

World Bank Loan Project

**Shaanxi Poor Rural Areas
Community Development Project
(P153541)**

Pest Management Plan (PMP)

Foreign Capital Project Management Centre of
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1. Project Overview

By taking advantage of the loan from the World Bank, Shaanxi Province has implemented the rural community development projects in poor areas, with the purpose of increasing the per capita income of the farmers, especially of the rural poor population and improving their living standards through supporting the rural industrial development of the targeted areas. The Shaanxi government aims to explore the new methods and approaches to build new rural communities in the poor areas through assisting the development of rural cooperative economic organization in the targeted impoverished counties, as well as aims to improve the fundamental conditions of agricultural production through introducing international and domestic good methods to realize the sustainable development in agriculture.

The project will be implemented in 5 cities and 11 counties of Shaanxi Province in total. They are: Linyou County and Long County in Baoji City, Changwu County in Xianyang City, Fuping County, Baishui County and Heyang County in Weinan City, Dingbian County and Mizhi County in Yulin City, Yichuan County, Yanchang County and Yanchuan County in Yan'an City. 29 villages and towns will be involved, as well as 221 administrative villages, 82 key poor villages and 683 natural villages.

The crops for which the project mainly supports include: facility agriculture (mainly for water melon, strawberry and fruit and vegetables), apple, morchella, chili, persimmon, mushroom and minor grain crops, etc. The objective is to improve the production condition and production capacity of the aforesaid crops and to prevent them from natural disasters and to reduce damage.

According to the "Pest Management Environment Assessment OP/BP4.09" Required by the World Bank and the regulations specified in "Pest Management", after taking the possible and potential problems which might occur to the projects based on current pest condition of the project area under consideration, we have established the "Pest Management Plan (PMP)" in the section 2.4 for the overall project. By encouraging the farmers to apply environmental-friendly agricultural methods and the technology of integrated pest management (IPM), the PMP seeks to provide technical assistance, farmer's training, facility purchasing, evaluation and monitoring, etc., improving the quality and safety level of the agricultural products.

The main contents are as follows:

(1) To introduce and promote the IPM technology in the project area (communities and cooperatives); to implement the biological diversity monitoring and regulating plans; to protect and take advantage of the natural enemy resources; to strengthen the prediction and forecast for agricultural pests.

(2) By substituting harmful chemical pesticide for microbial pesticide and botanical pesticide in the project area, to reduce the adverse effect of chemical pesticide on the environment and human health.

(3) By production skill training and on-site training for farmers and other forms of studying, to improve the operation skills of the farmers in real practice and equip them with the skills of integrated pest management.

(4) To provide training for the technician in the technology station, the salesmen and distributors of pesticide, the management staff and assistants of the

community, and the management staff of the county project management office (PMO) to increase their awareness of the Integrated Pest Management (IPM).

(5) By keeping in close touch with the quality monitoring departments, to enhance the monitoring and regulation of the sales and application of pesticide in the project area, so as to comply with the related requirements of “OP/BP4.09” by the World Bank on this project as well as other international conventions, rules and usage specifications for pesticide.

In order to implement this Plan effectively, the provincial pest integrated management and monitoring team and the expert consultant team is formed. Also, project management offices will be set up in the cities and counties concerned. The counties and communities shall assign certain people to be responsible for the execution and management of this Plan.

There are 5 parts for the PMP: Project Overview, Project Background, Integrated Pest Management Plan, Implementation Plan, and Working Plan and Costs.

2 Project Background

2.1 Project Objective

By applying the loan from the World Bank, Shaanxi Province developed the rural area community project to improve the agricultural production capacity and the ability to deal with climate change through the construction of industry and production infrastructure and agricultural production facilities, and then realize the sustainable development of the agriculture. Also, by encouraging the farmers to apply better agricultural methods, they will be able to adjust the measures to local conditions and figure out a set of Integrated Pest Management technological combination to ease the adverse effect caused by the increased amount of pesticide, improve the quality of agricultural products and minimize the potential risks of pesticide on human health and environment. In this way, we can guarantee the environment safety, production increase in agriculture, income increase for farmers and the agricultural sustainable development at the same time.

2.2 Crop Disease and Pest Problems in Project Counties

2.2.1 Current Agricultural Production Condition in Project Counties

By checking the agricultural production statistics of the 5 cities and 11 counties of the project, it is recorded that the grain crops are mainly wheat, corn and minor grain crops; the commercial crops are mainly vegetables, chili and edible mushrooms; and the fruit trees are mainly apple trees.

2.2.2 Current Condition of Agricultural Technology and Measures in Project Counties

(1) Apply the adverse resistance high-quality new crop variants. In the project area of 11 counties and 29 towns and villages, the farmers usually purchase the fine and new crop variants from local seed sale agencies and markets. The main measure to prevent pests is to buy the disease-resistant variant. But there are problems in two aspects: firstly, some varieties haven't been tested in the project area. The farmers might purchase them blindly just by reading the instructions on the package, which leads to production reduction; secondly, the variants of the crops are not diverse enough, so that the poor biodiversity and genetic diversity of the field ecosystem often leads to plant diseases and insect pests.

(2) Apply advanced and practical water and fertilizer management technology. In the project area, the farmers have increasing awareness to apply advanced and practical technology. In the irrigated area with assured water source, they can irrigate and fertilize the crops as needed so that the water-fertilizer usage efficiency can be enhanced. In the dry farming areas which completely depend on natural rainfall, people often collect water by mulching to keep the soil moisture and improve the usage efficiency of natural rainfall. Mainly apply technologies such as soil testing before fertilization, crop full plastic-film mulching on double rainwater-harvested ridges and plastic film mulching-furrow irrigation, potato ridge culture, vegetable pollution-free standardized planting, wheat mechanized operation and so on. But there are mainly problems of four aspects: firstly, the application of advanced technology is

not widely enough, for example, broad irrigation is still mainly used for facility vegetables, corn for seed, etc. The application rate of the technology of drip irrigation under plastic film is below 30%; secondly, there are few measures for high yield soil conservation and fertilization or fertility for mediate and low yield soils. The soil organic matter of the crop land is less than 1%; thirdly, the integration of agricultural technology and machinery is not close enough, while the manual labor still prevails; fourthly, the continuous cropping has extended the planting years and the problems of continuously cropped soil stand out, leading to severe plant diseases and insect pests and over 30% of production reduction.

(3) Increase the investment in agricultural chemicals. The large scale promotion and application of chemical technology and chemical products has greatly improved the production capacity and benefits of the crops and prevented them from natural disasters in the project area. However, the application of a large amount of chemicals has made the crops depend on them more. What's worse, the unreasonable application of chemicals has asserted negative influence on the environment and food safety. For example, the excessive chemical fertilizer on the facility agriculture (vegetables, fruits) mainly in Linyou County and Mizhi County has surpassed the safety limit of the international regulation, with the chemical fertilizer usage efficiency of less than 30%. The maximum usage amount of pesticide has exceeded 20kg/acre, among which chemical pesticide accounted for more than 92%, while the organic pesticide is less than 5%.

2.2.3 Type and Condition of Plant diseases and insect pests

In Shaanxi Province, the average figure for the crops to be hit by a natural disaster each year is 4,893,000 hectare time, and the average figure for the crops to cause a disaster each year is 2,965,000 hectare time. Each year, there will be a loss of 193,800 tons of grains. In 2014, the accumulated occurrence area of plant diseases and insect pests in the province totaled 7,734,000 hectares. It is estimated that the plant diseases and insect pests of crops have caused the production reduction of over 15% grains, 15%-20% commercial crops and about 30% of melons and fruits in general years.

2.2.3.1 Contents of Main Plant diseases and insect pests

The investigations and researches in the project area show that there are mainly the following crop plant diseases and insect pests (Table 1):

Table 1 Common Pests and Regular Pesticide for Prevention and Control in Project area

Crops	Common Pests	Common Diseases	Regular Pesticide for Prevention and Control
Vegetable	Soil insects, plutella xylostella, cabbage caterpillar, aphid, liriomyza sativae, whitefly	downy mildew, gray mold, anthracnose, epidemic disease, powdery mildew, virus disease, greensickness, wilt,	Phoxim, chlorpyrifos, abamectin, spinosad, deltamethrin, thiophanate-methyl, carbendazim, chlorothalonil, mancozeb, cymoxanil MZ

		root knot nematode disease	propamocarb, dimethomorph, fosetyl aluminum, polysulfide suspensions, ene. hydroxyl. guanidine, streptomycin, copper hydroxide, pyrimethanil, iprodione, etc.
Strawberry	Aphid, red spider	Leaf spot disease, powdery mildew, gray mold, root rot disease, greensickness	Chlorothalonil, mancozeb, lime sulfur, thiophanate-methyl, tuzet, trifluralin, carbendazim, captan, iprodione, green asparagus powder, chloropicrin, aphid wu, fenvalerate
Water Melon	Maggot, mole cricket, scarab, grub, aphid, red spider	Damping-off, virus disease, leaf blight, anthracnose, epidemic disease, sclerotiniase	Mancozeb, thiophanate-methyl, chlorothalonil, Junduqing, Zhibingling
Morchella	Rhabditida, sciarid, mite	Bacteria, actinomycetes, yeast, mould	Pyrethrum, lime, mushroom-protection drug, benomyl, carbendazim, thiophanate
Shiitake mushroom	Phorid fly, mite	Black spot, slice mushroom disease, pleated rot, brown leaf spot	Baibingsha, carbendazim, phenol, thiophanate, formalin, Bordeaux mixture, Saibei liquid
Chili	aphid, oriental tobacco budworm, cotton bollworm, yellow tea mite	Anthracnose, epidemic disease, powdery mildew, virus disease	Phoxim, chlorpyrifos, abamectin, deltamethrin, thiophanate-methyl, carbendazim, chlorothalonil, mancozeb, cymoxanil MZ polysulfide suspensions, ene. Hydroxyl. guanidine, streptomycin, copper hydroxide, pyrimethanil, iprodione, etc.
Persimmon	Scale insects, Shidi worms, persimmon jassids	Persimmon angular leaf spot, round spot disease, persimmon anthracnose	Bordeaux mixture, pyrethrin, lime sulfur, diesel fuel emulsions, malathion
Apple	Pod borer, red spider, aphid, pear psylla, scale insects, leaf rollers, codling	Rot disease, powdery mildew, mosaic disease, anthracnose, leaf cast	Chlorpyrifos, acetamiprid, avermectin, fenvalerate, propargite, thiophanate-methyl, lime sulfur, carbendazim,

	moth		mancozeb, rot clear, tebuconazole, propiconazole, etc.
Minor grain crops	European corn borer, armyworm, aphid, mite, virus	Millet blast, millet downy mildew, millet smut, millet red-leaf disease, millet gray spot, smut millet, millet streak and spot disease, leaf blight of sorghum, sorghum anthracnose	Carbendazim, thiophanate-methyl, mancozeb, metalaxyl, chlorothalonil

Through the researches and interviews with the farmers, we know that in the project area, most farmers and local agricultural technical promotion staff are not familiar with the plant diseases and insect pests in the vegetables and fruit trees and they can't tell the differences of various plant diseases and insect pests. Moreover, they lack the experience in prevention and control of such condition. Therefore, they all regard the prevention and control of vegetables and fruit trees from plant diseases and insect pests a very difficult task. Because that the commercial value of vegetables and fruits is higher than that of the grains, the loss caused by the plant diseases and insect pests of vegetables and pests is usually higher than that of the grains.

2.2.4.2 Characteristics of and Reasons for Major Plant diseases and insect pests

(1), Characteristics of Major Plant diseases and insect pests

First, the occurrence area is large, wide range and that the yield damaged caused by the disease is more serious than that by pests. The main plant diseases and insect pests in the project area of crop production occur in different degrees, especially apple powdery mildew, mosaic disease, chili blight and powdery mildew, cucurbits wilt, cucumber downy mildew and viral diseases, watermelon damping-off disease, strawberry leaf spot are recurrent disease. Overall, the pest occurrence area is greater than that of the disease and the damage caused by disease is greater than pest.

Second, the speed of prevalence is fast and the damage is heavy. For example, it takes only half month for the chili blight spread from sporadic to the whole field and only one week for the melon powdery mildew. Under the condition of protected cultivation, the disease prevalence rate is faster, which can cause harm in a short time. For example, it takes only five to seven days for cucumber downy mildew spread from sporadic to the whole shed with loss of cucumber yield in greenhouse 10%-20% and more than 50% if worst-affected. In the project area, almost all kinds of fruits and vegetables are affected by the virus, vegetable blight and gray mold occur annually and aphids and whitefly remains serious.

Third, the damage period is long and the loss is great. The agricultural facilities develop rapidly in the project area and the ecological conditions are very suitable for plant diseases and insect pests which increase the duration of plant diseases and insect pests. After the field crops are harvested, some pests are migrating

to the greenhouse, for example, pests like whitefly and vegetable leaf miner overlap and increase in generation in the solar greenhouse changing from seasonal occurrence under the conventional planting to annual occurrence. The season occurrence of some plant diseases and insect pests is earlier than that of open field cultivation, for example, cucumber downy mildew, occurred mainly in the middle and late stage of the growth, occurs on the beginning of the epidemic onset seedling and at the same time, cucumber scab, chili powdery mildew and vegetable leaf miner has introduced continuously in recent year with serious damage and difficult prevention and treatment.

Fourth, the species of plant diseases and insect pests are complicated. ① The main pests are still rampant, for example, watermelon red spider and strawberry aphid cause rampant damage; Cucumber downy mildew, chili powdery mildew, greenhouse whitefly and vegetable leaf miner still cause rampant damage and may cause serious damage if timely or proper control methods fail to be adopted. ② Minor plant diseases and insect pests have become major plant diseases and insect pests, for example, cucumber and eggplant gray mold doesn't occur or causes lighter damage in open field cultivation whereas occur and cause serious damage and is difficult to prevent and treat in the greenhouse. ③ Soil-borne diseases are becoming more and more serious. Melon wilt, chili blight and other soil-borne disease show a trend of increased occurrence; Cucumber, watermelon damping-off disease and other diseases occur frequently and cause aggravating damage with increasing greenhouse cultivation time. ④ New plant diseases and insect pests continue to appear. With the introduction of new varieties, some new plant diseases and insect pests continue to emerge and cause damage. Letinous edodes black spot and morchella rhabditis disease are increasing year by year. ⑤ The speed of p physiological loss becomes faster and spread. The application of mulching and greenhouse cultivation techniques in the project area has provided favorable conditions for the occurrence and spread of plant diseases and insect pests. A considerable number of farmers in the project area blindly use fertilizer or a large number of fertilizers which lead to disease, pest and reduction of yield.

