Pest Management Plan

Liaoning Comprehensive Agricultural Development Office
October 12, 2012
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1 Project Overview

This Pest Management Plan under the Sustainable Agricultural Development Project of Liaoning China with World Bank Loans aims at improving pest management level, effectively bringing plant diseases and insect pests under control, reducing losses caused by pests and diseases, and eventually realizing safe and sustainable crop development. Under this plan, pest management facilities will be enhanced in consideration of the actualities of pest strikes in the project areas. New pest control techniques, biological control products, and new disease-resistant varieties will be introduced, demonstrated and promoted. Six counties (cities, districts) are finally selected to be the project areas, namely, Sujiatun District of Shenyang City, Changtu County of Tieling City, Zhangwu County of Fuxin City, Xiaodong Livestock Farm of Jinzhou City, Lianshan District of Huludao City, Lingyuan of Chaoyang City, which are listed on the following map. The budget for this project is 11.8548 million Yuan, which will be mainly used in buying pest management equipment, subsidies on biological control, and training expenses.

Fig. 1 Distributions of project areas in Liaoning
This pest management plan is designed under the requirement of World Bank Pest Management Environment Evaluation OP/BP4.09 and Pest management Regulations and in view of the present state of pest strikes in Liaoning project areas and of the potential threats. The formulation of the plan is guided by the internationally recognized 1972 Integrated Pest Management (IPM), and the 1995 Sustainable Pest Management (SPM), as well as the Chinese guideline of “Prevention First and Integrated Control”. The design of this plan has taken the production actuality of these project areas into consideration. The implementation of the plan will improve pest management, reduce the use of chemicals and pesticides, improve ecological environment, boost crop qualities and yields, decrease losses caused by diseases and pests, and realize sustainable agricultural development. The major tasks are as follows:

(1) 20 ~ 30 demonstration areas will be established consisting of cooperatives, associations and typical farmer households in the project areas. Internationally advanced plant protection technologies and products will be introduced, demonstrated and promoted. The practical experiences accumulated from these demonstration areas will be disseminated to the entire project areas and the overall pest management capacity of these project areas will be enhanced.

(2) New techniques such as biological control and physical control will be adopted and promoted. The crop pest management will be reduced 2 ~ 3 times on the average per mu, chemical pesticides will be reduced by 5 ~ 10%, and pest damages will be cut by 5%. Environmental pollution caused by chemical pesticides will be restrained, and high-toxicant and high-residue chemicals will be eliminated, leading to the improvement in ecological environment.
(3) Pest and disease monitoring and warning and control system will be established with plant protection station at the provincial level as the core and the plant protection stations at county (city or district) levels as the major bodies. This system will give early warnings to the potential outburst of pest strikes and react promptly and effectively to the pest strikes and formulate corresponding measures to address them.

(4) Professional pest management team will be organized consisting of cooperatives, professional technical associations. Pest control techniques will be improved through purchasing new plant protection equipment, offering trainings to professionals in an effort to reduce losses caused by diseases and pests.

(5) Centralized and decentralized trainings will be offered to grass roots agricultural technology extension personnel, agricultural associations, cooperatives, dealers of agricultural materials and ordinary farmers in the project areas to improve their awareness on PMP and ensure the smooth implementation of this PMP.

(6) PMP Implementation Monitoring Team will be established headed by provincial agricultural development office and composed of experts from plant protection stations and inspection organizations. Regulations on incentives and punishments will be formulated. Inspections will be conducted routinely as well as randomly on the project areas, including inspections on agricultural materials and farm products.
2 Project Background

Liaoning Sustainable Agricultural Development Project with World Bank Loan aims at improving agricultural capacities against natural calamities and achieving sustainable development through high standard farmland renovation and improvement in irrigation works. Farmers are encouraged to adopt such advanced measures as biological method, physical method, and agricultural method. Sustainable Pest Management System (SPM) will be established in view of the local actualities aiming at maintaining healthy and effective plant ecosystem, boosting and regulating ecobalance, protecting the health of plant population and realizing restorable ecosystem and recyclable economy. This system will be acceptable to the society and it will reduce the use of pesticides and chemicals, improve qualities of farm products, and minimize the negative effects created by chemicals on human health and environment. This system will increase farm yields and farmers’ income and achieve sustainable development on the basis of ensuring the safety of environment.

2.1 Agricultural Production Actuality in Liaoning province

Liaoning lies in the south of northeast China, facing Bohai Sea and Huanghai Sea. It is the only ocean outlet for Northeast China and east Inner Mongolia; Liaoning Province is also located at center of Northeast Asia, neighboring North Korea and echoing with South Korea and Japan in the southeast, adjacent to Russia and Republic of Mongolia in the north. Its geographic coordinates range from east longitude 118°53’ to 125°46’, northern latitude from 38°43’ to 43°26’. The whole province covers 14 cities, 100
Sustainable Agricultural Development Project of Liaoning China with World Bank Loans

counties (cities, districts) with a total population of 42.71 million and a total land area of 148 thousand sq.km, or 1.5% of the total land area of China.

Liaoning is of temperate zone and continental climate with abundant sunlight and relatively high accumulated temperature. Annual sunlight hours range from 2200 to 2950h. The average temperature of January ranges from \(-4.517\)°C to \(-17\)°C. The average temperature of July ranges from \(22\)°C to \(27\)°C, and the annual average temperature ranges from \(5\)°C to \(11\)°C. The frost-free season lasts for 125 d ~ 220d. The annual rainfall varies from 450 to 1150mm. the crops in Liaoning are mainly composed of maize, rice and oil-bearing plants. The food crop plantation area in Liaoning for year 2011 covers 46.6 million mu, and its grain output topped 20 billion kg. for the first time, an increase of 15.3%, reaching a record high and the rate of increase came the first nationwide.

### 2.2 Facts about Agricultural Production in the Project Areas

Liaoning project area covers 17 rural towns, or 140 administrative villages of the selected 6 counties (cities). The project involves 90 thousand households, or an agricultural population of 292.8 thousand, among them ethnic minorities 1.541 thousand households, or 5.124 thousand persons, rural labors 161.1 thousand persons. The details are listed on Table 1.

