering the technology of safety interval, applying medicine according to indications, timely and appropriate medication, alternate medication, mixed medication, etc. Chlorantraniliprole amine, Emamectin benzoate and other pesticides are used to control diamondback moth, cabbage caterpillar, *Prodenia litura*, *asparagus caterpillar* larvae; When incidence of plants with soft rot symptoms, the affecting area should be cleaned up affected plants, and smeared with the lime for disinfection, and then handled with copper oxychloride. For preventing downy mildew, Propamocarb, Enoyl morpholine, and Metalaxyl, etc, can be used in the early stages; Chlorothalonil, Carbendazim and Kresoxim are the optional choice of preventing anthrax.

7.3.5 Fruiter (Citrus, Litchi and Longan)

7.3.5.1 Citrus

The main pests attack Citrusare: Huanglongbing, ulcer disease, red spider, spider rust, leaf miner, lice, aphids, scale insects, whitefly etc. **Aims of prevention and control**

Prevention and control aims are: raising control effect up to over 85%, controlling the loss rate of pest damage below 10%, reducing the use of chemical pesticides and pollution to agro-ecological environment, controlling the citrus pesticide residues within the scope of state regulations, meeting the purpose of high-quality citrus and be harmless to environment.

Control strategy

The control strategy is: adhering to the "prevention firstly, comprehensive prevention and control secondly", mainly focusing on major diseases and insects, paying close attention to the prevention and control of main pests and diseases in key pests generation and popular period, leading to improve the effect of prevention and treatment, protecting the environment of citrus fields, and striving to achieve the sustainable governance of citrus pests.

Technical measures for prevention and control

(1) Agricultural control The first measure is rational close planting, which should maintain good light and ventilation in citrus orchards. Annually fertilizing 4-5 times, to avoid excessive fertilization, promote and protect the spring shoot growth. Strengthening the management of water and fertilizer, increasing organic fertilizer, reducing chemical fertilizer, to improve plant resilience. Improving orchard environment, to protect natural enemies. Less using herbicides, cultivating the gender weeds in the surrounding orchards, such as ageratum thistle, providing suitable habitat for feeding, predatory mites, appropriate pricking malignant weed.

(2) Physical control. An electronic moth-trapping light is installed every 15-30 acres, to kill pests, as dung beetles, bugs, sucking moth and other pests.

(3) Biological control. The main measure is releasing predatory mites to control red spider and other pests, and appling biological preparation for preventing other pests as auxiliaries. The main technologies are: firstly, pruning and clearing ill branches before the release, spraying avermectin and

carbendazim 1 times, after 7 days spraying with Phenthoate and prochloraz 1 times, and the control focus on scale insects, psyllids, whitefly, anthracnose, to decrease the cardinal number of orchard insect source, prior to the release of 10 days, avoid to spray chemical pesticides, eliminating influence on the predatory mite; secondly, releasing predatory mites at March and May, and releasing in the evening, 1 bag (above 300 living mites, including eggs, larvae and adult) on each tree bearing fruits. 20 days after the release, the orchard should be appropriate to stay grass, such as retention of Ageratum thistle, for creating a favorable ecological environment for their reproduction; thirdly, after the release of predatory mites, it must be timely and appropriate to apply pesticides to control the main diseases and insect pests. The restriction of the use of chemical pesticides avoids to kill natural enemies ; Once the pest occur in individual plant or district, we can choose the suitable pesticides to apply on specified plants or district. Controlling the plant diseases and insect pests on new shoots, the application should be on tree crown, to reduce the effect on the activity of natural enemies within canopy and ground vegetation. In the shoot period from August and September, the Azadirachtin agents should spray 1-2 times monthly, to control Citrus leafminer, and treat phylloxera, aphid.

(4) Chemical control. The efficient, low toxicity, low residue chemical pesticides should be the first choice, and the use of highly toxic, highly toxic, high residue should be prohibit. 2-3 days after autumn unified shoots, when the shooting rate reach 50%, azadirachtin, matrine biopesticide can be used for controlling leafminer, lice, aphids and other pests. Bideli, Shinaaning and other pesticides can be used to control citrus disease.

Shatian Yu

The main pests attack Shatian yu are: Huanglongbing, ulcer disease, scab, brown rot, black rot, red spider, spider rust, oriental fruit fly, Reseliel acitrifrugisJiang,

Unaspis yanonensis etc.

Aims of prevention and control

Prevention and control aims are: raising control effect up to over 85%, controlling the loss rate of pest damage below 10%, reducing the use of chemical pesticides and pollution to agro-ecological environment, controlling the Shatian Yu pesticide residues within the scope of state regulations, meeting the purpose of high-quality citrus and be harmless to environment.

Control strategy

The control strategy is: adhering to the “prevention firstly, comprehensive prevention and control secondly”, mainly focusing on major diseases and insects, paying close attention to the prevention and control of main pests and diseases in key pests generation and popular period, leading to improve the effect of prevention and treatment, protecting the environment of Shatian Yu fields, and striving to achieve the sustainable governance of Shatian Yu pests.

Technical measures for prevention and control

(1) Agricultural control. The first measure is rational close planting, which should maintain good light and ventilation in Shatian Yu orchards. Annually fertilizing 4-5 times, to avoid excessive fertilization, promote and protect the spring shoot growth. Strengthening the management of water and fertilizer, increasing organic fertilizer, reducing chemical fertilizer, to improve plant resilience. Improving orchard environment, to protect natural enemies. Less using herbicides, cultivating the gender weeds in the surrounding orchards, such as Ageratum thistle, providing suitable habitat for feeding, predatory mites, appropriate pricking malignant weed.

(2) Physical control. An electronic moth-trapping light is installed every 15-30 mu, to kill pests, as dung beetles, bugs, sucking moth and other pests.