(2) Reason for the aggravating occurrence of plant diseases and insect pests for main crops

First, the cultivation environment and condition is beneficial for the occurrence of the plant diseases and insect pests. In the project area, much emphasis has been laid in commercial crops such as fruits and vegetables. The type of crops is not diverse enough so that the biocenosis in the croplands tends to be single, which leads to the speeding up of pathogenicity of the bacteria. The disease-resistance ability of the crop varieties will be lost very quickly. What's worse, epidemic disease might occur. The application of the technologies such as plastic film mulching and greenhouse cultivation has provided convenience for the occurrence of plant diseases and insect pests in the project area. Many farmers fertilize the land blindly or in a large amount, which leads to the occurrence of plant diseases and insect pests as well as production reduction.

Second, methods and measures for the prevention and treatment are not in place. Great importance has been attached to the chemical prevention and treatment

whereas lesser importance has been attached to other methods in the prevention and treatment of plant diseases and insect pests in the project area. As far as the medical prevention and treatment is concerned, there is blind medication, a single variety of drugs and free increase of dose which leads to less effective prevention and treatment.

Third, the update of crop varieties is one of the reasons for the change of plant diseases and insect pests. To select crop varieties is in general to choose superior varieties and superior varieties not only have strong adaptability, high yield, good quality, but also have strong resistance, for the prevalence of different varieties of disease resistance is different. In many cases, the resistance of crop varieties is the dominant factor to determine the prevalence of plant diseases and insect pests.

Fourth, climate warming exacerbates the occurrence of plant diseases and insect pests. Since 1980s, the province's meteorological disasters show a clear upward trend in the global climate warming background and extreme weather events occur frequently. The temperature rises in the project area, precipitation decreases, and the number of disastrous weather events increases. Climate warming is conducive to the safe hibernation of pests and pathogens, the occurrence of plant diseases and insect pests, the northern boundary of the winter and the distribution range have changed. The occurrence area of plant diseases and insect pests as well as the extent and frequency of hazards showed a yearly growth trend.

2.3 Current use of chemical pesticides

In the project area, the control of plant diseases and insect pests mainly depends on the pesticide, especially the chemical pesticide. According to the data of Shaanxi Province Rural Statistical Yearbook in 2014, the province's pesticide usage is 40364.8 tons and the average farmland is 8-10kg/ hm² among which pesticide accounts for about 65%, mushroomcide 25% and herbicide 10%. The application of chemical pesticide dosage in the agricultural production in the eleven counties is 1310.7 tons among which pesticides accounts for 67.4% and mushroomcide 31.9%.

Regard to the types of pesticides, most farmers use chlorothalonil, carbendazim, thiophanate methyl and Bordeaux mixture of highly toxic pesticides, that is, pay attention to pest control but ignore the disease which is due to farmers' lack of disease prevention knowledge. Once the plant diseases and insect pests occur, the possibility of the use of pesticides or mushroomcides greatly increases, while few farmers use biological pesticides. The spray equipment are generally conventional sprayer with no ultra-low volume sprayers basically which reduces the utilization of pesticide and increases the pesticide pollution to the environment.

The amount of pesticide used in various crops in the project area (Table 2) is very different with greenhouse vegetables the largest assumption reaching 30 kilos per hectare and the average assumption of wheat and corn reaching 5 kilos.

Table 2 Types and Dose of Pesticides Used on Major Crops

Crops	The possibility of use			Dose (kg/hm ²)
	Pesticide	Bactericide	Herbicide	

Wheat	90%	80%	10%	4.5-7.5
Corn	80%	80%	20%	5.0-8.0
Greenhouse vegetables	80%	100%	/	30-45

2.4 Control situation and existing problems of plant diseases and insect pests

Pest control area of the project area accounts for about 80% of the sown area of crops. The level of prevention and treatment of plant diseases and insect pests is relatively low and great differences exist between project area. To sum up, pest control measures mainly include agricultural measures, physical and mechanical, biological, ecological and chemical control (Table 3).

2.4.1 Integrated pest management

In the prevention and control of plant diseases and insect pests, farmers in the project area are fully aware that the selection and application of resistant cultivars, crop rotation and other agricultural measures are the fundamental measure for prevention and control of plant diseases and insect pests and that chemical pesticide control, biological control, physical control and other methods can be used but with less frequency. When there is a disease and pest, use pesticides to kill pests, use farm chemicals to control diseases, give priority to productivity and profitability, and as for pesticide residues, they can never be seen or touched so that ignored. Only in the occurrence of residual hazards and causing human and animal poisoning, great attention shall be paid to the rational use of drugs.

Most farmers in the project area lack the necessary technology of integrated pest control and they are very weak in biological control, ecological control, physical control and scientific drug control and so on. Only a few farmers understand the concept of integrated pest management (IPM), but do not know the IPM technical system and working procedures.

Table 3 Main Pest Control Measures Used in the Project Area

Prevention and control measures		Suitable crops
Agricultural countermeasures	Selection of resistant varieties, seedling	Suitable for all kinds of crops
	Plastic mulching	Vegetable
	Crop rotation, intercropping	Suitable for all kinds of crops
	Adjust sowing time and rational close planting	Chili
	High deep furrow cultivation	Chili
	Clean the pastoral	fruit trees, vegetables
	Reasonable scientific ingredients	Edible mushroom
Physical prevention and control	Set trap lamp, sweet and sour liquid and hang yellow board to trap insects	Fruit trees, vegetables

	High-temperature soaking sterilization and high-temperature stuffy shed	Vegetables
	Scientific design of bacteria and temperature and humidity control	Edible mushroom
Ecological control	Regulate the room temperature and humidity of the shed	Facility agriculture (vegetables)
Biological control	Conserve and utilize natural enemies	Suitable for all kinds of crops
	Use biological agents to control plant diseases and insect pests	Fruit trees, vegetables
Chemical prevention and control	Biological pesticide	Fruit trees, vegetables
	Sowing groove (hole) medication or pesticide-clay mixture	Vegetables
	Make various types of bait to trap and kill pests	Suitable for all kinds of crops
	Smoke agent to fumigate plant diseases and insect pests	Facility vegetables
	Ground spray or subsurface irrigation	Suitable for all kinds of crops

2.4.2 Agricultural control measures

- Selection of resistant varieties. Using the disease resistant variety is one of the most effective, economical and feasible measure to control plant diseases and insect pests with the application rate of improved varieties more than 85% which is suitable for the disease and pest that is difficult to control by using agricultural measures or that lacks of effective farm chemicals.

- Crop rotation. Farmers generally believe that rotation is an important reason for the initiation and exacerbation of disease and pest, for rotation plays a role in the deterioration of the nutritional conditions of diet specific or relatively simple pests or a variety of disease and pests so as to effectively prevent the spread of these plant diseases and insect pests. Using food crops and commercial crops rotation, vegetables and solanaceous crop rotation, and solanaceous and leafy rotation can reduce plant diseases and insect pests.

- Water saving technology. Farmers can basically irrigate by observing the climate, ground and seedling to avoid the occurrence of disease caused by excessive field humidity through flood irrigation.

- Removal of diseased plants. Strengthen field management, timely remove pest foliage, fruit or diseased plants to bury and burn so as to reduce the infection source.

2.4.3 Chemical control methods

Farmers in the project area in the past tend to use dimethoate, dichlorvos, pyrethroid pesticides, and even the high toxic pesticide isocarbophos, methamidophos to control pests of either kind; once disease occurs in the vegetables, they tend to use carbendazim and thiophanate no matter there is any effect. The average farm chemicals of the counties in the project area is 120kg/hectare with a majority reaching 30kg/hectare. The pesticide residues of high dimethoate, kung fu, dichlorvos, thiophanate-methyl and chlorothalonil are relatively high. According to the survey, an embarrassing situation appears in the project area in the pesticide market that there is a high share of highly toxic pesticides, that is, the proportion of pesticides in pesticide market is large, there is high proportion of organic phosphorus in pesticide and methamidophos, omethoate, high toxicity, high toxic pesticides in organic phosphorus. There is often the use of methamidophos or omethoate in the prevention and control of disease and pest.

2.4.4 Poor standard of prevention and control technology

There is an optimum control stage in prevention and control of plant diseases and insect pests during which period there is less dosage but good effect and low cost. However, most of the farmers are in a serious disorder, and arbitrarily increase the number of drugs which increases the cost of prevention and treatment. As can be seen from the survey, high toxicity and high residual pesticides such as isocarbophos and dicofol are mainly used in the prevention and control of vegetable varieties that are easily damaged by the pests such as cowpea, eggplant and chili; Its application is generally 8-10 times a year with prevention costs per acres \$ 100 a year. The number of drugs is up to 20 times during the whole growth period of cucumbers in the solar greenhouse, for in the peak of cucumber yield, spray every two or three days or even spray one to two kinds of pesticides every one day.

2.4.5 Main problems in the management of plant diseases and insect pests

The farmers' overall qualities are low, lack technical guidance and apply the pesticides blindly. First is to spray pesticide. No matter there is pest or not, spray regularly, which takes a lot of work, medicine and high costs; Second, to spray belated pesticide. Disease prevention and control advocate prevention first and early prevention, but farmers pay attention to treatment rather than prevention and tend to spray only when the situation is getting serious; Third is to prevent and cure in the wrong way. Some farmers use agents for the prevention and treatment of viral diseases to prevent and cure verticillium wilt and others use pesticide to prevent disease.

Due to the lack of conventional technical guidance, most farmers solve plant diseases and insect pests in accordance with the recommendations of the pesticide dealers. However, pesticide dealers' guidance is driven by the interests rather than consider how to prevent and cure plant diseases and insect pests with high efficiency, low investment and low pollution. As there is no knowledge of occurrence and control period, farmers are unable to control plant diseases and insect pests by spraying insecticide regularly.

Large amount of highly toxic pesticides have been used. Due to the high production capacity, lower cost and better effect of highly toxic organophosphorus pesticides, it is well welcomed by the farmers and they are willing to use. However, as farmers lack scientific knowledge and understanding of a variety of pesticides, the excessive use of pesticides is getting more serious which manifests itself in the excessive use of highly toxic pesticides on vegetables, fruits and other commercial crops. A considerable number of farmers have no idea of the relevant provisions that which kind of pesticide is allowed or prohibited. Hence, they tend to use the pesticide that is cheap and effective without taking the toxicity into consideration.

The pesticide application mode is single and the awareness of pesticide pollution is insufficient. Atomizing is the main way which accounts for 85% of the number of spraying but with a very low pesticide utilization. Farmers lack the awareness of acute poisoning caused by high toxic pesticides and are unknown to the fact that pesticides in the human body gradually accumulate to cause the harm of chronic poisoning. A few farmers have a weak legal concept and they make abuse of highly toxic pesticides driven by the interests.

Farmers' acceptance of new pesticides, especially biological pesticides, is slow. First, as compared with chemical pesticide, the readily availability of biological pesticide is slightly worse; farmers believe that the effect is not good. Second, the price of new pesticide is slightly higher than that of the old pesticide, but farmers never understand the truth (New pesticides are generally efficient with long holding period, which can reduce the number of pesticide as well as the cost) of “expensive on surface but cheap in nature”.

Poor pesticide management. As monitoring and management of pesticide market is not strict and some regulations can't play the role of “Every order is executed without fail”, highly toxic and high residual pesticides that are prohibited to use on vegetables and fruit trees are still used by the farmers and are the major pesticide varieties to prevent and cure most of the disease and pests; Unreasonable storage of pesticides and other agricultural chemicals; Pesticide residues and packaging are not properly handled.

The following problems exist in the use of chemical pesticides in the comprehensive analysis of the project area:

(a) High degree of dependence on chemical pesticides which manifests itself especially in vegetables, melons and fruits and commercial crops of high commodity value and economic benefit;

(b) There is a trend of increase on a yearly basis in the use of chemical pesticides, especially in the use of pesticides;

(c) Lack proper use and management of chemical pesticides and other pesticides;

(d) Make random disposal of residual chemical pesticides and discarded packaging materials which may cause hidden dangers of pollution and poisoning;

(e) Inadequate understanding of the comprehensive management of plant diseases and insect pests by promotion agencies, pesticide dealers and farmers;

(f) Traditional training can't solve the specific production problems and new problems of individual farmers;

(g) Lack the timely and adequate information on chemical pesticides.

The above problems can be summed up as:

a. Ineffective implementation of relevant policies and regulations;
 b. Lack of pest management knowledge and inappropriate pest control measures
 c. Lack of the consciousness of environmental protection and severe abuse of chemical pesticide;

d. Lack of the timely and adequate information by farmers and grassroots extension personnel;

e. Backward prevention concept that fails to put the idea of crop fitness cultivation into the practice of preventing crop pests lacks the pest management in accordance with the ecological system point of view;

f. The monitoring of pesticide market is ineffective; there are a large number of pesticide business entities with small-scale, non-formal purchase channels; the pesticide market order is chaotic; there is low professional quality of pesticide dealers; agricultural products quality and safety incidents have occurred owing to improper use of pesticides and pesticide residue;

g. Capacity-building system is not perfect and the integrated control technology training of crop pests is backward. Currently farmers mainly rely on the guidance of pesticide dealers to control pest and the introduction of advanced monitoring and control technology, demonstration and promotion of the corresponding organization and training measures are not perfect. The awareness of the risk of agricultural pests is not enough, which fail to carry out a real-time monitoring and early warning of agricultural pests.

2.5 Environmental impact and environmental risks that may appear after the implementation of the project

2.5.1 Statistics of the status quo of the planting industry in the project area and new planting area

The statistics of the status quo of the planting industry in the project area and new planting area can be seen from Table 4.

Table 4 Statistics of Current Planting Industry and Newly Added Planting Area in the Project Area

Project counties	Project area	Leading Industry	Quantity (acre)	Planting content	New planting area (acre)	change planting structure (Y/N)
Linyou county	Chang Feng community	Facility agriculture	50	Thirty new sunlight greenhouses have been built, covering an area of 50 acres, including the planting of watermelon, strawberry, fruits and vegetables. Original land cultivation type is the field planting for wheat and corn.	50	Yes
		Morchella	100	New Morchella cultivation demonstration base with new 100 acres planting area. Original land cultivation type is the field planting for wheat and corn.	100	Yes
Heyang county	Ganjing community	Apple	1050	Upgrade the existing apple orchards with 1050 new apple orchard irrigation facilities of which 450 acres of apple orchard are supported with the construction of anti-hail net.	0	No
		Mushrooms	18	Fifty new mushrooms demonstration	18	Yes

				greenhouses are built with new micro-irrigation facilities, covering an area of 18 acres. Original land cultivation type is the field planting for wheat and corn.		
Changwu county	Tingkou community	Apple	1326	Upgrade the existing apple orchards with 1326 new apple orchard irrigation facilities of which 666 acres are constructed with plant facilities supporting rod.	0	No
Baishui county	Lingao community	Apple	957.8	Upgrade the existing apple orchards to convert into a standardized orchard with anti-hail net, covering an area of 957.8 acres.	0	No
	Shiguan community	Apple	805	Upgrade the existing apple orchards to convert into a standardized orchard with anti-hail net, covering an area of 805 acres.	0	No
Mizhi county	Yangjiagou community	Facility agriculture	15	Fifteen new solar greenhouses are built, covering an area of 15 acres for vegetables and fruits. Original land cultivation type is the field planting for wheat and corn.	15	Yes
		Fruits	540	Renovate the 540 acres fruit picking garden for apple, grape, jujube, peach and pear to optimize and transform the old orchard.	0	No
Dingbian county	Long Zhen community	Minor grain crops	1400	Carry out fertilizer subsidy of existing manor grain crops base and optimize the planting structure.	0	No
Total			6021.8	--	183	--

The edible mushroom and minor grain crops cover a planting area of 6021.8 acres among which the new planting area is 183.0 acres for the corn and wheat that are converted into facility agriculture and the planting of edible fungus with the changing planting structure of 183.0 acres; Fruit and minor grain crops were planted for the reconstruction of the existing planting base which doesn't increase the planting area or change the planting structure.