The total land area in the project areas is 244,110 hm\(^2\), among them, arable land covers 88,340 hm\(^2\), effective irrigated area 20,380 hm\(^2\), water-saving irrigation area 8,030 hm\(^2\). Currently, there are 59 farmers’ professional associations, 61 farmers’ professional cooperatives, and 2 farmer water-consumer associations in these areas. The integrated pest control area
Table 1 Population distribution in the project areas

<table>
<thead>
<tr>
<th>Name of index</th>
<th>County(city, district)</th>
<th>Rural town</th>
<th>Administrative villages</th>
<th>Farmer households</th>
<th>Ethnic minorities</th>
<th>Agricultural population</th>
<th>Agricultural labors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit</td>
<td>Thousand household</td>
<td>Thousand persons</td>
<td>Thousand persons</td>
<td>Thousand persons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changtu</td>
<td>1</td>
<td>3</td>
<td>25</td>
<td>18</td>
<td>1.316</td>
<td>55</td>
<td>31</td>
</tr>
<tr>
<td>Lianshan District</td>
<td>1</td>
<td>1</td>
<td>30</td>
<td>4</td>
<td>0.096</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Lingyuan</td>
<td>1</td>
<td>3</td>
<td>24</td>
<td>15.5</td>
<td>1.712</td>
<td>43.1</td>
<td>31</td>
</tr>
<tr>
<td>Sujiatun District</td>
<td>1</td>
<td>2</td>
<td>26</td>
<td>16</td>
<td>54</td>
<td>51</td>
<td>27</td>
</tr>
<tr>
<td>Zhangwu County</td>
<td>1</td>
<td>4</td>
<td>20</td>
<td>29</td>
<td>2.000</td>
<td>103</td>
<td>51</td>
</tr>
<tr>
<td>Xiaodong Livestock Farm</td>
<td>1</td>
<td>4</td>
<td>15</td>
<td>7.5</td>
<td>22.7</td>
<td>15.1</td>
<td></td>
</tr>
<tr>
<td>Project area aggregation</td>
<td>6</td>
<td>17</td>
<td>140</td>
<td>90</td>
<td>5.124</td>
<td>292.8</td>
<td>161.1</td>
</tr>
</tbody>
</table>

covers 45,440 hm$^2$, accounting for 51.44% of the crop sown area. The ratio of integrated pest control in these areas is relatively low and the overall preventive treatment level is not high. The crop sown area for year 2010 is 83,000 hm$^2$, of this, grain crops account for 52,220 hm$^2$, cash crops for 27,310 hm$^2$, and other crops for 2,360 hm$^2$. Areas producing high quality farm products cover 30.91 hm$^2$, organic food 49 hm$^2$, green farm product area 1,940 hm$^2$, and pollution-free farm product area 27,180 hm$^2$. The gross grain output for year 2010 is 0.34 million tons, total agricultural output value 6.004 billion Yuan, of this, total plantation output value 2.739 billion Yuan. Net per capita income in the project areas ranges from 4635 to 8928 Yuan, of this, that of farmers in Sujiatun area is the highest while that of farmers in Xiaodong Livestock Farm is the lowest.

The project areas cover 17 rural towns and the project implementation area is 16667hm$^2$. The project implementation areas are major grain
Sustainable Agricultural Development Project of Liaoning China with World Bank Loans

producing areas, consisting of rice, maize, vegetables, potato, and peanut planting areas.

Table 2 Plan for crop development area of Liaoning World Bank Project

<table>
<thead>
<tr>
<th>Project area</th>
<th>Crop</th>
<th>Maize</th>
<th>Rice</th>
<th>Potato</th>
<th>Peanut</th>
<th>Vegetable(s)</th>
<th>Other cash crops</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sujiatun</td>
<td>To be developed</td>
<td>1320</td>
<td>1247</td>
<td></td>
<td>327</td>
<td></td>
<td></td>
<td>2893</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>400</td>
<td>1260</td>
<td></td>
<td>1333</td>
<td></td>
<td></td>
<td>2993</td>
</tr>
<tr>
<td>Xiaodong</td>
<td>To be developed</td>
<td>2787</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2787</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>2453</td>
<td></td>
<td></td>
<td>133</td>
<td>400</td>
<td></td>
<td>2987</td>
</tr>
<tr>
<td>Zhangwu</td>
<td>To be developed</td>
<td>2520</td>
<td>133</td>
<td></td>
<td></td>
<td>133</td>
<td></td>
<td>2787</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>2120</td>
<td>333</td>
<td></td>
<td></td>
<td>333</td>
<td></td>
<td>2787</td>
</tr>
<tr>
<td>Changtu</td>
<td>To be developed</td>
<td>1933</td>
<td></td>
<td></td>
<td>800</td>
<td></td>
<td></td>
<td>2733</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>933</td>
<td></td>
<td></td>
<td>1800</td>
<td></td>
<td></td>
<td>2733</td>
</tr>
<tr>
<td>Lingyuan</td>
<td>To be developed</td>
<td>2587</td>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td></td>
<td>2987</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>2520</td>
<td></td>
<td></td>
<td>533</td>
<td></td>
<td></td>
<td>3053</td>
</tr>
<tr>
<td>Lianshan</td>
<td>To be developed</td>
<td>2607</td>
<td></td>
<td></td>
<td>180</td>
<td></td>
<td></td>
<td>2787</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>2313</td>
<td></td>
<td></td>
<td>473</td>
<td></td>
<td></td>
<td>2787</td>
</tr>
<tr>
<td>Liaoning Province</td>
<td>To be developed</td>
<td>13753</td>
<td>1247</td>
<td>133</td>
<td>800</td>
<td>907</td>
<td>133</td>
<td>16973</td>
</tr>
<tr>
<td></td>
<td>Already developed</td>
<td>10740</td>
<td>1260</td>
<td>333</td>
<td>1933</td>
<td>2740</td>
<td>333</td>
<td>17340</td>
</tr>
</tbody>
</table>

Unit (hm²)
The project areas are of typical arid and semi-arid climate and are of unstable irrigation belt. Currently, they are mainly well-irrigated areas with shallow ground water. Only part of Sujiatun area is irrigated with water from Dahuofang Reservoir. The irrigation patterns are gradually developed from extensive irrigations into low pressure pipeline water delivery. Vegetables and cash crops are gradually irrigated in the form of water-saving irrigations such as spray irrigation and tiny drip irrigation.