(3) Biological control. The main measure is releasing predatory mites to control red spider and other pests, and applying biological preparation for preventing other pests as auxiliaries. The main technologies are: firstly, pruning and clearing ill branches before the release, spraying avermectin and carbendazim 1 times, and spraying with deltamethrin and prochloraz 1 times after 7 days, and the control focus on scale

insects, psyllids, whitefly, anthracnose, to decrease the cardinal number of orchard insect source; prior to the release of 10 days, avoid to spray chemical pesticides, eliminating influence on the predatory mite. Secondly, releasing predatory mites at March and May, and releasing in the evening, 1 bag (above 300 living mites, including eggs, larvae and adult) on each tree bearing fruits. 20 days after the release, the orchard should be appropriate to stay grass, such as retention of Ageratum thistle, for creating a favorable ecological environment for their reproduction. Thirdly, after the release of predatory mites, it must be timely and appropriate to apply pesticides to control the main diseases and insect pests. The restriction of the use of chemical pesticides avoids to kill natural enemies; once the pest occur in individual plant or district, we can choose the suitable pesticides to apply on specified plants or districts. Controlling the plant diseases and insect pests on new shoots, the application should be on tree crown, to reduce the effect on the activity of natural enemies within canopy and ground vegetation. In the shoot period from August and September, the highly effective and low-toxic pesticides should spray 1-2 times monthly, to control Citrus leafminer, and treat phylloxera, aphid.

(4) Chemical control. The efficient, low toxicity, low residue chemical pesticides should be the first choice, and the use of highly toxic and high residue pesticides should be prohibited.

Scab control:

- ✓ The Disease-free seedling should be used in new orchards, and seedlings form other nursery were dipped in solution of 50% carbendazim wettable powder for 30 min.
- ✓ Cutting off and burning infected, weak and hade branches. Maintain good light and ventilation in orchards and reduce humidity. Spraying 0.5 Lime-sulphur mixtures and increase potassium fertilizer to guarantee the growth of new shoots of Shatian Yu.
- ✓ 75% Chlorothalonil Powder of 600~800 times is spray to protect the new shoot leaves and fruits in germination and emergence from long-term seed storage.

Brown rot control:

- ✓ Removing the infected fruits timely, and disinfecting soil with lime powder. Trenching the fields for draining, and Proper pruning to maintain good light and ventilation.
- ✓ Nitrogenous, phosphate and potash fertilizers Combined with farm manure are used to build up resistance during the growth and development period.
- ✓ Spraying on crown and ground with dimethomorph and another times after 7-15 days at high temperature and less rain period.

Black rot control:

- ✓ Spraying 50% thiophanate methyl Powder of 500 times at 15 days after flowers, 2 to 3 times, one times 7 days intervals.
- ✓ Cutting off and burning infected, fallen leaves and fruit drop in winter and spring.
- ✓ Combined Application of Organic and Inorganic Fertilizers to build up resistance.

Spider rust control:

- ✓ Spraying pesticides, when the density of pest exceed 2~3 pests on the scan of 10 x magnifier or brown rust leaves and black fruits were found in branches.
- ✓ 1.8 % Avermectin oil of 2000 times should be used. 2 to 3 times after 15 days in the high pest density, and pay more attention on the inside of crown, the leaf blade and the shade of fruit.

Unaspis yanonensis control:

- ✓ Spraying 2.5% decamethrin of 3000 times in late March to early April , 2 to 3 times, one times 7-10 days intervals, because of Newly hatched nymphs, the scale unformed and no secrete wax on the body during this time.
- ✓ taking notice of protect the natural predators, like as Australian ladybeetle, Rodolia rufopilosa, Golden Aphelinidae, Soft scale Aphelinidae and Chilocorus kuwanae Silvestri, and using natural enemy to control Unaspis yanonensis.

Reseliel acitrifrugisJiang control:

- ✓ Burning the residual branches and leaves, and fruit drop.
- ✓ Shallowing hoeing 10-15 cm deep after drain the water. Lime powder is applied to breach the winter environment and reduce the overwintering insect source.
- ✓ Spraying 50 phoxim oil of 300-400 times, 7.5-11.3 kg per hectare on the ground

at 7 days after flowers. And two times more when most of the larval and pupal were found.

- ✓ Spraying the whole garden at fruit thinning in May, and fruit bagging 1-2 days later, removing the bag 20 days before seeding.

Bactrocera dorsalis control:

- ✓ Picking up and removing the pest of fruit on the ground and the branches, and burning, deeply planting or sealing them in order to prevent the pest insects continue to harm after emergence.
- ✓ Fruit fly trap could be used to trap adult and reduce damage, 3-5 traps per mu.
- ✓ Spraying low toxicity pesticides on the top at the fruit ripening period.
- ✓ Spraying beta-cypermethrin on the ground, 2 to 3 times 7 days intervals at the beginning period storage of larvae pupate and adult emergence.

7.3.5.2 Litchi and Longan

Aims of prevention and control

Raise control effect up to over 85%, control the loss rate of pest damage below 10%, reduce the use of chemical pesticides and pollution to agro-ecological environment. The fruit pesticide residues are controlled within the scope of state regulations, to meet the purpose of high-quality fruit and harmless to environment.

Control strategy

Adhering to the working principles of plant protection "prevention first, comprehensive prevention and control," and mainly targeting major diseases and insects, the prevention and control of pests in main damaging generation and disease epidemics critical period should be paid close attention to, leading to improve the effect of prevention and treatment, protect the environment of fruit fields, and strive to achieve the sustainable governance of fruit pests.

Technical measures for prevention and control

1) **Agricultural control**. Strengthening the management of fertilizer, to increase plant resistance to diseases and pests. Timely removal of fallen fruit, and centralized treatment. Timely shoots controlling and pruning. Cleaning the fruit garden in winter,

and cutting off worm sticks to reduce pests source after fruit harvest.

2) **Physical control**. An electronic moth-trapping light is installed every 10-15 acres, to kill the stinkbug, scarabs, suck fruit leaves moth and other pests, and other artificial hunting for longicorn.

3) **Biological Control**. *Ageratum conyzoides* or other benign weeds are planted in orchards to protect natural enemies. In the spawning period of Lychee stink-bug , *Anastatus sp* can be released artificially for controlling.