2.5.2 Statistical analysis on the change of fertilizer and pesticide usage in project area

According to the statistical analysis of 2.5.1, the implementation of the project has expanded the planting area (detailed in Table 5) of facility agriculture (growing vegetables and fruits), edible mushroom (morchella and mushroom) and other commercial crops and at the same time reduced the planting area of corn and wheat in field and changed the planting structure. If we continue to apply the existing disease and pest control measures without (IPM) method, it will lead to the change of types and doses of pesticide and fertilizer. The basic changes are detailed in Table 5.

Table 5 Estimation of pesticide and fertilizer usage changes Caused by the change in planting structure

Crop	Average amount (kg/acre·year)		Change of planting area (acre)	Total usage (kg·year)		Increment or decrement (kg·year)	
	Pesticide	Fertilizer		Pesticide	Fertilizer	Pesticide	Fertilizer
Wheat	0.4	26.6	-109.8	43.92	2920.68	-43.92	-2920.68
Corn	0.5	15.3	-73.2	36.6	1119.96	-36.6	-1119.96
Greenhouse vegetable and fruit	2.5	84.0	+65	162.5	5460	+162.5	+5460
Edible mushroom	1.5	30.0	+118	177	3540	+177	+3540

Total	--	--	0	--	--	+258.98	+4959.36
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It can be seen from Table 5 that if we continue to apply the existing disease and pest control measures without (IPM) method, it will lead to the increase of usage amount of pesticide and fertilizer, among which the use of pesticides increases by approximately 0.25 tons and fertilizer increases by approximately 4.96 tons.

2.5.3 Changes in plant diseases and insect pests that may occur in the implementation of the project

It can be seen from Table 5 that due to the change in planting structure, original farmland for wheat and corn has converted into such commercial crops as edible fungus, vegetables and fruits. The way and quantity of pesticide and fertilizer as well as the types and characteristics of the disease and pest has changed to some extent. Prediction of the possible occurrence of plant diseases and insect pests is as follows:

(1) Change in the disease and pest of edible mushroom

After the implementation of the project, the newly-built morchella demonstration bases and mushrooms greenhouses will lead to the increasing frequency of morchella nematodes, mushroom mosquito, mites and letinous edodes mushroom flies and mites and the enlarged occurrence area of the disease such as letinous edodes black spot, mushroom disease, f old rot and cercospora leaf spot. However, as the demonstration base has been properly managed and artificially intervened, the diseases caused by miscellaneous fungus will greatly reduce. Among them, Morchella mushrooms and black spot still occupy an absolutely dominant position in the plant diseases and insect pests of edible fungus.

(2) Change in the disease and pest of vegetables

Since the introduction of various new varieties and successive planting in recent years, some exotic plant diseases and insect pests are likely to invade and some soil-borne diseases such as root rot, blight and wilt will occur in cruciferous vegetables due to pathogen accumulation; The early blight, late blight and gray mold of solanaceae vegetables and blight, downy mildew, powdery mildew and nematodes of cucurbit vegetables continue to occur and damage all year round. Under the facility condition, the vegetable continuous cropping obstacle has already become the increasing focus of vegetable production day by day. Intensive cultivation and use of nitrogen fertilizer will lead to the aggravation of plant diseases and insect pests of vegetables. Furthermore, the occurrence frequency of frost damage caused by low temperature in early spring and physiological disorder will increase.

(3) Change in the disease and pest of fruit trees

Through the implementation of project and training of farmers, the occurrence of apple rot, powdery mildew and mosaic disease has been effectively controlled but attention should be paid to the spread of two diseases of anthrax and leaf diseases. However, due to changes in environmental conditions and different configurations of the surrounding crops in apple orchards, great attention should be paid to the monitoring of leaf roller, codling moth and other lepidoptera pests.

2.5.4 Environmental risks caused by utilization of pesticides and fertilizers

2.5.4.1 Environmental risks caused by pesticides

Once the pesticides invade into the environment, the toxicity and high residues will set off a chemical reaction in the environment, resulting in air, water and soil pollution.

Environmental impacts and environmental risks that may arise from pesticides and other chemicals include:

(a) Impact on the atmosphere: Under normal circumstances, when spraying pesticides, some pesticide floats in the air in the form of fine particles, and influences the atmosphere by photolysis decomposition;

(b) Impact on the soil: Since the pesticide is not easily decomposed by microorganisms, stable to acid and heat, less volatile and insoluble in water, the increase of pesticide residues and its derivatives in soil remains longer in soil and leads to the maximum residue of clay and organic matter;

(c) Impact on living organism and human body: Most of the pesticides fall into the soil and enter into the environment which will cause harm to aquatic organisms, terrestrial organisms and human and animal as well as destroy the ecological balance. Part of the pesticide components can be enriched in organisms and make pesticide residues exceed the standard through biological enrichment and amplification.

The harm of pesticides on human body can be divided into direct and indirect harm. Direct intake tend to kill instantly; Indirect harm enters into human body mainly through the use of pesticides containing residual pesticides and the long-term consumption of food containing pesticide residues and continuous accumulation in the human body may lead to the chronic poisoning such as cancer and diseases of reproductive system and nervous system.

2.5.4.2 Environmental risks caused by chemical fertilizers

Environmental impacts and environmental risks that may arise from chemical fertilizers include:

(a) The eutrophication of rivers and lakes. The reason of eutrophication is that the content of nitrogen and phosphorus in water is increased, which makes the algae and other aquatic plants grow too much;

(b) The soil is polluted, and the physical property of the soil is deteriorating. Long term excessive and simple application of chemical fertilizers will make the soil acidified. The increase of ammonium ion of organic and inorganic complex and substitution of Ca^{2+} and Mg^{2+} make the soil colloidal disperse, destroy the soil structure, compact the soil and lead to a direct impact on agricultural production costs, crop yield and quality;

(c) The toxic ingredients in food, feed and drinking water have increased. The biological toxicity of nitrite is 5-10 times larger than that of azotate. N-nitroso-compound of nitrite and amine is a strong carcinogen. The content of nitrogen compound in the well or river water that has applied the fertilizer will increase or even exceeds the standard of drinking water. Excessive soil fertilizer will increase the nitrate content of vegetables and forage crops. Excessive levels of nitrite in food and feed has caused children and livestock poison;

(d) The content of nitrogen oxides in the atmosphere has increased. A considerable number of nitrogen fertilizers that have applied to the field evaporate from the soil surface and enter into the atmosphere. A considerable number of nitrogen fertilizers enter into the soil in the form of organic or inorganic carbon and convert from nitrogen compounds of insoluble state, adsorbed state and water soluble state into nitrogen and nitrogen oxides.

Therefore, to address potential pesticide and fertilizer pollution problem in the project area, it is necessary to adopt IPM pest control strategy, to change the chemical fertilizer technology and to improve fertilizer use efficiency.

This project has formulated the pest management plan by widely using pest management technology and combining the promotion of disease-resistant varieties with application of pesticides and biological pesticide of high efficiency, low toxicity and low residue to replace the original use of highly toxic pesticides, which will effectively improve the agricultural ecological environment in the project area.

2.6 Assessment of existing policies and systems

2.6.1 Existing policies and systems

During the preparation of integrated pest management plan in the project feasibility study report, relevant policies, laws and regulations involved include the national and local levels, as well as the World Bank's policies. In order to strengthen the work of pest control, the policies and regulations formulated by Chinese government and the Shaanxi Provincial People's Government are as follows:

(a) *Standards for the Use of Pesticide Safety in the People's Republic of China* (1982) .

(b) *Regulations of the People's Republic of China on Pesticide Administration* (Promulgated by the State Council, implemented on May 8, 1997, revised on November 29, 2001).

(c) *Measures for the Implementation of the Regulations of the People's Republic of China on Pesticide Management* (Issued by Ministry of Agriculture on April 27th 1999, revised and implemented on August 1st 2008)

(d) *The Measures for the Administration of Pollution-Free Agricultural Products* (Issued by Ministry of Agriculture, General Administration of Quality Monitoring, Inspection and Quarantine in 2002).

(e) Ministry of Agriculture has promulgated the *Regulations on the Management of Pesticide Restrictions* on August 1st 2002 which is formulated in accordance with *Regulations on the Control of Agricultural Chemicals* to restrict the use of pesticides in order to do management work.

(f) *Standard for Safe Use of Pesticides GB4285-84 and Guidelines for the Rational Use of Pesticides(GB/T8321.1-GB/T 8321.7)* Carry out the provisions of the spraying amount, times, the safe interval period, maximum residue limits and precautions of all kinds of crops.

(g) *Measures for the Administration of Pollution-Free Agricultural Products in Shaanxi Province* (Agriculture Department of Shaanxi Province, August, 2002)

(h) *Antitoxic Regulations for Storage-Transportation, Marketing and Use of Pesticides* (GB12475-2006)(Ministry of Agriculture) ;

Through the implementation of these standards and guidelines, pesticide research, production, application, monitoring and management service system has been established in China. *Regulations on the Control of Agricultural Chemicals* issued by the State Council on May 8th 1997 is the first legally binding administrative regulations for pesticide management which signifies that pesticide management has entered the track of standardization, legalization and internationalization. *Measures for the Implementation of the Regulations on*

Pesticide Management revised in January 2008 has played a good role in the protection of *Regulations on the Control of Agricultural Chemicals*.

In the ten security policies of the World Bank, the one that applies to this assessment is "OP/BP4.09" Pest Management.

Under the implementation of relevant policies in our country, the integrated management of plant diseases and insect pests (IMP) in the project area has been advanced.

2.6.2 China's existing policy on plant protection

The Chinese government attaches great importance to the prevention and control of plant diseases and insect pests, emphasizing the use of "prevention first, scientific prevention, control in accordance with law and health promotion" policy of pest control. The prevention and control methods based on biological control are gradually adopted in the future.

The aim of the government policy is to confine the density (the degree of harm) of plant diseases and insect pests to low levels, and to improve the yield and safety level of agricultural products, that is, to protect agricultural resources and the ecological environment. When a serious pest occurs that can't be effectively controlled by other control methods, the application of chemical pesticides is essential for prevention and control methods, for it can prevent and control effectively with high-efficiency, low-toxicity and pollution-free chemicals.

The prevention and control of plant diseases and insect pests should follow the guidelines of "Prevention first and comprehensive prevention" and adhere to the principles of equal importance of plant disease and insect pest prevention and control with the protection of ecological environment, quality and safety of agricultural products. Provincial and municipal (county) people's government is supposed to strengthen the leadership within their respective administrative areas of the plant diseases and insect pests prevention and control and strengthen the construction of plant protection agencies and team; Agricultural departments at or above the county level are in charge of the plant diseases and insect pests prevention and control in the administrative area. Plant protection agencies, to which agricultural administrations subordinate, are responsible for the monitoring and forecasting of plant diseases and insect pests, the prevention and control of plant diseases and insect pests as well as the guidance and monitoring of safe use of pesticides. A subsidy policy has been carried out by the State for major agricultural prevention and control of disease and pests.

The Chinese government has attached great importance to the food safety and clearly demonstrated in *Regulations on the Control of Agricultural Chemicals* (Issued by the Chinese government) and *Standards for the Safe Use of Pesticides* (Issued by Ministry of Agriculture of China) that:

- Which kind of pesticides can be applied to the prevention and control of plant diseases and insect pests;
- Which kind of efficient, low toxicity and low residual pesticides can be recommended to prevent and control if non-pesticide methods fail to control;
- Agricultural products of excessive pesticide residues are prohibited to enter the market for sale;
- Methods for the safe use of pesticides

Regulations on the Control of Agricultural Chemicals encourage the use of high efficiency, low toxicity and low residue pesticides and provide the

standard for the sales of pesticides. Some chemical pesticides such as parathion, monocrotophos and phorate are banned in *Standards for the Safe Use of Pesticides and Regulations on the Control of Agricultural Chemicals*.

2.7 Framework of pest management and regulation

PMP pest management regulatory agencies comprise pesticide regulatory agencies, pest management agencies and pesticide testing organization. Table 6 shows the roles and responsibilities of different departments in pesticide market management, production and postpartum of agricultural products after the implementation of the project.