2.3 Facts about Agrotechnical Measures in the Project Areas

There are differences and variations in the natural conditions and farming habits in the six project areas in Liaoning province, and the agricultural management is different. The currently acceptable and adopted agricultural measures include cultivation of fine varieties with stress resistance and yield increasing abilities, adoption of advanced and pragmatic water and fertilizer effective management techniques, increased applications of chemicals and prevention and treatment on pests and diseases in a bid to improve crop yields and crop qualities.

(1) Selection of varieties with resistant capacities. Currently, a common practice for farmers is to purchase seeds from local seed dealers and select resistant varieties as a major means to fight against diseases and pests.

Yet, two problems exist. One concerns the seed itself. Some seed varieties are not demonstrated in the region after introduction and farmers buy them only upon dealers’ recommendation and publicity, which may result in reduction in yields because the chosen varieties may not suit the localities.
The other is that resistant varieties tend to be unitary. Plantation of unitary variety on a large scale is likely to lead to major pest strikes.

(2) Application of water and fertilizer management techniques. Emphasis is placed on applications of soil testing and formulated fertilization, maize plantation of double rows on a wide ridge, 2-0 cultivation, returning straws to fields, biological reactor, growing vegetables on protective ground with drip irrigation under mulching, potato ridge plantation, standardized pollution-free vegetable plantation, and mechanized rice and maize operations.

Yet, problems exist in four respects. First, the applications of advanced technologies are relatively at a low level. Some areas are still using broad irrigation forms while the application of drip irrigation under mulching is of a low ratio. Second, measures to preserve the fertility of high-yield farmland and to apply fertilizers and manures to low and intermediate-yield farmland are few. The contents of organic matters in farmland for growing field crops are at a low level. Third, farming techniques and agricultural machines are not properly matched, manual work remains dominant in the farming. Forth, continuous cropping term is lengthened, resulting in outstanding soil continuous cropping obstacles and serious disease and pest strikes.

(3) Input of agricultural chemicals. The advancement in chemical technology and the wide use of chemicals have significantly improved the crop yields and economic benefits and strengthened capacities in fighting against natural calamities in the project areas. It is widely accepted in farmers’ mind that no crops will grow without mulching, no yield-increase will be made without the use of chemicals, and no pests and diseases will be cured without the use of pesticides.
Yet, the large input of chemicals has enhanced agricultural dependence on chemicals, and the wide use of chemicals has brought about environmental pollution and reduced the quantity of beneficial biological population. In particular, the pollution to underground water and rise in soil nitrate content is becoming increasingly serious.

2.4 Facts about Pest Categories and their Occurrences

In recent years, Liaoning province has seen the rise in agricultural biohazards. The categories of pests are on the rise, and the occurrence areas are on the rise, too. Most often pests strike all of a sudden, resulting in aggravated hazard. In the production of rice and maize, ostrinia nubilalis, loxostege sticticalis, armyworm, lissorhoptrus oryzophilus kuschel, chilo suppressalis, rice blast, ustilaginoidea virens, laodelphax striatellus, rice stripe disease often occur. In the production of facility vegetables, open ground peanut and potato, soil-borne diseases, cucumber downy mildew, tomato grey mould, tomato late blight, cercospora brown spot of peanut, and subterranean pest-insect rise with the increase in plantation areas and plantation years and the caused damage is on the rise. On the average, the entire province experiences 0.17 billion mu/times of various disease and pests strikes and the control area reaches 0.16 billion mu/times. The effective disease and pest control has saved 11.80 million tons of losses in crop production and 6 billion Yuan in economic loss.

2.4.1 Compositions of Major Crop Diseases and Pests

A survey was conducted by plant protection experts organized by the Provincial Agricultural Development Office on the major crop diseases and
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pests in the project areas. The currently common occurrences of diseases and pests and medicaments in the six project areas are listed in Table 3. Medicaments toxicity is listed in Table 4. A random survey was also conducted on the plant protection departments and 100 farm households in the 17 rural towns in the project areas. The findings show that a majority of farmers and local agricultural technology extension personnel are unfamiliar with peanut, vegetable and potato diseases and pests. They can not identify the category of these diseases and pests and lack professional knowledge and expertise to prevent and cure these diseases. Consequently, the resulted losses on these crops are heavier than that of the field crops as their added value is higher than that of rice and maize.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Common pests</th>
<th>Common diseases</th>
<th>Regular medicaments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>subterranean pest-insect, Ostrinia nubilalis, aphid, armyworm</td>
<td>Sporisorium reilianum, gall smut, ear rot, stalk rot, top rot, leaf blight, gray leaf spot</td>
<td>Phoxim, isofenphos-methyl, Trichogramma Thiacloprid, trichlorphon, Imidacloprid, Thiophanate-methyl, mancozeb</td>
</tr>
<tr>
<td>Rice</td>
<td>rice planthopper, Lissorhoptrus oryzophilus Chilo suppressalis, paddy stem maggot, Cnaphalocrocis medinalis</td>
<td>Rice blast, False smut, stripe virus disease, banded sclerotial blight, Xanthomonas oryzae</td>
<td>Fernasan, Actara, Pymetrozine, dexion, taghigaren, Ruimiaqing, tricyclazole, isoprothiolane, Wenqing, Armure, Validamycin, prochloraz, imidacloprid</td>
</tr>
<tr>
<td>Facility vegetables</td>
<td>aleyrodid, cabbage aphid, Liriomyza sativae, laphygma exigua</td>
<td>Soil-borne diseases (blight, epidemic diseases, Verticillium wilt), gray mold, Downy Mildew, nematode</td>
<td>Polyoxin, chlorothalonil smoke agent, Bacillus thuringiensis, abamectin, imidacloprid, acetamiprid missible oil, kasugamycin, validamycin, carbendazim, Lvxiang 1</td>
</tr>
<tr>
<td>Peanut</td>
<td>subterranean pest-insect such as aphid, grub</td>
<td>Tan disease, scab, Web Blotch, black rot</td>
<td>Pymetrozine, imidacloprid, Thiophanate-methyl, Difenoconazole, Tebuconazole, Hexaconazole</td>
</tr>
</tbody>
</table>
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Potato: subterranean pest-insect, aphid, leaf beetle