4) **Chemical control**. Timely and appropriate medication, strictly requirements of spraying frequencies and drug concentration, can not only reduce the fruit residues to improve fruit quality, but also save costs to improve economic benefit. Priorly, it is necessary to improve forecast accuracy of the incidence of pests in orchards, helping timely and appropriate medication. Generally,orchard needs spray medicine of 6-8 times one year, and the amount of drugs used should accord to the instructions, such as, one time spraying mainly for controlling stinkbugs in March, 4-5 times spraying for Moth pedicle and downy mildew from May to July of fruit development period, 1-2 times of spraying lime sulfur from August to September, following the works of pruning trees and cleaning garden after fruits harvest. Mastering the safe intervals of pesticides can minimize the fruit residues to control the residues within the allowable range of Pollution-free Agricultural Quality Standards, and the strict implementation of Pollution-free Agricultural Quality Standardsa needs to master accurate safety interval of different types of pesticides. The general safety interval of last spraying is to 15-20 days before fruit harvest.

Agriculture, physical and biological measures of the comprehensive management of pests of main crops

Crops	Agriculture or physical control	Biological control

Rice	Pest forecasting,tilling or burying stubbles,Water and fertilizer management, Removing or burying stubbles or straws, Rotation (with Potato, Melon,Vegetable, Banana)	Selection of resistant varieties, Trapping by trap lamps or sex pheromone, Using natural enemies of pest
Sweet corn	Pest forecasting, Rotation, intertilling and earthing up,Removing or burying stubbles or straws, Removing leaves infected by pests and diseases, artificially capturing larvae	Selection of resistant varieties, Rotation, Using natural enemies of pest and biological pesticides
Potato	Pest forecasting, Removing or burying stubbles or straws, Rotation with rice	Selection of resistant varieties
Vegetable	Pest forecasting, Deeply tilling, Burning the leaves infected by pests and diseases. The Attracting aphids with yellow board, Attracting moth with sweet sour or light	Selection of resistant varieties, Trapping by sex pheromone. Using natural enemies of pest
Fruit	Pest forecasting,Cutting off and burning the branches infected by pests and diseases, Shallow ploughing, Strawing to keep the soil's moisture. Light trap	Using natural enemies of pest

7.4 The principles of using pesticides

Selection and use of pesticides by the project of pesticide reduction and controlling pests of Guangdong Province, is in accordance with **the following criteria:**

1) Harmless to the human being.
2) Obviously affecting on the target species.
3) Less impact on non-target species and the environment.
4) Non-repeatedly using the same drug，to avoid the resistance of pest and disease.
5) Belonging to high efficiency, low toxicity and residue, or non-residue biological pesticides.

The following table lists the toxicity of biological pesticide used in this project, their impacts on the target species and non-target species, and induced resistance to

pests.

The project plans to purchase and use of pesticides, according with the standers of World Bank, which is referred to "The pesticides classification advice according to the guidelines of harmfulness and classification "(Geneva, WHO, 2009) drew up by WHO.

The project will not procure the banned, non-registered, or WHO Ⅰ Pesticides.

The project intends to use biological pesticides

Pesticide	Toxicity (WHO, 2009)	Target species	Risk assessment
Kasugamycin	III	Rice blast, Angular leaf spot of Cucumber	Drugs used in this project are all low toxicity or little toxicity to humans, but obviously affect target objects.
Bacillus (Bt)	III	Diamondback moth, Oriental tobacco budworm, Corn borer	
Bassiana	U	Corn borer	
Trichogramma	U	Corn borer	
Pyrimidine nucleoside class of antibiotics	U	Powdery mildew, Anthracnose, Downy mildew, Early blight	
Diamondback moth granulosis virus	U	Diamondback moth	
Polyoxin	III	Powdery mildew	
Predatory mite	U	Mites	
Toosendanin, Osthole	III	Diamondback moth, Cabbage caterpillar, and other Lepidoptera pests	
Fenitrothion bacilli	U	*Lepidoptera* larvae	
Streptomycin	III	Soft rot of Chinese cabbage	
Newly planted neomycin	III	Soft rot of Chinese cabbage, Bacterial wilt of tomato, Leaf spot of Cabbage	
Jinggangmycin	U	Size blotch of corn, Melons blight	
Nuclear polyhedrosis virus	U	Cotton bollworm	
1.8% Avermectin	III	Diamondback moth, Tetranychid mite s, Root knot nematode	
Bacillus thuringiensis (Bt)	U	*Orthoptera*, *Coleoptera*, *Diptera* pests	

7.5 The pesticide varieties and dosage intends to be used

The project will priorly select the control measures of agriculture, physics (such as trapping, biology or biological pesticides (such as Bt), the control effect of which is equated to synthetic pesticides. The project mainly support biological control measures of pest and seed coating agent, they have minimum impacts on the

environment and human. In addition, the same pesticides will not be used continuously, repeatedly on the same crops, to avoid the emergence of drug-resistant. The following pesticides are national registration products, the proper use according to "Standards of rationally using pesticides" (National standards), will make the the target crops and human being safety, and the proper use according to the labels and package inserts of pesticide products, will not damage the environment. "Pesticide Management Regulations of the People's Republic of China" stipulates that: The production, operation and use of pesticides in the People's Republic of China, should comply with the regulations. The regulations have make detailed requirements on the registration, production, operation and use of pesticides.