Table 6 Roles and responsibilities of different departments

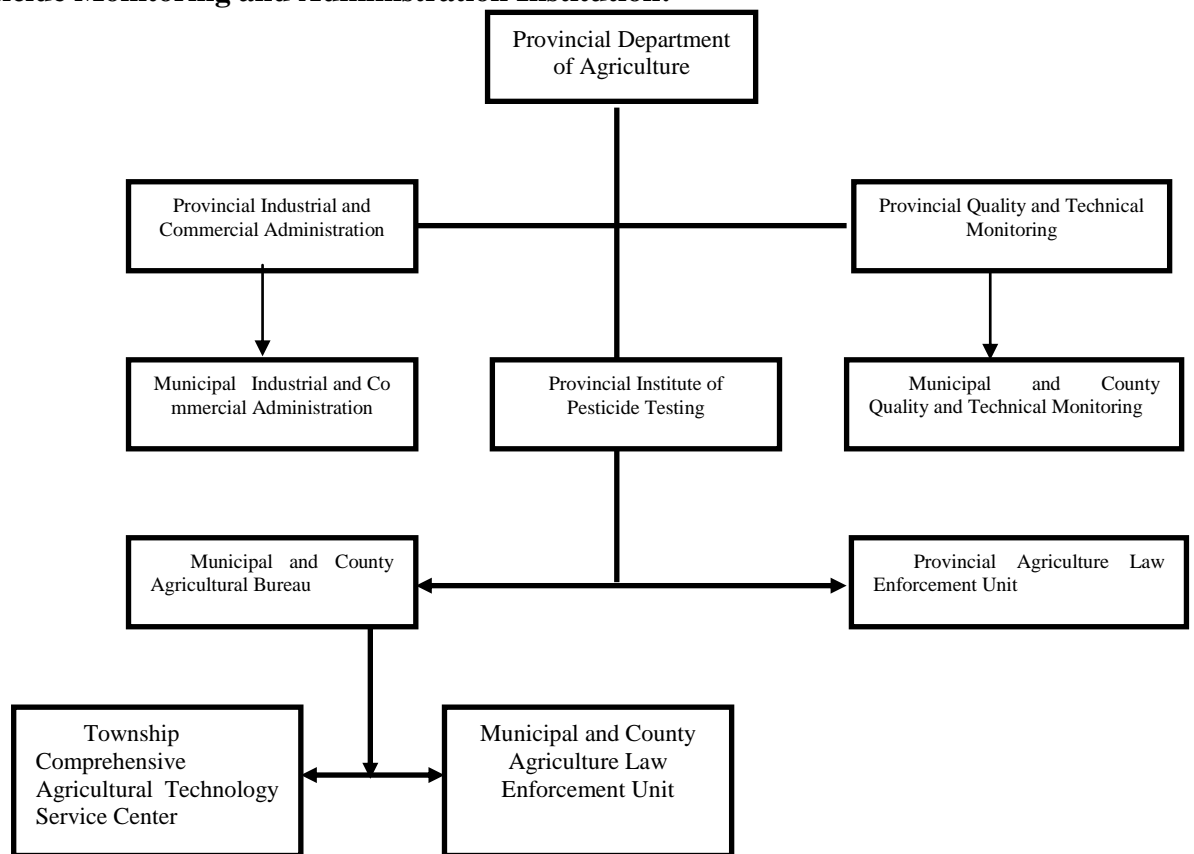
Project	Government	Agricultural Technology Department	Farmers
1. Pesticide market monitoring	Organize the cooperation of industry and commerce and agricultural law enforcement unit to carry out regular inspection of agricultural materials market, prevent counterfeit sales and prohibit the sale of highly toxic pesticides in the vegetable and fruit production areas.	Assist the government departments in carrying out the investigation of pesticide market and conducting field investigation of farmers.	Purchase pesticides and reduce the number of highly toxic pesticides under the guidance of local technical personnel.
2. Management in the agricultural production process	Release, validate and modify the prohibited and banned registration list of highly toxic pesticides according to the standards of World Bank, FDA and EU; Establish a more strict regulation on the use of pesticides, strictly prohibit the use of highly toxic pesticides on vegetables and fruits; Reduce the registration and approval of highly toxic pesticide production enterprises and varieties; Strengthen the monitoring and inspection of forest and crop seed seedling interprovincial allocation.	Strengthen farmers' training and guidance of daily pest control and guide farmers to take advantage of low-toxicity chemical pesticides, bio-pesticides and other control methods to control plant diseases and insect pests.	Participate in agricultural technical training and carry out pest control in accordance with the guidelines provided by agricultural technicians. Resolutely put an end to the application of highly toxic pesticides on crops
3. Management after the listing of agricultural products	Implement agricultural product recall system; Strengthen market monitoring and inspection of pesticide residues in agricultural products; Encourage farmers to produce green food, pollution-free food and IPM food and establish the sustainable agricultural market system of competitive prices to drive the farmers to adopt IPM technology by the advantage of the competitive prices; Encourage leading enterprises of agricultural products and farmers to establish order system.	Encourage farmers to adopt IPM technology to produce agricultural products and help farmers to apply for registration of green food, pollution-free and organic food.	Join in farmers association and production base of leading enterprises or apply for registration of green food, pollution-free and organic food; Make active use of IPM measures to produce higher value-added agricultural products.

Pesticides used in the project area must comply with national standards, industry standards or enterprise standards and pesticide packaging, transportation and storage is an essential part of the production and use of pesticides. Pesticide packaging should comply with relevant provisions of the three national standards issued by State Bureau of Technical Monitoring such as GB3796-85 *General Rules of Pesticide Packaging*, GB4838-84 *EC Pesticide Packaging* and GB5736-85 *Plastic Calcium Corrugated Box*. The transportation of pesticide has followed the national standards of “*Antitoxic Regulations for Storage-Transportation, Marketing and Use of Pesticides*” and the storage of pesticide shall follow the overall requirements of the third article in *Regulations on Safe Use of Pesticides*.

Laws and regulations on pesticide production, packaging, storage, transportation, sale and use in China have great difference with those in the international level. Like other provinces, pesticide management in Shaanxi Province has inadequate monitoring. Farmers there still use highly toxic pesticides, make excessive use of pesticides and fail to comply with the national provisions of spraying intervals.

To address the risk of plant diseases and insect pests that may arise in the implementation of the project and to help farmers not only effectively control pest damage without increasing the environmental and agricultural product pollution in the project area, the joint efforts of government, technicians and farmers are required.

Pesticide Monitoring and Administration Institution:



Responsibilities of various departments:

Department of Agriculture: Responsible for local agricultural development planning and management of related agricultural affairs.

Industrial and Commercial Administration: Responsible for the management of pesticide market

Bureau of Quality Monitoring: Responsible for the management of pesticide production processes.

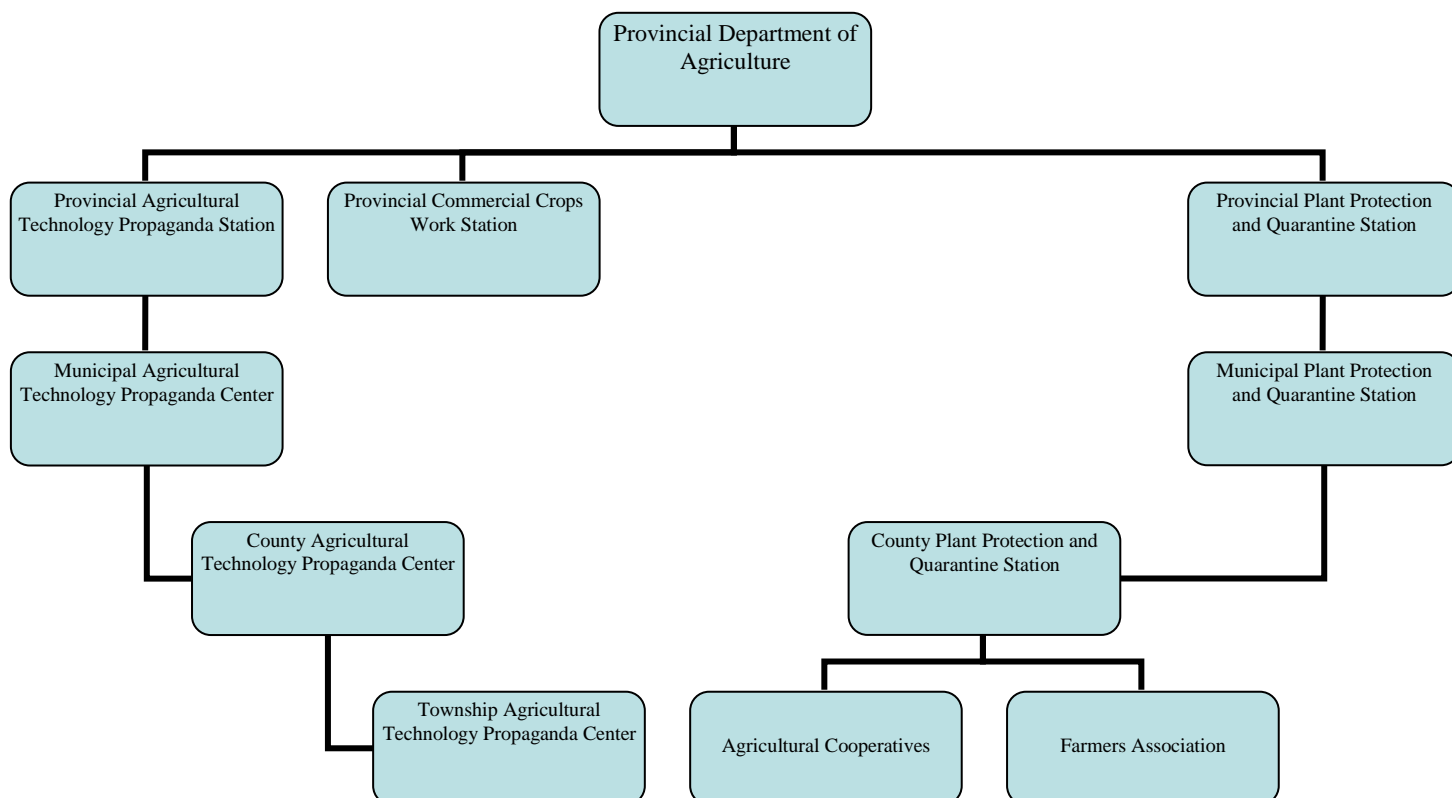
Institute for Drug Control: Responsible for pesticide registration application, use, monitoring and administration. Develop or participate in the formulation of safe use of pesticides, pesticide product quality and pesticide residues in the national or industrial standards and other related matters.

Agricultural Law Enforcement Agencies: Responsible for market monitoring and quality management of agricultural chemicals.

Township Agricultural Comprehensive Technical Service Center: Assist and coordinate with the relevant law enforcement and technical departments to carry out the promotion, training and guidance of pesticide management and pest management in the local area.

Pest Management Agencies:

Responsibilities of various departments:



Provincial Department of Agriculture: Responsible for province's agricultural and animal husbandry work, the province's agricultural departments at all levels and the organization of plant diseases and insect pests prevention and control.

Provincial Plant Protection and Quarantine Station: carry out plant quarantine inspection; regularly issue the long-term, mid-term and short-term prediction on plant diseases and insect pests; emergency prevention and control of major plant diseases and insect pests and the sustainable control; the promotion and safe use of new pesticide and machinery. Promotion for the plant disease and insect pest control technology and provide corresponding training.

Provincial Agricultural Technology Promotion Station: assist the farming and livestock office with the management; be responsible for the promotion for the technology.

Provincial Commercial Crops Work Station: be responsible for the planting plan for vegetables, fruit trees, traditional Chinese medicine of the province, as well as the technology promotion and plant disease and insect pest management.

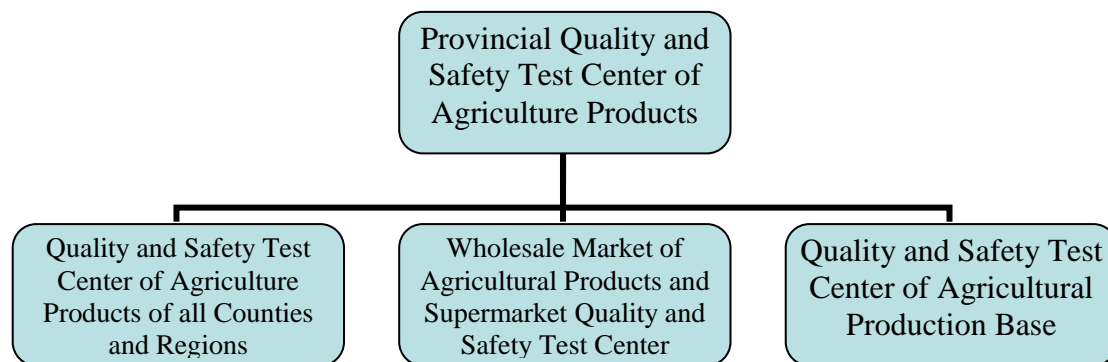
City and County (Region) Agricultural Technology Promotion Center: be responsible for the promotion for the agricultural technology in the areas under its jurisdiction; be responsible for the organization, planning, coordination, monitoring, decision-making and work management of the prevention and control of plant diseases and insect pests.

City and County (Region) Plant Protection Station: be responsible for the organization, management, guide and monitoring of prevention and control of plant diseases and insect pests of the areas under its jurisdiction. Assist and coordinate related law enforcement and technology departments to carry out the technology promotion, training and guidance on pesticide management and integrated plant disease and insect pest management technology.

Township Agricultural Technology Promotion Center: be responsible for the monitoring and prediction of major plant diseases and insect pests within the areas under its jurisdiction and implement in-time Prevention and control measures.

Agricultural Cooperatives and Farmers Association: organize and carry out local prevention and control of plant diseases and insect pests.

Pesticide Residue Test Organization:



Responsibilities of various departments:

Provincial Quality and Safety Test Center of Agriculture Products: be responsible for the quality and safety monitoring and management of the agricultural products in the province, and guide the safety and quality monitoring works in all cities and counties (regions).

Quality and Safety Test Center (Station) of Agriculture Products of all Counties and Regions: be responsible for the quality and safety monitoring and management of local agricultural products.

Wholesale Market of Agricultural Products and Supermarket Quality and Safety Test Center: be responsible for the access quality test to the market (supermarket) for agricultural products.

Quality and Safety Test Center of Agricultural Production Base: be responsible for the quality test for the agricultural products coming out of the production base.

3. PMP Integrated Plant disease and insect pest Management Plan

3.1 Project Objective

This project intends to implement the plant disease and insect pest management plan only in 11 counties and 29 towns and villages in 5 cities of Shaanxi Province: Baoji, Xianyang, Weinan, Yulin, Yan'an. 48,000 farmer households will be involved. In the project, we intend to apply the integrated plant disease and insect pest

management method to carry out the prevention and control for plant diseases and insect pests, so as to improve the standardized level of integrated pest management in agriculture. The purpose is to help the project area to get rid of the highly toxicant chemical pesticides. We intend to increase the amount of biological pesticides which has passed the risk assessment and been registered as products by over 100% and control the damage caused by plant diseases and insect pests below 10%.

The main tasks of this project are as follows:

(1) To introduce and promote the IPM technology in the project area (communities and cooperatives); to implement the biological diversity monitoring and regulating plans; to protect and take advantage of the natural enemy resources; to strengthen the prediction and forecast for agricultural pests.

(2) By substituting harmful chemical pesticide for microbial pesticide and botanical pesticide in the project area to reduce the adverse effect of chemical pesticide on the environment and human health.

(3) By production skill training and on-site training for farmers and other forms of studying, to improve the operation skills of the farmers in real practice and equip them with the skills of integrated pest management.

(4) To provide training for the technical workers in the technology station, the salesmen and distributors of pesticide, the management layer and assistants of the community, and the management layer of the county project management office to increase their awareness of the Integrated Pest Management (IPM).

(5) By keeping in close touch with the quality monitoring departments, to enhance the monitoring and regulation of the sales and application of pesticide in the project area, so as to comply with the related requirements of “OP/BP4.09” by the World Bank on this project as well as other international conventions, rules and usage specifications for pesticide.

3.2 Project Components

Through the loans from the World Bank for the Rural Community Development Project for Poor Areas, Shaanxi Province will apply agricultural, physics, biological and chemical prevention and control measures for integrated plant disease and insect pest management for the specific crops of multiple projects, communities and cooperatives, so as to reduce the dependency on chemical pesticides of the agricultural product during the production process.