Late blight, earlyblight, ring rot, Pectobacterium atrosepticum, scab, Stalk rot, viral disease

medicaments toxicity

<table>
<thead>
<tr>
<th>Medicaments Name</th>
<th>Toxicity</th>
<th>Medicaments Name</th>
<th>Toxicity</th>
<th>Medicaments Name</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiram</td>
<td>low</td>
<td>Thiacloprid</td>
<td>low</td>
<td>Tebuconazole</td>
<td>low</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>low</td>
<td>Thiacloprid</td>
<td>low</td>
<td>Mancozeb</td>
<td>low</td>
</tr>
<tr>
<td>Pyometrozine</td>
<td>low</td>
<td>Dipherex</td>
<td>low</td>
<td>Wenquining</td>
<td>low</td>
</tr>
<tr>
<td>Isoprothiolane</td>
<td>low</td>
<td>Thiophanate-methyl</td>
<td>low</td>
<td>Polyoxxins</td>
<td>low</td>
</tr>
<tr>
<td>Armure</td>
<td>low</td>
<td>Chlorothalonil</td>
<td>low</td>
<td>Bacillus</td>
<td>low</td>
</tr>
<tr>
<td>Organism insect</td>
<td>Low</td>
<td>Carbendazim</td>
<td>Low</td>
<td>Abamectin</td>
<td>Low</td>
</tr>
<tr>
<td>Cream urea</td>
<td>Low</td>
<td>Difenoconazole</td>
<td>Low</td>
<td>Kasugamycin</td>
<td>Low</td>
</tr>
<tr>
<td>Cyanide zinc</td>
<td>Low</td>
<td>Tebuconazole</td>
<td>Low</td>
<td>Validamycin</td>
<td>Low</td>
</tr>
<tr>
<td>Manganese</td>
<td>Low</td>
<td>Imidacloprid</td>
<td>Low</td>
<td>Fenaminoxulf</td>
<td>Medium</td>
</tr>
<tr>
<td>Number one lv heng</td>
<td>Low</td>
<td>Acetamiprid</td>
<td>Low</td>
<td>Chlorpyrifos</td>
<td>Medium</td>
</tr>
<tr>
<td>Hexaconazole</td>
<td>Low</td>
<td>Copper hydroxide</td>
<td>Low</td>
<td>Tricyclazole</td>
<td>Medium</td>
</tr>
<tr>
<td>Phoxim</td>
<td>Low</td>
<td>Captan</td>
<td>Low</td>
<td>Isofenphos-methyl</td>
<td>High</td>
</tr>
<tr>
<td>Metalaxyl</td>
<td>Low</td>
<td>Captan</td>
<td>Low</td>
<td>Isofenphos-methyl</td>
<td>High</td>
</tr>
</tbody>
</table>

2.4.2 Features and Causes of Major Crop Diseases and Pests

(1) Features of Major Crop Diseases and Pests

One major feature of crop diseases and pests is its seriousness and significant negative effect on crop yields. Such pests and diseases as ostrinia
nubilalis, chilo suppressalis, subterranean pest-insect, pyricularia oryzae, ustilaginoidea virens, vegetable soil-borne diseases, peanut scab, pose immediate threat to crop yields and they are common occurrence.

The second feature is the constant emergence of new pests and minor pest damages evolve into major ones. With the constant introduction of new crop varieties and rapid development in logistics industry and increasing human mobility, some foreign diseases and pests show up in the project areas and the hazard is getting increasingly serious. Along with the changes in plantation patterns and planting habits, some sporadic diseases and pests gradually develop into major threats. For example, some bacterial vegetable diseases were sporadic and had minor influence on yields. Now they are common occurrence and post great threat to the yields and qualities of farm products.

The third is physiological diseases caused by non-pests are on the rise, such as soil salinization due to long term application and overuse of chemical compounds and chemical residues, extreme weather caused by climate change, environmental pollution and acid rains.

(2) Occurrences of Major Pests and Causes for Increasing Damages

One factor of the increasing damages is plantation of single crop variety which leads to the outburst of some pests. The relatively uniform natural ecological environment in each project area leads to singularity in crop plantation and in variety, which poses damage to biodiversity, and the selection pressure of pest hosts increases, and the quantity of pest increases over years. Once the dominant species is established, along with abundant host resources, pest reproduces rapidly and pest population increases fast with
the result that pest outburst is evident and hence brings about significant losses.

The second is early warning mechanism on major pests has not been established and lack of grassroots technicians, which often leads to untimely extension of pest control techniques and undue measures. The lack of effective monitoring on major pest strikes makes it impossible to make prompt prediction and forecast, missing the best period to prevent pest strikes. In addition, appropriate preventive measures can not be taken because of lack of grassroots technicians and farmers’ failure to identify pests and diseases and the potential damages they may cause, hence, resulting in significant losses.

The third is global warming which brings more disastrous weather and with it comes more serious pest strikes. Global warming is an irrefutable fact. The effect of warm winter on pests includes: overwintering and arctogaean realm tend to move to high latitude; overwintering death rate is low and the base number rises; pest strikes earlier with more serious damages; and the disastrous weather becomes active and frequent with abnormal climate. Taking 2010 as an example, crops in Liaoning province witnessed extreme climate in year 2010. The first half year experienced long-term, large-scale low temperature, scant sunlight, and rainy weather. Especially, after April and May, overcast rainy weather and low temperature spread across the province with the result that phenological period was delayed ten to fifteen days, bringing negative effect on spring plowing and the growth of seedlings. After May-end, the temperature rose quickly and crops experienced vain and rampant growth. From late July to Mid-August, Liaoning witnessed intense
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rainfall consecutively. Some dry crops suffered from serious waterlogging, and some plastic tunnels collapsed. The extreme climate brought about exceptional pest strikes and caused heavy losses.