Common pest species and recommend prevention pharmacy in project areas

Crops	Common insects	Common diseases	Recommend pharmacy
Rice	Planthoppers, Leaf roller, Yellow rice borer, Rice stem borer	Rice blast, Sheath blight, False smut of rice, Southern rice black-streaked dwarf virus disease	1.8% Avermectin (III) *, 0.2% Emamectin benzoate (III), Bt (U), Chlorantraniliprole (III), Thiazine ketone (III), Spinosad (III), Jinggangmycin (U), Kasugamycin (III), Isoprothiolane (III), Bran tea (U)
Corn	Soil pests, Corn borer, Cotton bollworm, Leafhoppers, Aphids, Spider mites	Head smut, Tumor smut, Ear rot, Rust, Size spot disease	Bassiana (U), Bt emulsion (U), Trichogramma (U), 1.8% Avermectin (III), 0.2% Emamectin benzoate (III), Chlorantraniliprole (III), Tebuconazole (III), G · ene seed coating agent (III), Bassiana (III), Mancozeb (III), Fluorine fludioxonil (U), Procyclidine Azoxystrobin (III), Pyrazole Kresoxim (U)
Potato	Soil pests, Aphids, Leaf beetle	Late blight, Early blight, Ring rot, Black shank, Scab, Stalk rot, Viral disease	Chlorpyrifos methyl (III), Acetamiprid (III), Imidacloprid (III), 0.2% Emamectin benzoate (III), Carbendazim (U), Thiabendazole (U), Chlorothalonil (U), Diethofencarb (U), Dimethomorph (III), Fluorine fludioxonil (U), Mancozeb (III), Propamocarb (U), Thiophanate methyl (U), Fluopicolide Propamocarb (U)
Melon and Vegetable	Soil pests, Aphids, Spider mites, Cabbage caterpillar, Diamondback moth, Leafminers, Whitefly	Downy mildew, Gray mold, Powdery mildew, blight, Damping-off disease, Anthracnose, Blight, Phytophthora Blight, Virus disease, Fusarium wilt, Sclerotinia, Bacterial angular leaf spot	Chlorpyrifos methyl (III), Acetamiprid (III), Imidacloprid (III), 0.2% Emamectin benzoate (III), Carbendazim (U), Thiabendazole (U), Chlorothalonil (U), Diethofencarb (U), Dimethomorph (III), Fluorine fludioxonil (U),

			Mancozeb (III), Propamocarb (U), Thiophanate methyl (U), Trichoderma(U), Streptomycin (U)
Tomato	Soil pests, Cotton bollworm, Aphids, Whitefly,	Early blight, Blight, Stalk rot, Navel rot, Soft rot, Viral disease	Chlorantraniliprole（III）, Chlorpyrifos methyl (III), Acetamiprid (III), Imidacloprid (III), 0.2% Emamectin benzoate (III), Carbendazim (U), Thiabendazole (U), Chlorothalonil (U), Diethofencarb (U), Dimethomorph (III), Fluorine fludioxonil (U), Mancozeb (III), Propamocarb (U), Thiophanate methyl (U), Streptomycin (U), Octicin Solution(III)
Banana	Banana skipper (leaf-roller moth), Lace bug, *Prodenia litura*, Spider mites, Leaf beetle, Banana Black Belt weevil	Fusarium wilt, Leaf spot, Scab, Banana bacterial soft rot, Banana bunchy top disease, Mosaic heart rot, Banana root-knot nematode	1.8% Avermectin (III), Chlorpyrifos methyl (III), Acetamiprid (III), Imidacloprid (III), 0.2% Emamectin benzoate (III), Pyrazole kresoxim-methyl (U), Propiconazole (III), Thiophanate methyl (U), Epoxiconazole (III), Alkene acyl · Pyrazole ester (U), Fluopicolide Propamocarb (U), Amino oligochitosan (U), Prochloraz (U), Kasugamycin (III), Basic Copper sulfate (III), Ningnanmycin (III)
Citrus	red spider, spider rust, leaf miner, lice, aphids, scale insects, whitefly	Huanglongbing, ulcer disease,	1.8% Avermectin (III), Cypermethrin (III), Bt(III), Chlorpyrifos methyl (III), Basic Copper sulfate (III), Mancozeb (III), Dimethomorph (III),Thiophanate methyl (U), Prochloraz (U), Difenoconazole (U)
Shatian Yu	red spider, spider rust, leaf miner, lice, aphids, scale insects, whitefly	Huanglongbing, ulcer disease,	1.8% Avermectin (III), Cypermethrin (III), Bt(III), Chlorpyrifos methyl (III), Basic Copper sulfate (III), Mancozeb (III), Dimethomorph (III),Thiophanate methyl (U), Prochloraz (U), Difenoconazole (U)
Litchi, Longan	Broad mite, Papillosa Drury, Pedicle borers, *Flgora candelaria*	Downy mildew, Anthracnose, Algae blotch	1.8% Avermectin (III), Cypermethrin (III), Bt(III), Chlorpyrifos methyl (III), Basic Copper sulfate (III), Mancozeb (III), Dimethomorph (III),Thiophanate methyl (U), Prochloraz (U), Difenoconazole (U)

Notes：Toxicity grading（WHO 2009）

According to the occurrence of disease and insect pests in the project area and the increasing of new highly effective and low-toxic pesticides in china, most pesticides could be recommend to the farmer in the project. At some time, in order to avoid the pest resistance by some pesticides reusing long and reduce the need for pesticide by raising the efficiency, some WHO Ⅲ type pesticides could be subsidy, as

follows:

Highly effective and low-toxic pesticides intended to be used in this project

Pesticides in PMP	**New pesticides**
* Abamectin+β-Cypermethrin,tiny-emulsion	Abamectin+ imidacloprid
Abamectin	Abamectin+ Acetamiprid
chlorothalonil	Abamectin+ chlorantraniliprole
difenoconazole	Abamectin+ cyromazine
imidacloprid	difenoconazole propiconazol
pymetrozine	difenoconazole azoxystrobin
pyraclostrobin	difenoconazole prochloraz
propiconazol azoxystrobin	imidacloprid buprofezin
propiconazol	propineb
propineb kresoxim-methyl	glufosinate-ammonium
kasugamycin	Kasugamycin copper oxychloride
mancozeb	fenoxanil
zineb	cyflumetofen
isoprothiolane	boscalid
acillus licheniformis	picoxystrobin
Acetamiprid	oxadixyl mancozeb
carbendazim	amoxadone flusilazole
polyoxin B	famoxadone cymoxanil
paenibacillus polymyza	sodium dichloroisocyanurate
hymexazol	dinotefuran
propamocarb hydrochloride fluopicolide	flusilazole
beta-cypermethrin emamectin benzoate	epoxiconazole
Beta cypermethrin	triflumizole
chitosan	Hexaflumuron
Emamectin Benzoate	flumorph fosetyl-aluminium
Thiophanate-Methyl	flusilazole prochloraz
metalaxyl-M fludioxonil azoxystrobin	hexaconazole isoprothiolane
metalaxyl-M fludioxonil	hexaconazole
metalaxyl-M mancozeb	metalaxyl chlorothalonil
jingangmycin A bacillus cereus	metalaxyl hymexazol
jingangmycin A	metalaxyl mancozeb
bacillus subtilis	pyriproxyfen
matrine azadirachtin	cypermethrin
Streptomycin sulfate	Bacillus thuringiensis
fludioxonil metalaxyl-M	Myclobutanil
chlorantraniliprole	metalaxyl-M chlorothalonil
prochloraz	metalaxyl-M hymexazol