3.2.1 Concept of PMP Integrated Pest Management

PMP Integrated Pest Management Plan intends to apply the integrated plant disease and insect pest management, in order to control harmful creatures, improve the safety level of agricultural products, protect the ecological environment and improve the farmers' quality. Also, we hope that the dependency on chemical pesticides of the agricultural products can be reduced and the economic damage caused by the plant diseases and insect pests can be limited to a certain level. The core is:

(1) It is to prevent and control the pests, not to eliminate them;

(2) Try as much as possible to apply non-chemical measures to limit the number of the pests at a low level;

(3) In the circumstances where pesticides are inevitable, the choice and application of pesticides should minimize the effect on the crops, humans and environment;

(4) Establish the standardized IPM technology system which matches regional characteristics by combining agricultural prevention and control, biological prevention and control, ecological control, physical avoidance and trap kill, to

substitute and limit the usage of chemical pesticides to the fullest degree. Try as much as possible not to eliminate the natural enemy or pollute the environment and control the plant disease and insect pest under an acceptable level.

3.2.2 Major Activity Content

(1) Strengthening the prediction and forecast of pests and disease

The plant protection and test center in all cities and counties should provide the information for plant disease and insect pest prevention and control prediction 7-10 days in advance. The information should include: the target crops, the proper time for prevention and control, the corresponding technology, the pesticide type, and so on. Special care should be taken for the plant disease and insect pest prevention and control in order to improve the efficiency and reduce the amount of pesticide.

(2) Agricultural prevention and control

Adjust measures based on the specific conditions of the 11 project counties and implement the following prevention and control measures specifically:

① Select the resistant variety: select the good-quality resistant variety to manifest the biological and genetic resistant potential of the variety and establish biodiversity, which is the most economic and significant way to reduce the amount of chemical pesticide.

② Rotation of crops: the rotation of crops is mainly for avoiding the serious plant diseases and insect pests caused by continuous cropping for many years.

③ Reasonable intercropping and multiple cropping.

④ Adjust the seedling time: arrange the seedling time early or postpone it, so as to avoid the period in which the crops are easy to get diseases or damaged, or attacked by pests. The plant diseases and insect pests can be avoided in this way.

⑤ Cultivation measures: deep ploughing, which can hide the stubble and weeds deep in the soil to avoid the breed of worm eggs; after harvesting of the crops, immediately plough and clean the stubble to reduce the occurrence of rice borers.

⑥ Nurture disease-free strong seedling: do well in seed nurture and soil disinfection treatment, to get rid of the ill seedling nurture the strong seedling.

⑦ Balanced fertilization and water-saving irrigation: provide sufficient base fertilizer and control the amount of nitrogenous fertilizer; apply the phosphate fertilizer and increase the amount of potash fertilizer. In this way, we can strengthen the ability of the crops to resist plant diseases and insect pests. Apply water-saving irrigation technologies such as drip irrigation under plastic film, alternate irrigation and unsaturated irrigation to lower the humidity of greenhouse for vegetables and lower the occurrence rate of plant diseases and insect pests.

⑧ Grafting: Promote the grafting technology of cucumber, eggplant and so on in sunlight greenhouse, which has an overall prevention rate of more than 90% for wilt, epidemic disease and greensickness.

⑨ Cleaning the field: clean the leaves, deadwoods or ill residue of the plants which had pests or diseases to reduce the source of plant diseases and insect pests.

(3) Physical prevention and control

①Set up the anti-pest net: this can be applied in the cultivation of vegetables and fruit trees, which can prevent the pests, diseases, rain, wind and light and keep the humidity.

②Trap kill: use the yellow mucilage glue board to set traps and kill the whiteflies, aphids, etc.

③ Pest-killing lamp: use the frequent-vibration pest-killing lamp to set traps and kill pests such as moths, beetles, and orthopteran pests.

④ Sugar-vinegar bait trap liquid: use this to set traps and kill moths, etc.

Together with the physical prevention and control technologies, increase 1500 frequent-vibration pest-killing lamps in the cultivation area for fruit trees and vegetables of the 11 project counties, as well as 5000 yellow mucilage glue board and 190 anti-pest nets.

(4) Biological prevention and control

①Apply biological agents, such as Bt emulsion, mycin, nuclear polyhedrosis viruses, beauveria bassiana, validamycin, and so on.

②Take advantage of the natural enemies of the pests, such as trichogramma.

③Apply the attractant to kill the pests, such as striped rice borer, plutella xylostella, and corn borer.

Promotion for the biological prevention and control technology in 401.5 hectares in 11 project counties.

(5) Chemical prevention and control

The combination of chemical measures and other measures in prevention and control will be the economic and efficient way to achieve better outcome, guarantee the agricultural harvests. It is required to apply high-quality pesticide which can well prevent the plant diseases and insect pests while having low-toxicant or non-toxicant effect toward humans and safe to the crops. The chemical prevention and control measures mainly include:

①The highly toxic, toxic and high-residue pesticides are prohibited in the project area. For the categories of pesticides, please refer to the latest “Suggestions on the Pesticides Categories Based on the Perniciousness and Classification Guide” by the World Health Organization.

②Make sure that different kinds of pesticides be applied for different plant diseases and insect pests based on specific symptoms.

③Apply the pesticides based on the occurrence period of the plant diseases and insect pests

③Apply the pesticides in a proper amount.

④Reasonably apply the combination of the pesticides alternatively.

⑤Strictly stick to the interval time for safe harvest.

3.2.3 Budget and Arrangement

According to the activity contents, the budget of the plant disease and insect pest prevention and control of this project covers the promotion costs for physical and biological prevention and control costs, etc. The specific budget details for the first batch of activities (in 13 communities) and all project activities (in 29 communities) are listed in Table 7.

Table 7 Budgets for PMP Prevention and Control Measure

Contents	Quantity	Budget (ten thousand yuan)
1. Frequent-vibration pest-killing lamp	1500 set	300.0
2. Yellow mucilage glue board	5000 piece	6.0
3. Anti-pest net	190 set	3.8
Promotion for plant disease and insect pest prevention and control technology	Including the purchase and application of biological pesticides	Has already been calculated into the operation fee for the cooperatives.
Budgets for the first batch of 13 communities	--	309.8
Budgets for 29 communities		691.1

3.3 Anticipated Outcome of PMP Project (main crops and integrated plant disease and insect pest management technology)

For the main crops in the project area, we stick to the planting protection principles of “focusing on prevention, applying integrated and green prevention and control”. For different kinds of crops, plant diseases and insect pests, choose the proper, highly-efficient pesticides and agents with the lowest negative effect; encourage the application of agricultural, biological and physical measures to reduce the areas and times of chemical prevention and control; encourage the application of biological pesticides. Apply low-toxic and low-residue pesticides for different kinds of crops, plant diseases and insect pests. The highly-toxic and high-residue pesticides are strictly prohibited.

3.3.1 Facility Agriculture

Major types of plant diseases and insect pests. There are gray mold, epidemic disease and cucumber downy mildew, as well as mealywing (whitefly and bemisia tabaci), vegetable leafminer, aphid, red spider, and so on.

The goals for plant disease and insect pest management, prevention and control

- Strictly stick to the safety interval of pesticide application for vegetable harvest and prohibit the highly-toxic pesticide;
- No increase in the amount of pesticides in case of planting structure changes (the greenhouse fruit tree planting area has increase by 65 mu);
- Increase the amount of applied biological pesticides for 100%;
- The pesticide residue in vegetables shall not exceed the national standards;
- Put an end to the pesticide poisoning accidents;

- Well control the temperature inside the greenhouse and reduce the number of plant diseases and insect pests;
- The damage rate by the plant diseases and insect pests should be controlled below 10%.

PMP Prevention and Control Measures

- Prevention and control strategies. The prevention and control strategies are: “based on the prediction and forecast of plant diseases and insect pests, centered on the optimization of agricultural and ecological environment, aimed at effectively control the damage caused by plant diseases and insect pests and reduce the pesticide residue, by comprehensively apply the agricultural, biological and physical prevention and control, and scientifically apply chemical measures”. Improve the skills to apply the pesticides in order to lower the risk of vegetable pesticide residue and enhance the plant protection, so as to guarantee the quality, safety and ecological environment protection of the agricultural products.

- Agricultural prevention and ecological regulation. Plant the disease-resistant variety; soil disinfection; apply the new nurture methods of nutrient soil, nutrition pot, seedling substrate, soil heating line, etc., to nurture “pest-and –disease-free” strong seedling; apply the changing root by grafting method to prevent and control wilt, greensick, bacterial wilt and other soil-borne diseases; apply the technology of reasonable rotation cropping and high-temperature greenhouse and others to control high-humidity diseases such as gray mold and prevent powdery mildew, downy mildew, bacterial angular leaf spot disease, the early and late epidemic disease and the leaf mold of tomato, and so on; apply the plastic films for double ridges and dripping irrigation under plastic film to lower the relative humidity of the air inside the greenhouse and limit the spread of high-humidity diseases such as gray mold and downy mildew.

- Biological prevention and control. Insect predators: using *sokolowsakii* to prevent and control lepidoptera pests like caterpillar and *plutella xylostella*, lacewing flies can prey on lepidoptera making eggs of aphids and mealworms, and *encarsia formosa gahan* can prevent whitefly. Microbial control: *bacillus thuringiensis*, *beauveria bassiana* and *abamectin* can kill pests. Biological agents: agricultural antibiotics, like agricultural antibiotic 120 and doxycycline can control damping off, downy mildew, powdery mildew, *fusarium wilt*, black rot and epidemic disease; *validamycin* can prevent and cure damping off, white southern blight, sheath blight, botanical pesticides like *azadirachtin*, *germine diacetate* solution can also reduce *plutella xylostella*, beet armyworm and whiteflies; *Matrine*, *neem* and *nicotine* can also prevent and treat several pests.

- Physical Prevention. Hung yellow sticky trap or yellow oil trap inside the greenhouse to trap and kill aphids, mealworms and *liriomyza sativae* Blanchard; use sweet lure to trap and kill cutworm pests, black light to collect and kill a variety of moth, dung beetles, leafhoppers, etc.

3.3.2 Edible mushroom

The edible mushroom in this project include *morchella* and *shitake* mushroom. Unlike general crops, the edible mushrooms have short duration period, tender tissue, and poor drug-resistance. Also, the fruit body can easily accumulate the residue of chemical pesticide, which will affect the taste of edible mushroom as well as human

health. Besides, the edible mushroom enjoys the same origin with most mixed and pathogenic bacteria, and there haven't been any efficient selective bactericides available. Therefore, in terms of the plant diseases and insect pests for edible mushrooms and mixed bacteria, we should focus on the prevention part, which lays much emphasis on the combination of environment control and physical prevention and control.

Prevention and control principles

- We should focus on the prevention part while apply integrated prevention and control measures;

- Select the disease-resistant and pest-resistant varieties for reasonably cultivation and management;

- Establish relatively complete prevention and control system to reduce or limit the sources of plant diseases and insect pests.

Notes

- The duration period of the fruit body is short and it will be eaten directly, therefore highly-toxic pesticides are strictly prohibited.

- Under the circumstances that the chemical agents are needed for adjuvant therapy, we must choose the registered, highly-efficient, low-toxic and low-residue pesticides and apply them properly, reasonably and in good time.

- During the fruiting time, the application of chemical agents to prevent and control plant diseases and insect pests is prohibited.

PMP Prevention and Control Measures

★ Design science of mushroom plant

From the perspective of alien species prevention, separate infection source area like raw material storage, batching plant and fertilizer dump from susceptible area like strain room, inoculation room, culture room and fungus producing shed; prevent flow of materials, personnel and waste from polluted area to susceptible area; for qualified mushroom plant, culture room shall be separated from fungus producing shed to reduce pollution in culture period.

★ Environment Sanitation

Doing a good job in sanitation is one of important ways to prevent and control a variety of alien species effectively, as well as foundation for other techniques of prevention. Handle daily cleaning and hygiene work well, burn or bury waste and pollutants deeply; clean up the weeds in the surrounding environment, pond and all kinds of organic residues timely to avoid pests breeding; avoid using unclean water; control the flow of cultivation field personnel at the same time. In addition, mushroom plant shall be cleaned thoroughly after ending of each season.

★ Select appropriate species

Select strains with strong resistance to pests and disease and stress resistance; meanwhile, utilize fungus strains of proper age and increase seedling rate appropriately to enhance the ability to resist plant diseases and insect pests.

★ Serious and reasonable burdening

Select fresh raw materials without deterioration; never add exceeding sugar and grain nutrition for burdening, as weak alkaline is required for mixing materials.

Undertake strict sterilization operation to avoid lot pollution caused by incomplete sterilization.

★Implement rotation of different corps

For culture room fungus producing shed suffered severe plant diseases and insect pests, methods of rotation shall be applied to avoid re-occurrence of pests.

★Effective physical prevention

Insect-proof nets and screens shall be installed for doors and windows of mushroom plant facilities; close the door immediately when entering and leaving mushroom room to prevent fly and mosquito to lay eggs. Harmful condition like over large or high temperature difference during the spawn running period shall be prevented; high temperature and high humidity shall be prevented during fruiting to reduce the diseases. In addition, measures like artificial hunting and luring are effective pest control methods, too.

3.3.3 Apple

Types of plant diseases and insect pests. There are mainly apple rot, powdery mildew and mosaic disease, etc. There are following pests: budworm Shadowed leaf moth, leaf beetle, leaf folder, coding moth, and so on.

Goals and Indicator for Plant disease and insect pest Management

- The application amount of biological pesticide increase by 100%;
- Substitute chemical fertilizer for organic fertilizer and compound 厩 fertilizer as much as possible, achieving the substitution rate of chemical fertilizer of 100%;
- Reduce the prevention and control by chemical pesticides for 3-5 times each year. Do not apply the banned pesticides.
- Limit the damage caused by plant diseases and insect pests within 10%.
- The pesticide residue in the fruits shall not exceed the national standards.

Strategies and approaches for plant disease and insect pest prevention and control

● Prevention and control strategy. Adopt the planting protection principle of “centering on prevention while applying integrated prevention and control measures”. The agricultural and physical prevention and control measures are the basis, while the biological means are the core. According to the occurrence rules and economic threshold values of the apple plant diseases and insect pests, by applying the chemical prevention and control measures scientifically and reasonably and choosing the safe, highly-efficient, low-toxic, pollution-free pesticides, we plan to keep the damage caused by plant diseases and insect pests below the level of economic injury.

●Plant quarantine, prediction and forecast. Strictly inspect the quarantine objects such as apple cotton aphid, flatheaded borer, scar skin and apple codling moth, etc., and prevent their entering the park. The occurrence period can be predicted based on the development progress of the pests, the phenological phase of the apple tree, the taxis to use the pest (trap kill by frequent-vibration pest-killing lamp, yellow mucilage glue, sugar-vinegar liquid), and the occurrence quantity can be measured and forecasted based on the pest population base investigation of the croplands and the analysis of the climate factors.