2.5 Pest Control Measures and Existent Problems in Project Areas

Currently, there are agricultural control, physical control, biological control, and chemical control adopted by the project areas. Agricultural control and chemical control are frequently used while biological control is seldom used. The specific method used and relative problems are listed as follows:

2.5.1 Agricultural Control and Existent Problems

Agricultural control refers to the scientific use of cultivation management techniques and measures to improve environment and make it beneficial to the growth of host plants and the reproduction of beneficial organisms while detrimental to the occurrence and development of pests and insects and eventually leading to the direct or indirect extermination of insects and other pests and minimizing the economic losses caused by pests. The currently adopted agricultural control in the project areas is as follows:

(1) Selection of Disease-resistant Fine Varieties

Crop varieties vary in their resistance to diseases. Using disease-resistant variety to fight against pests is an effective and reliable method. The practice of selecting disease-resistant varieties is generally acceptable to farmers in the project areas, and it is widely used in rice, vegetables and maize production. But it takes a long time to breed a disease-resistant variety. The disease resistance of the bred variety needs to be appraised and its yield has to be
taken into consideration before it is applied. With the passage of time and changes in environmental conditions, the disease resistance of the variety may decay, vary, or disappear. In addition, the relative singularity of the resistant variety or the resistance gene tends to be dominant solitary gene may increase the host selection pressure and deprive the variety of its resistance features.

(2) Rational Cultivation, Application of Crop rotation, Intercropping, and Interplantation

Rational cultivation system can improve soil fertility, help crops grow healthily, and increase disease resistance. The cultivation of different crops and changes in cultivation techniques may alter farmland environment, and shape environmental conditions to the disadvantage of pest occurrence. Farmers in the project areas have not fully recognized the advantages of scientific cultivation measures such as crop rotation, intercropping and interplantation due to their established cultivation habit and decentralized management and labor cost considerations.

(3) Rational Application of Fertilizers, Using Water Scientifically, and Improving Disease and Pest Resistance

Rational application of fertilizer is an important means to achieve good harvest and it plays significant roles in fighting against pests. It can not only improve nutritional conditions for crops and improve disease resistance and reduce losses caused by pests, but also promote the growth of crops, avert the period of intense pest damage or accelerate wound healing; it can alter soil properties, deteriorate the living conditions for soil pests, or even kill them. Soil testing and formulated fertilization has been conducted in part of the project areas with limited effect due to small areas and disjunction with pest
control. And the long-established fertilization concept of emphasizing nitrogen fertilizer is likely to create favorable conditions for pest strikes and pest reproduction. For example, in the project area of Sujiatun district, partial application and exceedingly late application or excessive application of nitrogen fertilizer has led to overgrowth of leaves as well as softened tissues and the occurrences of rice blast and bacterial blight.

Using water scientifically is also an effective measure to control pests. For example, after the pupation of first generation of chilo suppressalis walker, irrigation is a good way to kill the pupa. Drying paddy field can not only reduce ineffective tillering, more importantly it can also prevent the occurrence and wide spread of sheath blight. In most project areas, scientific irrigation is impossible due to lack of fund and technology and farmers’ indifference to scientific use of water. Broad irrigation is a dominant practice. Drip irrigation and spray irrigation remain to be promoted.

(4) Strengthen Field Management and Improve Control Efficiency

Field management plays a significant role in pest control. From sowing to harvesting, importance should be attached to every linkage to ensure crops free from pest damage in an effort to achieve bumper harvest. First, field should be cleaned to reduce pest primary infection sources; sowing in due time can stimulate crops to grow healthily and to build up their resistance; intertillage in due time can improve soil aeration and adjust temperature which is good for root growth; cleaning weed, picking out ill leaves and removing diseased or infected plants and insect seedlings can reduce pest hosts, worsen their environment, or exterminate pests directly. The population in the project areas is mainly agricultural population, and agricultural income
is their major economic sources. Therefore, they attach great importance to field management and they can basically meet the above requirement for field management. Still, they lack knowledge in how to deal with the removed or eradicated diseased or infected plants.

2.5.2 Biological Control and Existent Problems

Biological control refers to the use of organisms or their metabolic products to manipulate the occurrence and reproduction of pest population or to reduce their damages. It generally refers to the use of the natural enemy of pests in terms of their parasitism, predatism, or pathogenicity to exterminate pests. Trichogramma and such biological control agents as Validamycins, gibberellin, abamectin, and Bt have been used in China for years. However, due to the fact of scattered management in the project areas, lack of correct understanding of biological control, the slower effect of biological products than chemicals, and lack of correct discrimination of pests and choosing the right preventive treatment, biological control products are seldom used except on some facility vegetables.

2.5.3 Physical Control and Existent Problems

Physical control refers to the use of simple tools and various physical factors such as light, heat, electricity, temperature, humidity, radiant energy, and sound wave to control pests. The commonly used measures include increasing or lowering temperature or humidity to make it exceed pest endurance, such as seed sterilization, high-temperature treatment of sealed greenhouse, building separation fence or installing insect proof net to reduce the incoming pests from the outside of the greenhouse, the use of bionics and ultrasonic to control pests, black light lamp and high-voltage fence insect
killer etc. Such physical control techniques as using hot water to make sterilization on seeds and trapping insects on the basis of their nature of phototaxis and installing fly net have been used in the project areas to an extent, in particular, by facility vegetable farmers. But because of lack of fund support and guidance, they have not covered the whole project areas.

2.5.4 Chemical Control and Existent Problems

Chemical control refers to the use of farm chemicals to control pests. Pesticides are highly effective, quick-acting, easy to use. But improper use of pesticides may bring about toxicant plants, human or animal intoxication, killing beneficial microorganisms, and making pathogen drug-resistant. The high residue of chemicals may also lead to environmental pollution. At present, chemical control is a major measure to fight against pests. Sometimes it is the only way to combat large area pest strikes. The use of pesticides is prevalent in the project areas and some farmers simply think that it is the only way to control pests. The lack of knowledge about pest control and about pollution-free production results in excessive and arbitrary use of pesticides, especially the use of high toxicant and high residue chemicals.

2.6 Current Pest Administrative Organizations and Policies

2.6.1 Pest Administrative Organizations

The current pest administrative organizations in Liaoning are mainly provincial plant protection station and various plant protection stations at county or city level. Their main task is to conduct plant quarantine, management of the production and dealings of pesticides, working out development plan about plant protection across the whole province,
introduction of plant protection technologies, offering trainings, technical extensions, and conducting investigations and surveys on relative policies, as well as issuing predictions and warnings about major pest strikes, and making quarantine inspections on foreign pests. Among these, pesticide management is empowered by the provincial agricultural department; plant quarantine is empowered by the state. Various plant protection stations at city or county level are mainly in charge of the monitoring and forecasting on pest strikes in their administrative areas and work out effective measures to control pests in accordance with the pest causes and extent. In the meanwhile, they should supervise and administrate the production and transaction of pesticides in their areas under relative regulations and laws.