kresoxim-methyl	jingangmycin A carbendazim
pyrimethanil diethofencarb	matrine
Pyrimidine nucleoside antibiotic	bifenthrin clothianidin
Azoxystrobin	chlorantraniliprole thiamethoxam
Pyrimethanil	moroxydine hydrochloride copper acetate
HaNPV	mancozeb flumorph
Cyromazine	mancozeb diniconazole
Trichodermaspp	pyraclostrobin boscalid
autographacalifornica NPV	fluoxastrobin chlorothalonil
* Streptomycin sulfate	azoxystrobin difenoconazole
Glucose polymer	Copper hydroxide
thiamethoxam	thiediazole copper
buprofezin	Zinc 2-mercaptobenzothiazole
propamocarb hydrochloride	triadimefon
bacillus thuringiensis	Lice mite urea
tebuconazole	mandipropamid
tebuconazole	Copper(Ⅱ)busic chloride
dimethomorph	tebuconazole prochloraz-manganese chloride complex
azadirachtin	enostroburin /carbendazim
pseudomonas fluorescens	dimethomorph pyraclostrobin
zhongshengmycin	dimethomorph mancozeb
fenpyroximate	dimethomorph azoxystrobin
	cyantraniliprole
	nicotine matrine
	spinetoram
	fosetyl-aluminium mancozeb
	/rotenone
	pyraclostrobin metiram

7.6 Forbidden pesticides varieties

HCH, DDT, camphechlor, dibromochloropane, chlordimeform, EDB, nitrofen, aldrin, dieldrin, Mercury compounds, arsena, acetate, Bis-ADTA, fluoroacetamide, gliftor, tetramine, sodium fluoroacetate, silatrane, parathion-methyl, parathion, monocrotophos, phosphamidon, fenamiphos, FONOFOS, isofenphos-methyl, Calciumphosphide, magnesium phosphide, Zinc phosphide, cadusafos, Coumaphos,

sulfotep, terbufos, Methamidophos, Gramoxone, dicofol, Sodium pentachlorophenol, 2,4-DB, metsulfuron-methyl, Ethametsulfuron-methyl, asomate, methylarsinediyl bis, chlorsulfuron, bis(2,3,3,3-tetrachloropropyl) ether

Pesticides restrictions:

Ban using thirteen kinds of pesticides, as Phorate, isofenphos-methyl, carbofuran, Isocarbophos, Methomyl, endosulfan, omethoate, Methidathion E.C, aldicarb, Ethopropophos, demeton, posfolan-methyl, isazofos, on vegetables, fruiters, tea, and herbal medicine materials.

Chlorpyrifos and triazophos on vegetables have been deregistered as of December 31, 2014, and the use of chlorpyrifos and triazophos on vegetables will be banned from December 31, 2016.

Carbofuran, Phorate and isofenphos-methyl on Sugarcane crop have been deregistered as of September 7, 2016, and the use of Carbofuran, Phorate and isofenphos-methyl on Sugarcane crop will be banned from October 1, 2018.

Apart from Health use and seed coating agents in corn, Fipronil was ban.

Flubendiamide on rice have been deregistered as of September 7, 2016, and the use of Flubendiamide will be banned from October 1, 2018.

Daminozide was banned in peanut.

As of October 1, 2015, the registered application scope and application method of methyl bromide and Chloropicrin will be changed to soil fumigation and other registrations of methyl bromide and Chloropicrin will be revoked except for vapour releasing product (VP). The use of methyl bromide and Chloropicrin should be directed by professional technicians.

Any pesticide products should be used in accordance with the range of application in pesticide registration approval, and prohibited exceeding the approval.

7.7 To recommend the use of spraying equipment

The spraying equipment used to control crop pests and diseases should be in line with FAO, ISO, or national standard of China. Manual sprayers, as domestic WS-16P, -16, NS-15 and Malaysia's BP-16, Spain's MATABI series. Motorized knapsack, as 3WFB-18AC 3WF-2.6. T\Motor jet sprayer, as WSJ-36A, 3WZ-34, etc.

8 Implementation arrangements of PMP

8.1 Institutional settings and responsibilities

Plant Protection Station of Guangdong Province and Plant Protection Station of the cities and counties are pesticides pollution control technology institutions. The Provincial Plant Protection Station of hired experts to set up an advisory group.

Main responsibility of Plant Protection Station of Guangdong Province: drafting the scheme of provincial pesticide reduction and controlling pests technology, and directing the PMP implementation of the project construction agencies in subordinate cities and counties.

Main responsibility of the specialistic advisory group: assist in drafting the scheme of provincial pesticide reduction and controlling pests technology. Providing technical assistance to the PMP technical problems. Involved in the training of project personnel. Assist in organizing study tour activities, to establish contacts with international PMP project. Preparation of field operations instruction manual, as well as other work related to the PMP project.

Municipal and county-level Plant Protection Station is responsible for organizing the implementation. County-level agricultural technology promotion center is the project's commitment unit and is responsible for drafting the scheme of pesticide pollution control technology, and technical training of the technical personnel of the township. The promotion center should take effective approaches and measures, to ensure that the successful implementation of the works of local PMP.

Township agricultural technology promotion station is responsible for guiding the investigation of the farmer association on plant diseases, insects and weeds, and subsequently reporting to the county (city) level of agriculture bureau. Under the guidance of the county (city) level agriculture bureau, the promotion station is responsible for organizing the implementation of IPM programs, and technically guiding and training the involved farmers.

8.2 Capacity building

8.2.1 Training

The training of safety use of pesticides:

1) Specific training of possible impact of pesticides on the environment, recommended use of applied methods and equipments, fort he village cadres, farmers and pesticide sales.