●Agricultural prevention and control. Strengthen management of water and fertilizers, increase organic fertilizer, compound fertilizer and refuse animal and

human excreta without compost maturity; promote fruit bagging, inter-row film and crop straw covering technology, especially the dry land ridge mulching rainwater harvesting soil conservation technology; promote tree construction technology of high photosynthetic efficiency, eliminate coppice shoot and sucker-growth inside the tree bore; in winter, remove plant residue of pests and burn or bury collectively out the yard.

- Biological prevention and control. (1) Control pest with pest. Mainly use beetles, lacewing flies, floret bugs, insectivorous fly and insectivorous bugs of best effect in aphids, leaf mites, leaf roller and budworm class, and measures like killing with insect hormone and beneficial birds. (2) Control pest with pathogens. Mainly use bacillus cereus, bacillus thuringiensis, beauveria bassiana, nutritional bacteria Bt emulsion, with good preventing effects on multiple larvae Lepidoptera. (3) Control pathogens with pathogens. Apply kasugamycin to prevent and cure canker, penicillin and validamycin to cure early deciduous disease, grisein to cure blossom blight.

- Physical prevention and control. Prevent wintering pests from recovery with membrane covered around the trunk, use lamplight, poison bait and stem residue to trap and kill pests; measures like scrape bark and fruit bagging are all effective in preventing and controlling plant diseases and insect pests.

- Chemical prevention and control. Give priority to biological pesticide and pesticide varieties of high-efficiency, low residual and toxic like pyrethrin and poultry oil emulsion vaccines, mineral source pesticide like mineral oil emulsion, petroleum spray oil of low sulphonate, as well as organic synthesis low-toxic pesticide like mildothane, carbendazim, bordeaux mixture. Carry out the safe use interval of pesticides strictly, use allowed pesticide varieties twice each year at most, with interval from last spraying to apply harvest over 20 days. Use the pesticides according to minimum effective dose and concentration and prevent respray and missed spray. Use pesticides of different mechanism in mixture and rotation to delay the resistance of germs and pests.

- PMP prevention and control measures. Based on the occurrence condition of condition of apple in multiple growth and development phases, apply integrated prevention measures on the targeted objects. There are five phases: the phase from spring-shoot to the early blooming, the phase from blooming to fruitlet, the phase from fruit expansion to fruit maturity, and the phase from dormancy in winter to flower bud differentiation. Corresponding measures should be taken.

During the phase from spring-shoot to the early blooming, the apple scab and scarabs should be mainly attended to.

- ★Comprehensive measures: cut and get rid of the leaves which have been damaged by the plant diseases and insect pests and burn them outside the park to reduce the base number of pests during the winter season. Improve the living environment of predatory mites and other natural enemies of the pests.

- ★Spray the whole tree with mancozeb before the sprouting period.

- ★For scarabs: select pyrethroid pesticides such as beta-cypermethrin for corresponding prevention and control.

During the phase from blooming to fruitlet, the following should be mainly attended to: scab, phyloxera, black spot, aphid, scarab, red spider and so on.

★Plant peanut, soybean and other crops in the park of the sapling for a better ecological environment. When it enters the drought season, apply shallow ploughing and grass mulching to the tree lands to prevent the drought and conserve the moisture of the soil.

★Prevent and control red spider: During the period when the red spiders are doing much harm and damage, we usually particularly locate and take care of the main spider strains. If the red spider has asserted adverse effect on the whole park, we will apply the pesticide comprehensively for prevention and control. Agentia such as Bt, amitraz, torgue, polynactin and so on can be applied.

★Prevention and control of aphid: the imidacloprid can be chosen.

During the phase from fruit expansion to fruit maturity, we should pay special attention to peach fruit moth and so on.

★Promote the application of fruit bagging: when it enters the phase of fruit expansion, the fruit bagging should be applied in time. ★Prevention and control of red spider: Pyridaben, torgue, amitraz and other drugs can be used for this purpose.

During the phase from dormancy in winter to flower bud differentiation, we should clean the park and lock it.

★Prevention and control of overwintering mites and scale insects: After fruit picking, spray 80 times of engine oil emulsion or 12 times gum resin compound.

★Paint the tree trunk white, heap soil at tree stump (to be clawed after spring comes) to prevent the tree from cold, sunburn, plant diseases and insect pests.

★Clean and lock the park in winter: cut the branches with the pests; get rid of raised skin and worm eggs on the trunk and main branches; clean the dry branches, fallen leaves and weeds on the ground and burn them together. To clean the park, the 0.5-1 Baume lime sulfur mixture can be used.

3.3.4 Chili

The types of pests and disease: anthracnose, epidemic disease, powdery mildew, virus disease as well as aphid, oriental tobacco budworm, cotton bollworm, yellow tea mite, etc.

Goals of Plant disease and insect pest Management and the Prevention and Control

The agricultural prevention and control is the basis. By taking advantage of natural enemy as the ecological control factor, we can make the products satisfy the national food and sanitation standards and control the damage of plant diseases and insect pests under the threshold value.

PMP Prevention and Control Measures

(1) Comprehensive agricultural prevention and control

① Selection of resistant varieties. According to the occurrence rule of local disease and major disease types, select chili species suitable for local cultivation of strong resistance.

② Reform cultivation system, apply reasonable rotation and promote intercropping. Apply rotation system of 2-3 years, intercropping of wheat-chili or single chili cultivation to improve resource utilization and reach high efficiency and low consumption, promote complementary between the groups of crops and soil

nutrient balance, so as to reduce natural disasters and plant diseases, as well as pesticide pollution.

③Adjust seedling period and avoid peak period of plant diseases. Seedling period not only affects yield and quality, but also keeps a close relationship with occurrence of plant diseases. So it is reasonable to avoid hot seasons to reduce occurrence of virus disease.

(2) Cultivate strong seedling

①Long distance or soil dressing seedling. Seedling in fields of replant problem is vulnerable for seedling blight and damping off, as long distance or soil dressing seedling can reduce occurrence of disease effectively.

②Fixed plant with pesticides. Before fixed seedling, spray pesticides of plant diseases once to keep the pests within the range of seedling and reduce spread; eliminate disease seedlings to ensure the strong seedling without plant diseases and insect pests.

③Reasonable close planting. Appropriate thin planting enables full growth of unique feature of chili to be strong and enhances resistance to pests and natural disasters.

④Deep furrow ridge planting. Prevent thicken soil of root caused by watering or pondering after raining, as improved soil permeability can keep dry and loose soil environment, so as to reduce the occurrence of plant diseases effectively.

(3) Biological prevention and control

①Control pest with pest: use ladybug, lacewing flies and other predatory natural enemy to control aphids; use trichogramma to control *helicoverpa armigera* and *helicoverpa assulta*.

②Control pest with pathogens: use bacteria like *bacillus thuringiensis* (Bt), fungus like *beauveria* and *metarhizium anisopliae* and *entomophthora aphidis* and antibiotics like abamectin and liuyangmycin to control all kinds of pests.

③Use botanical pesticides like neem oil, melia azedarach, Cortex Meliae and nicotine to control all kinds of pests.

④ Control diseases with pathogens (including antibiotics); control (such as CMV satellite vaccine S52 and attenuated vaccine of tobacco Mosaic virus N14) virus disease with virus preparation; control all kinds of fungi with agricultural antibiotics like plant disease resistance inductors, polyoxin , agricultural antibiotic 120, streptomycin and new phytobacteriomycin.

(4) Physical prevention and control

①Use sun seeds, seed heat treatment to treat the seeds, destroy or reduce the pests spread by seeds.

② Trap and kill pests with frequent-vibration pest-killing lamp;

③ Trap and kill aphids with yellow boards;

④ Collect and kill cotton bollworm with sugar-vinegar liquid lure.

3.4 Application Principles for Biological Pesticide

The rural community development project in poor areas of Shaanxi Province by the loan from the World Bank shall apply the following standards for pesticide selection:

- (1) harmless to human health;
- (2) distinct influence on the target varieties;
- (3) little influence on non-target varieties and the environment;
- (4) the same drug shall not be repeatedly used;
- (5) the pesticide must be highly-efficient, low-toxic with low residue or no residue.

The Table 8 has listed the toxicity (based on the Harm Categories and Classification Guide of Pesticides recommended by the WHO) and risks of the application of biological pesticides.

Table 8 Suggested Biological Pesticides for this Project

Pesticide name	Toxicity classification (WHO)	Targeted varieties	Risk evaluation
Kasugamycin , penicillin	Low toxic , III	Tomato leaf mold, Pseudomonas lachrymans, bacterial spot of chili,	The pesticides applied in this project all have little or low toxicity for human beings. But the influence on the target object is significant.
Bacillus cereus (Bt)	Low toxic , III	Plutella xylostella, oriental tobacco budworm, european corn borer	
Polynactin	Low toxic , III	Aphid, tetranychid mite	
Pyrimidine nucleoside antibiotic	Low toxic , III	Alternaria brassicae, powdery mildew of vegetables, anthracnose, downy mildew, alternaria solani	
plutella xylostellagranulosis virus	Low toxic , III	Plutella xylostella	
Polyoxins	Low toxic , III	Downy mildew, cucumber powdery mildew	
Predatory mites	Low toxic , III	mite	
Agricultural antibiotic	Low toxic , III	Vegetable damping-off, downy mildew, powdery mildew, epidemic disease	
Toosendani, cnidium lactone	Low toxic , III	plutella xylostella, cabbage caterpillar, lepidopterous pest such as cabbage webworm	
Veratramine alcohol, nicotine	Low toxic , III	plutella xylostella, beet armyworm, bemisia tabaci, etc.	
Bacillus cereus	Low toxic ,	Various lepidoptera larva of	

	III	fruit trees	
Streptomycin	Low toxic , III	Cabbage soft rot	
Xinzhimycin	Low toxic , III	Cabbage soft rot, tomato bacterial wilt, cabbage leaf spot	
Abamectin	Low toxic , III	plutella xylostella ,tetranychid mite, RKN	
Bacillus thuringiensis (Bt)	Low toxic , III	Pests of orthopteran, coleopteran and diptera	
* Toxicity classification is based on the Harm Categories and Classification Guide of Pesticides recommended by the WHO.			

It is suggested that the pesticides applied in this project should be in conformity with the standards specified in “Suggestions on the Pesticides Categories Based on the Perniciousness and Classification Guide” by the WHO (Geneva, WHO), to which the World Bank refers.

In this project, we will not purchase the pesticides which have been prohibited from application, or unregistered, or belong to the type I pesticide regulated by the WHO.

3.5 Type and Usage of the Permitted Pesticides

In this project, we will first choose and synthesize the pesticides which have equal prevention and control effect as the agricultural, physical (such as trap kill) and biological prevention and control measures or biological pesticides (such as Bt). This project mainly supports the prevention and control measures for pests. Such measures have the minimum influence on the environment, humans and cattle. Besides, for the same type of crop, we will not repeatedly apply one type of pesticide so as to avoid drug resistance. The applied pesticides should all be registered in the country and correctly applied based on the “Code for Reasonable Pesticide Application” (National Standard). They should be safe to humans and target crops. The labels and instructions of the pesticides (made according to “Regulations of Pesticide Labels and Instructions”) should be abided by to ensure the environmental safety. It is specified in the “Regulation of Pesticide Management of People’s Republic of China” that: Those who produce, sell and apply pesticides in the People’s Republic of China should abide by this regulation. The Regulation has had detailed requirements on the registration, production, business and application of pesticides.

- for permitted pesticides, the following laws and regulations should be strictly abided by:

- FAO Behavioral Code of Pesticide Management, Sales and Application (or corresponding laws and documents in China).

- FAO Guide for Pesticide Packing and Storage (or corresponding laws and documents in China).

○FAO Instructions for Correct Labeling of Pesticides (or corresponding laws and documents in China).

○FAO Disposition Guide for Waste Pesticide and Pesticide Containers (or corresponding laws and documents in China).

4. PMP Implementation Plan

4.1 The Setting and Responsibilities of Project Implementation Institutions

4.1.1 Setting of Institutions

Shaanxi Province will establish supervising and guiding expert team and Technical Expert Panel for PMP integrated plant disease and insect pest management plan. The supervising and guiding team will be made up of the provincial project management offices and other departments concerned; and the Technical Expert Panel will be made up of experts from units of scientific research and promotion (such as plant protection station, agricultural technology promotion center, and so on).

4.1.2 Responsibilities of all stakeholder parties

Technical Advisory Group:

- The examination of planting model base in the project area;
- The monitoring over the implementation status of plant disease and insect pest prevention and control plan;
- The coordination for the activities by the project management office of the cities and counties as well as the construction units of the project.

Technical Expert Panel:

- Making the plant disease and insect pest management plan in the project area;
- Providing technical guide for the plant disease and insect pest management;
- Assisting the provincial project management office to monitor and assess the implementation of the project;
- Assisting the plant protection station of the cities and counties to carry out technical inspections, in order to decide whether to provide fund or not;
- Providing technical support for technological problems related to PMP;
- Participating in the training for the staff of the project;
- Helping and organizing the activities of visiting and studying and contact with the international PMP project;
- Write and edit the Field Operation Manual and other works related to PMP.

Plant Protection Station of Cities and Counties:

- Mainly be responsible for the monitoring, prediction and forecast of the plant diseases and insect pests in the project area;

- Be responsible for the making of PMP schedules for each county and area and assign specific staff to organize and implement the plan together with the staff from the communities (villages and towns) and cooperatives;

- Be responsible for the technical training for the technical staff of the Communities (villages and towns) ;

- Making sure of the implementation of PMP by applying effective methods and approaches.

Grassroots Agricultural Technology Promotion Station :

- Be responsible for guiding the farmer households associations to investigate the plant diseases and insect pests and report to the plant protection station of the counties (cities).

- Be responsible for organizing and implementing the integrated plant disease and insect pest prevention and control plan under the guidance of the plant protection station of the counties (cities);

- Be responsible for the technical guide and training for participating farmer households.

Provincial Agricultural Science, Research and Teaching Organization:

- Participate in the making and perfection of the PMP plans;
- Establishing technological experiment zone in the project area to show the effect of new prevention and control technology and products;
- Enhancing the monitoring and assessment of the application effects;
- Participating in the technical training and the editing of the training textbooks related to the project.

4.2 Capacity building

4.2.1 Training

The training contents mainly include:

- Relevant national and local laws and regulations
- The plan and implementation of integrated plant disease and insect pest management of the project
 - Methods of safe procurement and application of pesticides
 - The identification, prevention and integration management technology of main plant diseases and insect pests of the project

Training for application of pesticides safely:

- Provide special training for village cadres, farmer households and pesticide salesmen about the possible influence of pesticides on the environment, the recommended application methods for the pesticide and the equipment, etc.