2.6.2 Current Policies

With the implementation of relative policies in China, integrated pest management (IPM) has been conducted preliminarily in the project areas. In the preparations of the IPM plan, we referred to policies and regulations from the state and the localities as well as those from the World Bank. Among the ten safety safeguard policies from the World Bank, OP/BP4.09 Pest Management is fit for use in this evaluation. In order to enhance the work in pest management, the policies and regulations made by the Chinese government and Liaoning province are as follows:


(2) Regulations on the Management of Pesticides of PRC, (issued by the State Council, effected from May 8th 1997, revised on November 29th 2001)
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(3) Measures for the Implementations of Regulations on the Management of Pesticides of PRC, (issued by ministry of agriculture on April 27th 1999 and revised and executed on January 1st 2008)

(4) Administration on Non-polluted Agricultural Products (issued by ministry of agriculture and General Administration for Quality Supervision, Inspection and Quarantine (AQSIQ) in 2002)

(5) Administrative Regulations on Restricted Use of Pesticides issued by ministry of agriculture on August 1st 2002

(6) Standards for Safety Application of Pesticides GB4285-84 and Codes on Rational Application of Pesticides (GB/T8321.1—GB/T 8321.7)

(7) Regulations on Standardized Administration of Pesticides by Liaoning Province, May 30th 2002

(8) Antitoxic Regulations for Storage-Transportation, Marketing and Use of Pesticides by Ministry of Agriculture (GB 12475-2006)

(9) Quality Safety Law of Agricultural Products of PRC (executed from November 1st 2006)

The implementations of these standards and codes have helped China to establish the system of pesticide research, production, application, supervision and operating service. In particular, Regulations on the Management of Pesticides of PRC, issued by the State Council and effected from May 8th 1997 is the first set of administrative laws and regulations on the management of pesticides, which indicates that China’s management on pesticides has been put into the orbit of standardization, legislation and internationalization. Measures for the Implementations of Regulations on the Management of
Pesticides revised and executed on January 1st 2008 has ensured the smooth implementation of Regulations on the Management of Pesticides.

2.7 Current Pest Management Capacity of the Project Areas and Evaluation

The consultations with the plant protection departments in the project areas and field research and surveys on these areas as well as talks with the farmers there have made clear about the pest strikes on major crops, including maize, rice, facility vegetables, peanut and potato and current control measures. Although these project areas are major agricultural production areas, the lack of fund and technologies has made pest control mainly dependent on pesticides while physical control and biological control are seldom used. Therefore, these areas are weak in fighting against major pest strikes. The crop sowing area in Liaoning project areas for year 2010 is 83,000 hm$^2$, of which, organic food accounts for 49 hm$^2$, green farm product area is 1,940 hm$^2$, pollution-free products accounts for 27.180 hm$^2$. From the above figures we can see that the production agricultural products still remains in the low end of the production stage and in pest control pesticides are in the dominant position. In the respect of chemical control, farmers mostly depend on their own experience and simple recommendations from pesticide dealers in solving pest problems besides the guidance from technical departments. The long-term use of chemicals and lack of knowledge on pesticides, environment and health bring risks to farmers in using pesticides. Pesticides cannot be used effectively and improper application of pesticides brings phytotoxicity to crops. There are such problems in using chemical
pesticides in the project areas:

(1) Overdependence on chemical pesticides, especially in facility vegetables of high commodity value and economic returns.

(2) The use of chemicals, especially pesticides, tends to be on the rise year on year.

(3) Lack of proper use and management on farm chemicals (bacteriacide, insecticide, and herbicide) and other pesticides.

(4) Random disposal of remanent farm chemicals and packing materials, leaving a hidden danger of pollution and poisoning.

(5) Being weak in executing regulations and laws and feeble in supervision on pesticides.

(6) Lack of awareness on integrated pest control among extension organizations, pesticide dealers and farmers.

(7) Traditional training mechanism cannot solve the specific production problems of individual farmers and newly emerging knots.

(8) Lack of timely and sufficient data and information on farm chemicals.

3. Integrated Pest Management Plan of Liaoning Project Areas

3.1 Necessity and Significance of PMP

Agricultural products are indispensable nutritional food for human existence. The twenty first century is a century of green products. With the development of economy and society and the rise in people’s living standard, people have a higher demand for the quality of agricultural products, especially for the quality of edible agricultural products. The quality of agricultural products has a direct impact on people’s health. With the rapid
growth in Chinese economy and in agricultural production, the relation between supply and demand of agricultural products has turned from long-term shortage into low level gross balance and relative surplus and turned from emphasis on quantity into quality oriented. There is no competitiveness in inferior low-quality agricultural products and their prices remain at a low level while safe and non-pollution products are favored by the markets.

With the economic globalization and China’s accession to the WTO, China lost its protection on agricultural products and tariff control. Green technology has been made a trade barrier on the world market. The food safety and quality control has become a major form in technical barrier. The promotion of IPM technologies and production of green food is inevitable in the development of economy and society.

In conclusion, IPM has become an inevitable trend at home and abroad. The formulation of PMP for Liaoning project areas will boost the integrated pest management in theses regions, promote safe production techniques and products, reduce the use of pesticides, and exterminate high toxicant and high residue pesticides. All these will help to ensure consumers’ health, preserve ecoenvironment and ecobalance, realize sustainable agricultural development, and increase competitiveness of agricultural products and farmers’ income.

3.2 Principles in Formulating PMP

The formulation of Liaoning PMP for the project areas follows the principle of “sustainable ecological development, green and environmental protection”. In the aspect of agricultural measures, tillage, cultivation
techniques, and field management will be taken to create favorable environment for the growth of crops while to the disadvantage of pests and to increase plant resistance in a bid to control and mitigate pest damages. As for biological measures, measures such as the use of natural enemies, insect pathogenic bacteria, agricultural antibiotics, and other biological control agents to fight against pests. These measures will replace part of farm chemicals and reduce the use of pesticides without polluting crops and environment and help to preserve ecobalance. In the aspect of physical measures, we should make good use of pest phototaxis and taste tendency to trap pests. Ecoenvironment should be improved to make it favorable for crop growth and to the detriment of pest growth. Efficient and green agricultural chemicals of low toxicant and low residue should be used and the use of high toxicant and high residue chemicals should be exterminated.