2) Training and presentation of related knowledge for the village cadres, farmers and pesticide sales, to enhance the consciousness on the following problems:

a) The possible effects of various pesticides on occupation or health

b) Recommend use of the processing and spraying methods

c) Approved devices (such as: sprayer, nozzle size) and using methods

d) Wearing safety clothing (such as: long sleeved shirt, masks, hats, gloves, pants, shoes)

e) Spraying in calm weather

f) Safe storage of pesticides, pesticides locked in cabinets, pesticides out of the access of children

g) Safely handling with packages and wastes of pesticides, as far as possible buried or burned

3）Monitoring the implementation of the above operations.If implemented correctly, the operations shoule be retrained.

4）Implementation of management measures listed in the the 6.5 part of the project.

In the project, the procurement of physical and biological control tools, and using a

variety of pest management technology (such as: agriculture, physics, biology, chemistry), make sure the pest non-resistant to pesticides.

8.2.2 Policy implementation

Pest management measures promoted by the project include:

1) Strict implementation of pesticide regulation.

2) Banning the use of unregistered pesticides in the project activities.

3) Banning the use of WHO I pesticides in the project activities.

4) Strict compliance with the following regulations:

a) The action code of pesticide management, sales and use by the United Nations Food and Agriculture Organization (Or corresponding legal documents in China).

b) Guide of pesticide packaging and storage by the United Nations Food and Agriculture Organization (Or corresponding legal documents in China).

c) Guide of correctly labeling method for pesticides by the United Nations Food and Agriculture Organization (Or corresponding legal documents in China).

d) Guide of abandoning pesticides and pesticide containers by the United Nations Food and Agriculture Organization (Or corresponding legal documents in China).

5) Implementation of relevant environmental standards of agricultural chemicals including pesticides, drafted by national environmental protection department, and ecological demonstration counties should also implement the environmental standards of ecological demonstration county.

6) Discussing and providing the successful cases of PMP program and their benefits (especially long-term benefits), to encourage the promotion and support of PMP methods from the county and township governments.

7) Requesting the farmers participating in the construction of demonstration base, to purchase the pesticides permitted and registered.

8) Priority to provide financial support on the PMP research and promotion of the project.

8.2.3 Supervision and Administration

To strengthen the implementation of the management of the PMP will apply the following methods:

1) Training for the technicians and promotion personnels in the county, township and farmers.

2) Developing a monitoring program to evaluate the application of the management of plant pests and diseases and PMP technology in the project, and monitor the biological diversity in the two project areas and the resistance of the main diseases and pests to the main chemical pesticides as well.

3) Every staffs of project office are specifically responsible for examining the organization and implementation of agricultural pest management and PMP methods, and providing appropriate economic support to management mechanism of PMP.

4) Determining the PMP as the direction of the research and outreach programs.

5) Establishing and strengthening cooperation relations with the domestic institutions, to improve the capacity of PMP project.

6) Strengthening the connection between provinces, cities, counties, townships and villages, and solving the existed problems, to guaranty the implementation of PMP project.

7) Vigorously promoting the measures and methods of reducing the use of chemical pesticides, and encouraging private owners to apply the methods of PMP, especially agricultural chemicals business owners.

8.2.4 Technical training and development of human resource

The training programs will be provided for the technician of province, city, county, township in the project.

The project will carry out the following works on the capacity construction of diseases and pests management:

1) Providing the pest management new methods for the inspection qualified institutions of plant protection experts and technicians in the province, city, county,

including PMP methods responding to specific diseases and insect pests on specific crops.

2) The plant protection experts of province, city, county regularly train the promotion personnels on the pest management methods, including

PMP methods responding to specific diseases and insect pests on specific crops.

3) Providing the training for promotion personnels of the county and countryside, to ensure the effective implementation of the management regulation of pesticides.

4) County technicians will provide regularly and timely training of newly pest management methods and PMP responding to specific crops or pests, to the farmers through field schools, etc.

5) Preparing and distributing the PMP training materials. Materials should be concise in language, and assisted with appropriate audiovisual teaching materials.

6) Encouraging the minority and women to participate in the activities of the PMP.

In the applied research projects, the PMP practical technology research should be carried out according to the actual needs of agricultural production and farmers.

8.2.5 Farmer training

The farmer training aims to enhance the farmers' safety and their skills of common biological pest control, that is the capacity of economically and effectively controlling pests and diseases, including: How to identify the plant diseases and insect pests, how to correctly make control decision and to take the appropriate prevention measures.

Every farmer will be trained 3-4 times annually during the period of preventing and controlling diseases and pests (1 days each time, and 50 farmers each training). **The Training contents include the follows:**

1) The characteristics and control methods of plant diseases and insect pests.

2) The harm of various diseases and insect pests.

3) Natural enemies of a variety of major diseases and insect pests, and their application.

4) Field investigation methods.

5) Control index.

6) Prevention and control measures, including PMP methods of comprehensive agricultural, physical, biological and chemical control.

7) Safe storage, management and treatment of pesticide waste and packaging containers.

8) Usage of chemical pesticides, and its protection requirements.

Trainings may include:

9) The advance large plantations and demonstration households.

10) Trained provincial, county and township promotion personnels.

11) Pesticide sales.

12) Plant Protection Station of Guangdong Province.

13) Other institutions in Guangdong or other provinces of China (such as, Guangdong Provincial Academy of Agricultural Sciences) .