- Provide training and demonstration for village cadres, farmer households and pesticide salesmen to enhance their understanding of the following problems:
 - Possible influence of all kinds of pesticides on the occupation/ health
 - Recommended application and spraying methods
 - Approved equipment (such as: sprayer, spray nozzle, etc.) and application methods
 - Wear safety suits (shirt with long sleeves, masks, hats, gloves, long trousers, shoes)
 - Apply the pesticides in days with static wind
 - Keep and store the pesticides safely; lock the pesticides in the cabinets with locks where the children could not access to
 - Get rid of the packing and wastes of pesticides in a safe manner; it is the best to bury them deep or burn them down
- Supervise the aforesaid operations. If there were any incorrect operations, the concerned people should be trained again.
- Implement the listed project management measures.

In the project, the instruments for physical and biological prevention and control should be purchased to apply multiple technologies for plant disease and insect pest prevention and control (agricultural/physical, biological, chemical), making sure the pests or the diseases do not form resistance to the pesticides.

4.2.2 Policy Implementation (Increase the awareness to implement the policies)

Through the implementation of the project, the awareness to implement integrated plant disease and insect pest management has been strengthened, which can be reflected through the following facts :

- Strictly follow the regulations on pesticide management.
- The application of unregistered pesticide in the project is prohibited.
- The application of I type pesticide defined by the WHO in the project is prohibited.
- The following laws and regulations should be strictly abided by:
 - FAO Behavioral Code of Pesticide Management, Sales and Application (or corresponding laws and documents in China).
 - FAO Guide for Pesticide Packing and Storage (or corresponding laws and documents in China).
 - FAO Instructions for Correct Labeling of Pesticides (or corresponding laws and documents in China).
 - FAO Disposition Guide for Waste Pesticide and Pesticide Containers (or corresponding laws and documents in China).
- Abide by the related environment requirements on chemicals including pesticides by the National Environment Protection Department; the ecological model

counties should also stick to the environment requirements on the ecological model county.

- Through discussing the providing the successful cases and outcome (especially long-term effects) of PMP, to encourage the governments of counties and villages to promote and support the PMP methods.

- Require the farmer households who apply to be part of the construction of model base to purchase permitted and registered pesticides.

- Providing fund support for the PMP study and promotion in this project should be regarded as the priority.

4.2.3 Monitoring and Management

Further implement the PMP through the following approaches:

- Train the promotion staff and farmer households in the counties and communities.

- Make a monitoring plan to evaluate the PMP technology and application in the plant disease and insect pest management in the project.

- Appoint one project management officer in charge of evaluating the organization and implementation of PMP methods in plant disease and insect pest management and provide certain financial support for PMP management organizations.

- Together with the Agricultural Technology Promotion Center of Shaanxi Province and other science and research institutes (such as the Agricultural Science Academy of Shaanxi Province), treat PMP as the focus for future study and promotion.

- Establish partnership with relevant organizations in the country and make a contribution to the PMP technology in this project.

- Enhance the relations among provinces, cities, counties, communities and cooperatives and solve the problems in time to facilitate the smoothing implementation of PMP.

- Promote the measures and methods to reduce the application highly-toxic pesticide. The private business owners are encouraged, especially those selling agricultural chemicals, to effectively apply PMP methods.

4.2.4 Technical training and human resource development

Training and human resource development is a vital part for strengthening the plant disease and insect pest management capacity. Depending on the different tasks and levels of people participating in this project, we will provide training for the technical staff from the province, the cities, the counties and communities. In this project, we will cultivate management capacity for plant disease and insect pest from the following aspects:

- The plant protection experts and technical staff from the county will visit the qualified organizations, such as the Plant Protection Work Station of Shaanxi Province and the Agricultural Science Academy of Shaanxi Province, to accept the training of the new plant disease and insect pest management, including the PMP approaches for specific crops/ plant diseases and insect pests.

- The plant protection experts should regularly train the promotion staff about the plant disease and insect pest prevention methods, including the PMP approaches for specific crops/plant diseases and insect pests.

- Train the promotion staff in the counties and communities to make sure that the regulations of the pesticides have been effectively implemented.

- The technical staff should regularly provide training for farmers about the new methods of plant disease and insect pest management and PMP for specific crops/plant diseases and insect pests through farmer's field school and other means.

- Edit and distribute the PMP training materials. The materials should be simple and plain with audio-visual teaching materials attached.

- Encourage the women to participate in PMP activities.

- Carry out PMP practical technology study based on the actual needs of agricultural production and the farmers.

4.2.5 Farmer household training

The purpose of farmer household training is to guarantee the safety of the farmer households and help them to identify common plant diseases and insect pests as well as carry out economic and efficient prevention and control measures, including: how to identify the plant diseases and insect pests, how to correctly make prevention and control decisions and how to apply proper measures, etc.

The farmer households should be trained 3-4 times during the plant disease and insect pest prevention and control period (1 time per day, and 50 households per time).

The training contents include:

- The morphological characteristics and identification of plant diseases and insect pests;

- The features of and damages by different plant diseases and insect pests;

- The identification of major plant diseases and insect pests as well as their natural enemies;

- The occurrence rule of major plant diseases and insect pests;

- The field sampling of plant diseases and insect pests and the estimation method of occurrence density;

- The threshold value of plant disease and insect pest control;

- Prevention and control measures of plant diseases and insect pests, including agricultural, physical, biological and chemical approaches;

- The selection and safe application of pesticides;

- The safe storage and disposition of agricultural chemicals and other packing wastes;

- Methods of field investigation

- Prevention and control indexes

- Prevention and control measures, including integrated PMP methods of agriculture, physical, biological and chemical prevention, as well as the safe storage, management and disposition of pesticide wastes and containers;

- The application methods and protection requirements for chemical pesticides.

The trainers may include:

- Staff and demonstration households of the cooperatives
- Seasoned agricultural technology promotion staff at the level of province, the counties and the communities

- Pesticide salesmen

- Plant Protection Work Station of Shaanxi Province

- Other organizations in Shaanxi Province (such as the Agricultural Science Academy of Shaanxi Province)

4.3 Arrangement for PMP Progress Report

- The undertaking unit of the project has the obligation to submit the annual project progress report in time. The mid-term implementation report is required at the mid-term of the project and the implementation report is required after the completion of the project.

- The annual report and mid-term report of the project should include: the implementation date, the fund utilization condition, the project progress, the outcome, the difference between the actual outcome and anticipated outcome, the problems met during the implementation and its corresponding solutions, etc.

- After the completion of the project, the final report should include: the implementation date, the fund utilization condition, the latest progress of the project, the difference between the actual outcome and anticipated outcome, the problems met during the implementation and corresponding solutions, etc.; The project implementation outcome assessment is reflected by the application of technology which has been promoted in the project, the increase of the farmers' income and the improvement degree of their living standards through the new technology, the quality and safety level of agricultural products, the influence on the ecological environment, the sustainability of the project, project organization and management, etc. By evaluating the outcome of the completed project, we can analyze the overall implementation achievements of this project.

5 Work Schedule and Costs

In order to achieve the goals, carry out the activities and meet the anticipated outcome of PMP, the project intends to carry out the work from the following four aspects: basic data collection, farmer training, technical assistance and monitoring and assessment.

5.1 Basic Data Collection

(1) Work Schedule

The purpose of basic data collection is to provide data source for the writing of project proposal, feasibility study report and choice of specific implementation

locations. It will affect the assessment of the plant disease and insect pest prevention and control project and help us know more about the background information before the implementation of the project. For project managers and fund providers, it can help monitor the implementation quality of the project. The plans and work schedule can be adjusted and modified based on the data collection.

For the basic data collection, we can apply the method of participative need and opportunity assessment before and during the implementation of the project. In order to keep the sustainability of the project, we need to establish a basic survey network which involves multiple aspects. The basic survey should also be integrated with the farmer training. The costs should be calculated in related training activities. The management team should coordinate and manage the basic survey activities.

(2) Budget

The costs and expenses for basic data collection (including the basic data collection for monitoring indexes) have already been included in the budget for training activities.

5.2 Farmer Training

Farmer training is a vital part for PMP Integrated Pest Management. The objective is to help the farmers from 11 project counties to be aware of the principles and methods of continuously apply the IPM technology through IPM training. The trained farmers will be equipped with IPM knowledge, the plant protection skills, and the sense of responsibility to protect the environment and the ownership spirit to participate in the IPM activities. In this way, we can control the plant diseases and insect pests by using pesticide in a safe and economic manner, reduce the pesticide residue and realize the sustainable development of production, the diversity of the ecosystem and the improvement of living standards. There are three aspects for the farmer training (Table 7): first, the training for the management and assistant officers, with the purpose to establish a team of assistants who can train farmers; second, the farmer production skill training, which help the farmers identify and analyze the problems they meet during production and make them more proactive and seasoned; third, the farmer production skill field training.

Participatory training: In the project area, the farmer production skill training will be carried out. The assistant team is mainly made up of the promotion staff for agricultural technology and the seasoned farming technical staff who have been specially trained. The assistants should solve the specific problems the farmers meet in the field and real practice in different phases of the plant diseases and insect pests of the crops and help them to well identify the plant diseases and insect pests and implement certain Prevention and Control measures. In this way, the farmers can acquire more skills and knowledge and can do better in organization, communication and management.

Farmer production skill field training: the project team should regularly or irregularly organize the field training team, which is made up experts from agriculture science and research institute, junior colleges and agriculture management and promotion organizations, to train local promotion staff, farming technician, farmers and pesticide distributors of the project communities with the latest knowledge of IPM, the new technology of pollution-free prevention and control for plant disease and insect pest, the safety application of pesticide, the related policies and regulations of pesticide business, and so on.

Training objects: the agriculture promotion staff at the level of counties (regions) and villages (towns), the special staff for plant protection, the farming technician, the farmers, the pesticide distributors, and so on.

5.2.1 Management and Assistant Officers Training (MAOT)

(1) Work schedule

In order to provide qualified production skill training for farmers, first of all, we need to train a team of skillful assistant officers who can carry out such training. Meanwhile, we need to organize a Technical Advisory Panel focusing on plant disease and insect pest prevention and control, soil fertilizer, gardening crops, fruit tree cultivation, livestock and so on. Based on the above-mentioned analysis, the main area we intend to enlarge in the project area is facility agriculture (fruit and vegetables), fruit trees, edible mushrooms and other crops. Considering the characteristics of these crops, it is suggested that the training courses should be provided during the two critical months for production: from the time of flower blooming to the time of yielding the fruits.

(2) Budget

The intensive training will be mainly carried out for the 69 technical managers and staff (1 management staff per project county and 2 assistants per community) who are responsible for vegetables, apples, edible mushroom, persimmon, chili, etc. in 29 communities in 11 project counties. The training will be provided twice per year. The budget for the official implementation of the project is 345,000 yuan (Table 9).

Table 9 Schedule and Budget for MAOT (2016-2020)

Period	Location	Number of Communities	MAOT Number	Number of Learners	MAOT Assistants	Budget (10,000 yuan)
2016-2020	Project counties	29	29	69	29 assistants graduated	34.5

5.2.2 Farmer Production Skill Training (FPST)

(1) Work schedule

As an important tool to support and help the farmers to understand and apply the IPM principles, the farmer production skill training is a new method to educate farmer and promote technology. According to the crop types of the project area, a typical farmer production skill training usually contains 25 farmer learners. The training time is usually 5-6 intensive hours per week or per month. For the training of the first season, each group should be equipped with a business assistant. In general, the assistants should be agricultural technology promotion staffs who have already attended IPM training.

(2) Budget

According to the planting period and growing seasons of the crops in the project communities, the farmer training will be held for 5 times each year in each project county (in total 55 times for 11 project counties). For each training, the number of assistants is 72 (55 assistants for project communities +11 technical responsible people in 11 project counties +6 invited provincial experts for science, research and promotion).150 farmers will be trained each time. During the implementation of the project, there will be 49,500 persons in total attending the training, and the budget is 2,475,000 yuan (Table 10).

Table 10 Schedule and Budget for Farmer Production Skill Training (2016-2020) (Ten Thousand Yuan)

Period	Crop	Number of assistants/year	FPST number /year	trained farmers per year	Total budget for 5 years
2016-2020	Apple	72	5	22500	112.5
2016-2020	Vegetables	72	15	9000	45.0
2016-2020	Chili	72	5	10350	51.75
2016-2020	Persimmon	72	5	1350	6.75
2016-2020	Morchella	72	20	1800	9.0
2016-2020	Mushroom	72	5	4500	22.5
Total				49500	247.5

5.2.3 Farmer production skill field training (FPSST)

(1) Work schedules

In the project area, the number of possible farmer production skill training classes is far from enough, because the assistants who have passed the MAOT can only carry out FPST in the places they work. Besides, there are not enough qualified assistants to train the great amount of farmers. As a result, those farmers who haven't attended the field school still face many pressing problems. Such training model applies lectures and not many farmers are involved, but it will be more flexible to choose the topics, the target crops and training methods. The choice of staff for Farmer production skill field training can be flexible, which may include staff from agriculture science and research or educational institutions or people from the agriculture promotion organizations.

(2) Budget

There will be 60 times of Farmer production skill field training. The total budget is 600,000 yuan. 6000 person time will be accumulatively trained. The transportation, subsidy, accommodation, meals, training materials, conference room charges and other costs are all covered.

Please see Table 11 for details of the work schedules and budget for this training of this project.

Table 11 Project Training Work schedule and Budget Summary

Training category	Training content	Training object	Training mode	Training times	Training number	Total expenditure (10,000 RMB)	Executing agencies
Management personnel+	The latest idea of IPM Pest management plan of the project New techniques for the control of plant	City, county (District), township (town) agricultural	Mobile training	Training 2 times per year	690 Person-time	34.5	Project Management

assistant training (MAOT)	diseases and insect pests Relevant policies and regulations on the safe use of pesticides and the sales of pesticides.	extension workers, plant protection engineer etc.		in each county			Office
(FPST) Farmers' production skills training	Identification, prevention and control measures of major plant diseases and insect pests; Safe use of pesticides and disposal of waste pesticides and packaging	Township (town) farmers, technicians, farmers, pesticide dealers in the project area.	Participative training	Training 5 times per year in each county	49,500 Person-time	247.5	Project Management Office
(FPSST) Farmers' production skills site training	The latest idea of IPM Pest management plan of the project New techniques for the control of plant diseases and insect pests Safe use of pesticides Occurrence regularity of plant diseases and insect pests	City, county (District), township (town) agricultural extension workers, plant protection personnel, agricultural engineer	Interactive training	Training 2 times per year in each county	6,000 person-time	60.0	Project Management Office

5.3 Monitoring and Assessment

5.3.1 Contents of monitoring

- Registration and use of pesticides
- Implementation of the monitoring plan

5.3.2 Monitoring indicators and examination content

(a) Monitoring indicators

- a) Integrated pest management area (ha);
- b)The number of farmers that participate in the training of integrated pest control (number);
- c)The number of purchase and use of physical control equipment(Corresponding to the number of insecticidal lamps and yellow plate in the project) ;
- d) The area of the procurement and use of biological control measures (Corresponding to the number of bio-control subsidies) ;

e) Changes in pesticide use (Data from the typical household survey data);

f) Changes in pesticide residues (Monitoring of pesticide residues in products, such as the main and typical crops, vegetables and fruits in the project area).