3.3 Project Objectives and Principles

The Liaoning PMP will be implemented in 17 rural towns of the 6 counties (cities) or districts, including Changtu County, Lianshan District, Lingyuan City, Sujiatun District, Zhangwu County and xiaodong Livestock Farm. The implemented area is 16,667hm², mainly composed of maize, rice, vegetables, peanut and potato. The formulation of this PMP is guided by the internationally recognized IPM and SPM in pest management as well as the Chinese plant protection working principle of “Prevention First and Integrated Control”. The production actuality of Liaoning project areas is also taken into consideration in making this PMP. Trainings will be offered to the technicians and farmers in the project areas to sharpen their awareness and notion on
integrated pest management and to improve their skills in this respect. Integrated pest management in the project areas will be regularized and standardized. Agricultural control and biological control will be boosted. Over five biological pesticides will be introduced and promoted. The areas of agricultural control and physical control will be extended. Pesticides will be used scientifically, rationally and safely. The use of pesticides will be reduced 5 ~ 10%, or 2 to 3 times per mu on the average. High toxicant pesticides will be exterminated. Losses caused by pests will be shrunk by above 5%. Efforts will be made to ensure stable yield, high yield and sustainable development.

The design principle of this PMP is:

(1)This project is based on agricultural control, coordinated with physical control. Emphasis is placed on biological control with rational use of pesticides to cut production reduction caused by pests and limit pesticide residue within the standard of product quality, food safety and environmental protection.

(2)Cultivation and selection of disease-resistant and insect-resistant varieties. Such measures as growth period adjustment will be adopted to improve crop pest-resistance. Strict plant quarantine will be conducted to prevent new pests. For the existent pests, such measures will be taken as lowering overwintering base numbers, cutting transmission path, preventing pest infection and exterminating pests before the damage is done.

(3)Making use of agricultural management measures to improve farmland ecoenvironment and make it favorable to crop growth while detrimental to pests. Great efforts will be made to promote and apply physical and biological controls and make rational use of available pesticides.
3.4 Overall Design of Project Implementations

In order to achieve the overall objective of this integrated pest management plan, experts from Shenyang Agricultural University, the provincial Plant Protection Station and Liaoning Academy of Agricultural Sciences will continue to offer support. In consideration of the actuality of pest occurrence in Liaoning, top priority will be given to biological, physical and agricultural controls, along with the use of low toxicant and low residue pesticides to avoid polluting surrounding environment. IPM leading group and technical team will be established in the implementation of the project.

(1) Trainings will be offered to grassroots technology extension personnel and farmers about IPM knowledge and skills to improve their competence in this respect. Trainings on PMP will be launched as well. In view of the actualities in the project areas, trainings will take the form of trainings at county (city) levels, rural town concentration trainings, and such scattered...
trainings as field guidance and farmers’ mutual help. Trainings will be conducted in the form of class instructions, demonstrations on the spot, and visiting demonstration areas. Modern communication media such as multimedia, internet, radio and television will be used to make the trainings rich in content and diversified in form and to meet requirement of different groups. The training contents depend on specific pest occurrence in the project areas along with the thought of disseminating IPM techniques and skills. These trainings will help grassroots technicians and ordinary farmers gain more understanding on IPM, promote the extension and application of relative IPM technologies and products, and increase the implementation area of IPM and realize sustainable agricultural development.

(2) Monitoring and warning system and prevention and control system on major pest strikes will be established. The monitoring and warning system will be composed of the provincial Plant Protection Station, Plant Protection Institute of Liaoning Academy of Agricultural Sciences, and plant protection stations at county or city level in the project areas with complementarity from cooperatives and associations. Regular supervision and fixed point monitoring will be conducted in the project areas. Timely diagnosis and analysis on significant pest strikes should be made, pre-arranged planning on major pest strikes should be developed so as to bring pest strikes under timely and effective control. Forecast work should be enhanced to give timely release on pest development. The provincial Plant Protection Station will conduct monitoring on pest using modern device, release warnings, and provide control measures. Plant protection stations should deliver messages to farmers on the forecast of pest emergence period, extent, possible damages
and prevention suggestions through short message, radio and television, and internet to keep farmers informed and adopt measures to reduce possible losses. The provincial Plant Protection Station and agricultural technology extension centers at county or city and rural town levels will provide specific guidance on pest control to minimize the pest base number and reduce losses and mitigate control pressure in case of wide range occurrence.

(3) Agricultural control measures in IPM will be enhanced. Agricultural control techniques have been widely accepted in the project areas. Disease-resistant crop varieties, rational planting system, and scientific cultivation management techniques should be introduced, demonstrated, and promoted. Such agricultural measures as regularly rotating variety, promoting high-yield, disease-resistant varieties, breeding healthy seedlings, rational close planting, balanced fertilization, scientific irrigation, and implementation of cultivation techniques should be adopted to increase crop resistance and make the environment detrimental to crop diseases and the growth of pests.

(4) Physical control techniques and products should be introduced and promoted. In view of farmers’ overdependence on chemicals in coping with pests, biological control products (Bt emulsion, Polynactin, nucleopolyhedrosis virus, Beauveria bassiana, kasugamycin, and validamycin) and physical control materials (solar insect-killing light, plant growing light, sulfurator, sex attractant, and fly net) should be purchased with the World Bank fund. Farmers should be encouraged to use physical and biological controls to combat pests and to reduce the use of pesticides.
(5) Chemical control should be regulated and pesticides should be used scientifically and safely. Although there are disadvantages in pesticides, they are irreplaceable in fighting against pests in the current project areas and they play important role. Hence, the use of chemical control should be guided from the perspective of ecology. The control index should be formulated in consideration of such factors as the category, quantity, hazard degree of the control object, and the capacity of natural enemies as well as the compensation ability of crops and estimate on yield loss. And the control should be coordinated with biological control, agricultural control, and other control measures on the basis of forecast. Chemicals with selectivity, efficiency, and low toxicant should be chosen and they should be easy to degrade. Chemicals should be applied rationally and at the right time. Tools and equipment for applying chemicals should be improved. Measures should be taken to increase chemical effectiveness and prevent the formation of drug resistance or killing natural enemies or bringing phytotoxicity to crops.