8.3 Monitoring and assessment

During the project execution, it is needed to monitor the implementation of the integrated pest management program, using patterns of pesticides,vcrop yield and quality, dynamics of main diseases and pests and natural enemy populations, and the impact on the environment after the implementation of the project's in the project areas, the monitoring contents as shown in the figure:

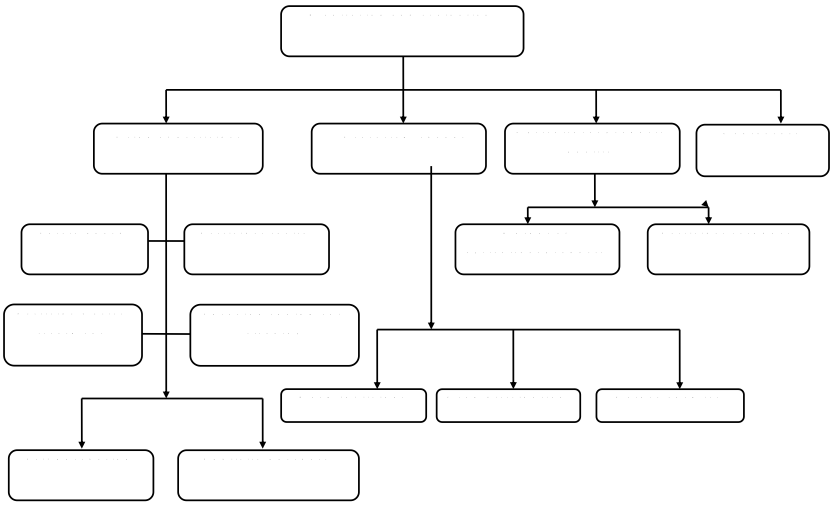

Fig.6 Schematic diagram of monitoring contents in the project

8.3.1 Monitoring contents

1) Registration of pesticides
2) Usage of WHO I class pesticides
3) Policy issues of using pesticides
4) Implementation of monitoring plan

The related experts will check the implementation of the PMP annually in the peak period of the occurrence of pests.

8.3.2 Indicators for monitoring and inspection content

8.3.2.1 Indicators for monitoring

1) The adoption of the comprehensive management measures:

a) Sampling survey of the number of farmers using the integrated management measures

b) The total area of farmland integrated management measures

c) The number of farmers using resistant varieties

d) The number of farmers participating in the integrated pest management

2) The usage patten of pesticides

3) Times of applying pesticides each crop / ha / growing season

4) Species and amount of applying pesticides each crop / ha / growing season (Check whether WHO class I or unregistered pesticides are used)

5) Costs of pesticides usage each crop / ha / growing season

6) Procedures of safely handling and applying pesticides (Such as, safe storage, and the number of farmers wearing protective clothing, etc.)

7) The excessive number of pesticide residues in agricultural products

8) The number of complaints of excessive pesticide residues in agricultural products

9) The number of refused deals because of pesticide residues

10) The incidents number of pest and disease resistant to pesticides

11) The incidents number of masses poisoned by pesticides

12) Other forms of environmental poisoning or contamination, such as: poisoning livestock (poultry), wild animals and bee, and water pollution and soil pollution.

Crop production:

1) The yield per hectare

2) Profit per hectare

3) Change of Agro-ecosystems, and resistance of pest and disease

4) The number and type of pest and disease outbreaks of each crop annually

5) The number of predatory and parasitoid natural enemies of pest in unit area each pilot

6) Species and diversity of beneficial insect, such as: the number of bee in each pilot district

Other indexes:

1) The visits number of pesticide sales to the project area

2) The number of pesticides advertising on the medias (television, radio and newspapers)

3) The number of pesticide brands sold by the retail points in the project areas

4) The number of pesticides brands for sale

8.3.2.2 Inspection contents

Pesticides registration:

1) Registration of new pesticides

2) Usage of class I pesticides

3) On-site checking pesticide cabinets at the pesticide sale points and the farmers, to determine whether Class I pesticides are saled or used in the project areas.

Policy issues:

1) The subsidies extent of government on pesticide (if any)

2) The implementation of policies and regulations related to the use of pesticides and the promotion of integrated pest management

Monitoring:

1) The evaluation on the local monitoring plan by the inspection teams from World Bank

2) The problems in the process of implementing PMP

3) Inspection of implementing PMP by different levels of agencies

8.3.3 Monitoring and inspection plan

1) Pest management monitoring: it is implemented by various project offices and peasant asscociation together, and is responsible for report timely and process the pest.

2) Inspection plan: it is usually in charge of various project offices, but the screening and prevention is implemented by plant protection and quarantine stations during the peak of plant diseases and insect pests.

3) Responsibility: plant protection and quarantine stations at all levels are responsible for the guidance, inspection, monitoring and training of PMP, and also undertake the obligations and responsibilities of timely investigating and reporting pests, and the implementation of PMP according to the requirements, together with the implementers in the project.

4) Professional technology needed: various plant protection and quarantine stations should provide plant protection experts and PMP methods.

5) Project budget: pest management works should be included in the daily management of various projects offices, and the required funds are included in the budget of monitoring and assessment.

8.3.4 The arrangement of progress report of the implementation of PMP project

1) Commitment units of the project are obliged to submit project progress report annually, submit interim performance report in the mid-term of the project, and submit the project performance report at the end of the project.

2) Annual reports and interim reports of the project include project implementation period, the use of project funds, project progresses, the effect of project implementation, the difference of the actual effect and the expected effect of project implementation, and the existing problems and solving methods during the implementation of the project, etc.

3) Concluding report of the project includes project implementation period, the use of project funds, project progresses, the effect and evaluation of project implementation, the difference of the actual effect and the expected effect of project implementation, and the existing problems and solving methods during the implementation of the project, etc. The evaluation of implementation effects refers to the adoption of standardized technologies promotion, the increase of farmers' income as well as the improvement of living standard due to the use of new technologies, the qualitative safety of agricultural products, the impact on ecological environment, the sustainability of projects, and organization and management of the project, etc. The overall achievement of the implementation of the project is evaluated by the effect of the complete project.