PMP monitoring mechanism and assessment indicators statistics are shown in table 12.

Table 12 PMP monitoring mechanism and assessment indicators statistics

No.	Indicators	Contents	Executing agency
1.	Integrated pest management area (ha)	Survey the number of households and application area of the PMP plan	Project management office at the county level (Internal monitoring)
2	The number of farmers that participate in the training of integrated pest control (person-time)	Count the times and the number of farmers to participate in the training of production skills (Through the sign-in rosters and training village seal).	Project management office at the county level (Internal monitoring)
3	The number of purchase and use of physical control equipment	Great importance should be attached to the counting of the number of insecticidal lamps and yellow plate in the project village.	Commission external agencies to monitor
4	(ha) The area of the procurement and use of biological control measures	Mainly monitor the number of biological sterilization and killing virus and pesticides and other subsidies in the issued project counties.	Commission external agencies to monitor
5	Changes in pesticide use	Investigation on the species and quantity of pesticides used in the project villages	Commission external agencies to monitor
6	Changes in pesticide residues	Pesticide residues monitoring of typical crops and vegetables, fruits and other products in the project village	Commission external agencies to monitor

(2) Budget

Another village carries out demonstration and promotion. The basic data collection budget of each village is 5000 RMB with a total of 290 thousand RMB. The follow-up survey data includes yield, pesticide use and carries out the population dynamics of natural enemies in 58 villages with 500 RMB each village one year which has lasted for 5 years with a total of 145 thousand RMB. The cost of pesticide residues in agricultural products detection is 600 RMB each sample and a total of three samples should undergo detection for one community for five year with a total

of 261 thousand RMB. Pesticide poisoning investigation is carried out in each county with 600 RMB per year reaching 33 thousand for a successive of five years. The entire monitoring budget is 729 thousand RMB (Table 13).

Table 13 Monitoring and assessment budget

Content	Scope	Budget (10,000RM B)
1. Basic data collection (including monitoring indicators related basic statistics)	58 villages, 29 communities, 11 project counties for the first year; Annual monitoring indicators for the implementation of the project (Such as the prevention and control area, the number of training, the use of pesticides, etc.)	29.0
2. Follow-up survey (Yield, pesticides, natural enemies)	Have a sport check in 58 villages, 29 communities, 11 project counties once or twice a year	14.5
3. Pesticide residues in agricultural products	Have a sport check in 58 villages, 29 communities, 11 project counties trice a year	26.1
4. Pesticide poisoning	Have a sport check in 58 villages, 29 communities, 11 project counties once a year	3.3
Total	--	72.9

(3) Contents of examination

Pesticide registration: Including the registration of new pesticides and the use of I pesticides: Number of pesticide brands sold by retail outlets in the project area and whether to sell or use I pesticides.

Policy issues: Including the degree of government pesticide subsidies; Implementation of policies and regulations relating to the use of pesticides and the promotion of integrated management of plant diseases and insect pests

5.3.3 Monitoring and examination plan

Project management offices at all levels shall be responsible for ensuring the regular monitoring of the normal activities. Project management offices at all levels and Agricultural Technology Promotion Center shall be responsible for monitoring and examination of the implementation of pest management plan at any time and cooperating with the monitoring team of World Bank for the monitoring and inspection of the project during the peak of plant diseases and insect pests. The monitoring team of World Bank should comprise experienced pest control experts and carry out monitoring and inspection once or twice per year which often occurs in the peak of plant diseases and insect pests.

- Pest management monitoring: Carry out by the project management offices at all levels and plant protection station to report and treat the plant disease and insect pest in time;

- Examination plan: Inspect by all levels of the project management offices at usual time and examine and prevent by plant protection station during the occurrence peak of disease and pests;

- Responsibility: Plant protection stations at all levels shall be responsible for the guidance, examination, monitoring and training of PMP; Bear the liabilities and responsibilities for timely discovery and report of the plant disease and insect pest and implementation of PMP pest according to the requirements;

- Required professional technology: Plant protection stations at all levels shall provide plan protection experts and PMP methods.
- Budget: Listing into the daily management of the project management offices at all levels and the required funds is included in the project budget.

5.4 The total budget and funding arrangements

The monitoring and assessment of the implementation quality of PMP plan should be consistent with the entire project and its budget shall be taken into account. However, as the comprehensive management of plant diseases and insect pests have its specialty, so it should put forward some suggestions for the monitoring and assessment of the comprehensive management of the plant diseases and insect pests (Table 8) and the budget which facilitates the overall consideration to develop the quality monitoring and assessment plan for the implementation of the entire project.

Since the target task, activity content, expected output and the technical route of the PMP plan have their special characteristics, the PMP plan should be considered separately in the total project budget and expenses which should be included in the management costs of project management office and agricultural sector. The arrangement of project funds is mainly dependent on the needs of all activities in the PMP plan which not only considers from the four aspects of the above work schedule but from the cost of PMP prevention and control measures.

The total budget is shown in Table 14-1 and Table 14-2.

Table 14-1 Total Budget of PMP for the first 13 communities (2016-2020)

Content	Budget (10,000 RMB)
1. Cost of PMP prevention and treatment methods	--
1.1 Frequent-vibration pest-killing lamp	300.0
1.2 Yellow sticky board	6.0
1.3 Anti-pest net	3.8
1.4 Promotion of biological control technology for plant diseases and insect pests	Included in the operating expenses of the cooperatives
2. The implementation of the project	--
2.1 Management personnel + assistant training (MAOT)	34.5
2.2 Farmer production skill training (FPST)	247.5
2.3 Farmer production skills site training (FPSST)	60.0
3, Monitoring and assessment	72.9
Total	714.7

Table 14-2 Total Budget of PMP for all the 29 communities (2016-2020)

Content	Budget (10,000 RMB)
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1. Cost of PMP prevention and control methods	691.1
2. The implementation of the project	342.0
3. Monitoring and assessment	72.9
Total	1106.0

6. Public consultations

In order to further improve the text of the PMP project, the opinions and advices of project management offices at all levels, agricultural technology departments, cooperatives and farmers are consulted during the budget preparation process to make the PMP plan meet the needs of the project area and comply with the management philosophy of the project management offices of the World Bank.

At the same time, symposiums on pest management are held in Fuping County, Longxian, Mizhi County, Baishui County, Yichuan County and Changwu County and the scene photos are shown in Annex 2. In the symposium, each county project management office and township workstation has introduced the project. Participants have carried out the discussion on the plant disease and insect pest prevention and control that are related to the construction of the project and staff in each county project management office and township workstation has answered the questions one by one.

The opinions and replies collected during the preparation of the plan are detailed in table 15.

Table 15 Public Consultations Opinion Summary

Time	Place	Materials provided	Participants	Questions raised	Reply to the questions raised
October-November, 2015	11 project counties	Provide the basic materials of project county according to the requirements of the World Bank	11 project management offices and relevant technical departments in the project county	1 Project objectives and scope of implementation. 2. Pest planning framework format file of the project	1 Reply after communication with the World Bank. 2. Preparation of PMP outline
2015.12-2016.1 December, 2015- January, 2016	Xianyang	Sort out the PMP-related content and PMP framework document draft in the 11 project counties	Shaanxi Academy of Agricultural Sciences and Plant Protection Station	1. Participative philosophy is not fully reflected in the PMP plan. 2 The PMP implementation plan is too rough.	1. Conduct research by the staff according to the participatory philosophy. 2. Preparation of detailed implementation plan for crops.
February-March, 2016	Xi'an	Draft of PMP plan text	Provincial Project management office and agricultural technical	1. Unfocused PMP prevention and control measures 2. Unclear	1. Staff of preparation further refines the targeted prevention and control

			experts	scope of PMP prevention and control	measures and clarifies the scope of prevention and control.
2016.4 April, 2016	6 project counties	PMP plan text	6 project county project management offices, township workstation staff, cooperatives and farmers representatives	1.Increase in the cost of crop planting. 2.Drug resistance by pests and disease 3. Chemical residue hazard 4. Harm to ecological environment	1.agricultural control 2. biological control 3.physical control 4.drug control of main disease and pests
April, 2016	Xi'an	Modified PMP plan text	Project management offices of the World Bank	1.The procurement of pesticides and the cost of farmers' subsidies are not included in the project. 2.Increase the content of the monitoring plan 3.Supplement the existing management organization chart 4.Increase the content of pest control of orchids and side crops.	1. Cancel the purchase content of pesticides and subsidies budget. 2. Increase the content of the monitoring plan 3.Supplement the existing management organization chart 4.Increase the content of pest control of orchids and side crops.

Annex 1 Plant Disease and Insect Pest Management Schedule

Sub-project activities (plant)	Crop type	Mitigation measures	Monitoring and evaluation	Responsible organ/staff
Facility agriculture	Fruits, vegetable	<ul style="list-style-type: none"> ● Plant resistant varieties; ● Soil disinfection; ● Apply new seedling methods like nutritional soil, nutritive bowl, seedlings matrix and soil heating line and cultivate “no pest” strong seedling; ● Apply grafting in root to prevent blight verticillium wilt, bacterial wilt, and nematodes and other soil borne disease; ● Apply reasonable rotation, high temperature tightly greenhouse, prevent and treat damp disease like grey mould and prevent occurrence of powdery mildew, downy mildew, bacterial spot, alternaria solani, late blight and leaf mildew ● apply the plastic films for double ridges and dripping irrigation under plastic film to lower the relative humidity of the air inside the greenhouse and limit the spread of high-humidity diseases such as gray mold and downy mildew. ● Insect predators: using sokolowsakii to prevent and control lepidoptera pests like caterpillar and plutella xylostella, lacewing flies can prey on lepidoptera making eggs of aphids and mealworms, and encarsia formosa gahan can prevent whitefly. ● Microbial control: bacillus thuringiensis, beauveria bassiana and abamectin can kill pests. ● Hung yellow sticky trap or yellow oil trap inside the greenhouse to trap and kill aphids, mealworms and liriomyza sativae Blanchard; use sweet lure to trap and kill 	Entrust external organ to monitor	<ol style="list-style-type: none"> 1. Project management office of cities and counties 2. Technical personnel of promotion station of cities and counties 3. Farmers of the demonstration pilots and peasant association. 4. Technical personnel of plant protection unit of cities and counties 5. Planting cooperatives and major producers 6. Training institutions of provincial project management office 7. Mobile training expert team

		cutworm pests, black light to collect and kill a variety of moth, dung beetles, leafhoppers, etc.		
Apple Planting	Apple	<ul style="list-style-type: none"> ● Strengthen management of water and fertilizers, increase organic fertilizer, compound fertilizer and refuse animal and human excreta without compost maturity; promote fruit bagging, inter-row film and crop straw covering technology, especially the dry land ridge mulching rainwater harvesting soil conservation technology; promote tree construction technology of high photosynthetic efficiency, eliminate coppice shoot and sucker-growth inside the tree bore; in winter, remove plant residue of pests and burn or bury collectively out the yard. ● Biological prevention. (1) Control pest with pest. (2) Control pest with pathogens. (3) Control pathogens with pathogens. ● Physical prevention. Prevent wintering pests from recovery with membrane covered around the trunk, use lamplight, poison bait and stem residue to trap and kill pests; measures like scrape bark and fruit bagging are all effective in preventing and controlling plant diseases and insect pests. ● Chemical prevention. Give priority to biological pesticide and pesticide varieties of high-efficiency, low residual and toxic like pyrethrin and poultry oil emulsion vaccines, mineral source pesticide like mineral oil emulsion, petroleum spray oil of low sulphonate, as well as organic synthesis low-toxic pesticide like mildothane, carbendazim, bordeaux mixture. Carry out the safe use interval of pesticides strictly, use allowed pesticide varieties twice each year at most, with interval from last spraying to apply harvest over 20 days. Use the pesticides according to minimum effective dose and concentration 	Entrust external organ to monitor	

		and prevent respray and missed spray. Use pesticides of different mechanism in mixture and rotation to delay the resistance of germs and pests.		
Edible fungus cultivation	Shitake-mushroom	<ul style="list-style-type: none"> ● Design science of mushroom plant, separate infection source area like raw material storage, batching plant and fertilizer dump from susceptible area like strain room, inoculation room, culture room and fungus producing shed; ● clean up the weeds in the surrounding environment, ponding and all kinds of organic residues timely to avoid pests breeding; avoid using unclean water; control the flow of cultivation field personnel at the same time. In addition, mushroom plant shall be cleaned thoroughly after ending of each season. ● Select appropriate species ● Select strains with strong resistance to pests and disease and stress resistance; meanwhile, utilize fungus strains of proper age and increase seeding rate appropriately to enhance the ability to resist plant diseases and insect pests. ● Serious and reasonable burdening; Select fresh raw materials without deterioration; ● Implement rotation of different corps. ● Insect-proof nets and screens shall be installed for doors and windows of mushroom plant facilities; close the door immediately when entering and leaving mushroom room, strengthen artificial hunting and luring. 	Entrust external organ to monitor	
	morchella		Entrust external organ to monitor	
Chili Cultivation	Chili	<ul style="list-style-type: none"> ● Comprehensive prevention of Agriculture (1) Selection of resistant varieties. (2) Reform cultivation system, apply reasonable rotation and promote intercropping. (3) Adjust seeding period and avoid peak period of plant diseases. ● Cultivate strong seedling. ① Long distance or soil 	Entrust external organ to monitor	

		<p>dressing seedling. ② Fixed plant with pesticides. ③ Reasonable close planting. ④ Deep furrow ridge planting.</p> <ul style="list-style-type: none"> ● Biological prevention and control. ① Control pest with pest ② Control pest with pathogens ③ Use botanical pesticides like neem oil, melia azedarach, Cortex Meliae and nicotine to control all kinds of pests. ④ Control diseases with pathogens(including antibiotics); ● Physical prevention and control. ① Use sun seeds, seed heat treatment to treat the seeds, destroy or reduce the pests spread by seeds. ② Trap and kill pests with frequency-vibrancy pest-killing lamp; ③ Trap and kill aphids with yellow boards; ④ Collect and kill cotton bollworm with sugar-vinegar liquid lure. 		
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Annex 2 Photos of the Forum



Forum in Fuping County



Forum in Long County



Forum in Mizhi County



Forum in Baishui County



Forum in Yichuan County



Forum in Changwu County