9 Budget

The total budget is 145.213 million Yuan, **The specific budget table as follow:**

Budget form

Num.	Project or expenditure	Estimated value （RMB, Ten thousand yuan）				
		Building engineering	Agricultural equipment Purchase	Installation Engineering	Other expenditure	Total
1	PMP pests prevention of major crops	0	1200	0.00	10934. 3	12134. 3
2	Monitoring and assessment, Capacity building, Knowledge management				2387. 00	2387. 00
	Total					14521. 3

Investment Schedule of Monitoring and assessment, Capacity building, Knowledge management

Num.	Construction items	Quantity	Unit	Unit-price (Yuan)	Total (Ten thousand yuan)	Remarks
1	Monitoring and assessment of project				**1750.00**	
1.1	Pesticide residues detection of agri-product and agri-environment	15500	Sample	1000	1550.00	Pesticides of WHO I and II class, Pesticide residues, 30 towns of 6 counties or cities, 5 years
1.2	Monitoring and assessment of PMP implemention	1	term	100	100.00	
1.3	Monitoring of biodiversity, and assessment of crop yield and profit	1	term	100	100.00	
2	Capacity building				611.00	
2.1	Promotion and training of controlling toxicity technology by pesticide reduction				**134.00**	
2.1.1	Mobile counselor training	14000	Person -time per day	100	140.00	Mainly aiming at agricultural extension staff and professional technicians of plant protection in the cities, counties (districts)and countries (towns) in project areas.Training with the up-to-date integrated pest management (IPM) concepts, pest management plan, the corresponding newest technologies of non-pollution control of crop diseases and insect pests, the safely using of pesticide, and the relevant policies and regulations of pesticide sales, etc.
2.1.2	Participatory training for farmers	11700	Person -time per day	100	117.00	Mainly aiming at the farmer technicians, farmers, pesticide distributors of countries (towns) in project areas. Training with identification, prevention and control measures of major diseases and insect pests. The members of uniform control organizations (service teams of spraying) will be trained for certification, including the test of PMP knowledges, using of pesticides and sprayers, and other practical operations.
2.1.3	Technical advisory services of experts	2000	Person -time per day	1000	200	During the growth of crops, three to four experts at plant protection, pesticide, ecology from agricultural research institutions at home and abroad, will be invited to guide the technicians and farmers in the fields, or perform the mobile trainings.
2.1.4	Service fee for counselor	1000	Person -time per day	200	20	According to the training projects, the farmer technicians, farmers, pesticide distributors of 30 countries (towns) in project areas should be participated at each training courses.

Num.	Construction items	Quantity	Unit	Unit-price (Yuan)	Total (Ten thousand yuan)	Remarks
3	Knowledge management				**26**	
3.1	Training materials,Propagation materials and experimental expenditure				26	Integrated pest management training materials and promotional materials will be compiled and designed completely before the implementation of the project ,including the diseases and pests of 9 crops in the project areas.
	Total				**2387.00**	

10 Public consultation

In order to further improve the item text of PMP, we have consulted frequently the opinions and advices from agriculture administrative departments at all levels, technical departments, agriculture and farmers associations, the provincial agricultural technology promotion departments, as well as the officials from World Bank Loan Project Office, etc, during the preparation of PMP, making PMP plan more satisfied with actual situation of the project areas, and complied with the management concepts of World Bank Project Office.

Public advice sheet

Schedule	Locale	Provided material	Participants	Questions raised	How to respond to the issues raised
2012.6-7	Six project counties	Providing the basic materials of project counties, according to the requirements of World Bank project s	Six comprehensive agricultural development offices as well as the relevant technical departments, and the institutions commissioned to work out PMP plan	1. Project objectives and scope. 2. Formated documents of pest plan framework	1.Reply after communicate with World Bank. 2.Referring to the existing PMP files, formulate the written outline.
2012.7-8	Guangzhou	Reorganized the relevant PMP contents and PMP draft framework document of six project counties	Station of Plant Protection of Guangdong Province, Guangdong Academy of Agricultural Science, and South China Agricultural University	Participatory concepts are reflected inadequately in PMP planning	Personnel s preparing the plan should in accordance with the participational concepts
2012.8-9	Guangzhou, and Various project counties	Questionnaire of pesticide use of farmers	Plant protection and agricultural extension agents of the 6 project counties	1.Farmers blindly use pesticides. 2.Biological pesticides are used rarely.	It should be strengthened and focused on in the PMP management plan, especially the training is particularly important
2012.9-10	Guangzhou	Modified PMP program text	World Bank Project Office (expert)	Checking the pesticide toxicity （WHO）	According to the World Bank standards, check the toxicity of pesticides provided in the texts
2012.10-11	Guangzhou	Re-modified PMP program text	World Bank Project Office (expert)	Providing a variety of application methods of WHO class III or U pesticides	According to the proposal of World Bank, provide a variety of application methods of WHO class III or U pesticide s

2015.11-12	Heyuan, Meizhou,Shanwei, Zhanjiang,Maoming, Qingyuan, Zhaoqing and Yunfou	Questionnaire of pesticide use of farmers	Plant protection and agricultural extension agents of the 9 project counties	1. Farmers blindly use pesticides. 2. Biological pesticides are used rarely.	It should be strengthened and focused on in the PMP management plan, especially the training is particularly important

Performance and report

Activity content	In first year				In second year				In third year				Etc.			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
A Mitigation measures																
1. Strengthening pest monitoring and prediction, and pesticide supervision.	X	X	X	X	X	X	X	X	X	X	X	X				
2. Focusing on agricultural measures, and to introduce biological and botanical insecticides, insecticidal lamp, etc, in order to reduce the use of chemical pesticides.		X	X	X	X	X	X	X	X							
3. Using physical and biological control. 4. Disable WHO I pesticides (1A, 1B).		X	X	X	X	X	X	X	X							
B Monitoring																
1. Application of IPM (including disease-resistant varieties).			X	X	X	X	X	X	X	X	X	X	X			
2. Effect test of novel biological and botanical insecticides.			X	X	X	X	X	X	X							
3.Pest monitoring forecast and pesticide supervision			X	X	X	X	X	X	X							
C Institutional arrangements	X	X	X	X	X			X	X			X				
1.Arrangement of implementing mitigation measures (Project Office, the supervision team and expert group) 2.Arrangement of implementing supervision and monitoring (agricultural law enforcement and technical application, agricultural testing and training institutions)	X		X	X	X		X	X	X		X	X				

D Training 1.Implementation of PMP training program 2.IPM training (farmers, agricultural sectors, and government departments, etc.) 3.Related policies, guidelines, standards, etc 4.Identification of plant pest, and pesticide authentication	X	X	X	X	X	X	X	X	X	X	X	X				