(6) Enhance Supervision and Evaluation on the Implementation of PMP.

The provincial Agricultural Development Office will organize experts from Liaoning Academy of Agricultural Sciences, Shenyang Agricultural University and the provincial Plant Protection Station to conduct supervision and evaluation on the implementation of PMP in the project areas. Agricultural Product Inspection Center of Ministry of Agriculture (Liaoning) and Ecology Institute of Chinese Academy of Sciences will be entrusted to conduct supervision and inspection on the farm products from these areas. The local agricultural technology extension departments and plant protection
stations will make random spot check and evaluation on agricultural associations, agricultural cooperatives and ordinary farmers.

### 3.5 Expected PMP Project Output (Integrated Pest Management Technologies of Major Crops in the Project Areas)

The pest control of major crops in the project areas sticks to the principle of “Prevention First, Integrated Control, and Green Prevention”. Various control techniques and drugs will be applied to different crops and pests to minimize negative effect. Agricultural, biological and physical controls will be encouraged while chemical control will be reduced in terms of applied area, using times, and dosages. Importance should be attached to biological control. Low toxicant and low residue pesticides should be selected and applied dependent on the categories of crops and pests while high toxicant and high residue chemicals should be exterminated.

#### 3.5.1 Maize Diseases and Pests

Major diseases and pests: maize head smut, gall smut, ear rot, stem rot, top rot, leaf blight, gray leaf spot, subterranean pest-insect, Ostrinia nubilalis, aphid, armyworm, etc.

(1) Pest Control Objective and Control Index

- **Strictly enforce and follow the regulations of safety interval in applying chemicals and ban on high toxicant chemicals on maize.**
- **Reduce the use of pesticides by 5 ~ 10%.**
- **Bring the loss rate caused by diseases and pests under 5%.**
- **Bring the rate of diseased and infected plant of gall smut and head smut under 5%.**
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- Eliminate pesticide poisoning in the production
- Preserve biodiversity in the farmland and reduce quantities of disease and pests.

(2) Pest Control Strategy and Methods

- Control Strategy: A series of integrated pest management techniques will be adopted covering 75% of maize plantation area in the project areas, including combination of host resistance with agricultural control, physical control (e.g. using insect-killing light to trap ostrinia nubilalis adults), biological control (set free trichogramma, sex pheromone, beauveria bassiana, spread Bt granular formulation against ostrinia nubilalis and armyworm), and chemical control (mixing drug with seed, using chemical agent). The specific measures are as follows:
  - Agricultural control: Disease-resistant and pest-resistant varieties fit for the local plantation will be selected, avoiding sowing varieties or hybrid with the same genetic background for a long term in the same area. Various varieties with good resistance and diversified genetic background should be selected. Distribution of crop variety should be rational and rotated. Diversified cultivation patterns and plantation structure should be adopted, such as double rows on a wide ridge, 2-0 cultivation, intercropping, etc. Rational and effective cultivation measures that are suitable for the project areas should be adopted, such as deep tillage, and harrowing soil intensively. Soil should be ploughed deeply in winter, about 30cm, so as to bury deeply the diseased remains of last crop and reduce sources of soil-borne diseases and pathogenic bacteria, and destroy the hideout of subterranean pests-insects and expose them to the open air and freeze them to death in a bid to lower
pest population. Sowing should be conducted at the right time. It is fitting to start sowing when the ground temperature is stabilized at 12°C to reduce the infection of pests and diseases. Planting with the optimum density to ensure the plants get good ventilation and light. Field water and fertilizer management should be enhanced, applying thoroughly decomposed organic fertilizer and abundant base fertilizer along with nitrogen, potassium, and phosphorus as well as multiple trace elements. Remove maize smut tumour before tasseling. Remove underpart diseased leaves during banded sclerotial blight, leaf blight occurrence. Harvesting and drying at due time and keeping the moisture content under 13% to prevent ear and kernel from mildewing to ensure a safe storage. Eliminate diseased remains and ears in time after harvesting to reduce overwintering bacteria sources.

- Biological control: Protect and make good use of natural enemies, such as using Chrysoperla sinica, trichogramma ostrinia, and ladybug against ostrinia nubilalis and aphid. Promote the application of beauveria bassiana. Release trichogramma, and spray biopesticides such as Bt emulsion, matrine to control ostrinia nubilalis. Trap ostrinia nubilalis, armyworm, cutworm, and other pests with sugar and vinegar liquid and insecticidal lamp or install sex pheromones to trap male imagoes and prevent ostrinia nubilalis mating.

- Chemical control: Mixing seed with chemical agents. For example, covering seeds with seed coatings can effectively prevent maize head smut, top rot, and stem rot as well as underground pests. Mixing seeds with thiram, carbendazim wettable powder can prevent maize gall smut, bacterial wilt. Trap subterranean pest-insect with phoxim,
isofenphos-methyl mixed with pesticide-clay mixture and arsenopyrite. Maize leaf blight, gray leaf spot, banded sclerotial blight, rhopalosiphum maidis, and tetranychidae can be cured with difenoconazole, mancozeb, thiophanate-methyl, and chlorothalonil along with imidacloprid, and pyridaben. 1.5% phoxim granula and 2.5% deltamethrin cream mixed with arsenopyrite can be used to prevent and cure Ostrinia nubilalis and armyworm.

3.5.2 Rice Diseases and Pests

Major rice diseases: rice blast, false smut, strip virus disease, banded sclerotial blight, bacterial blight, etc.

Major rice pests: rice planthopper, lissorhoptrus oryzophilus kuschel, Chilo suppressalis, paddy stem maggot, cnaphalocrocis medinalis

(1) Control Objects

- Reduce the use of pesticides by 5~10%.
- Reduce the loss caused by diseases and pests by over 5%.
- Preserve biodiversity in the farmland and reduce quantities of diseases and pests

(2) Disease and pest control strategy and methods

- Making forecast and predictions

Making forecast and predictions in consideration of the occurrence degree and regularity over the years. In making predictions and forecast, factors about temperature, humid, precipitation, and wind within the coming week will be taken into consideration in the key stages of rice growth and in the critical control period. Chemical control measures should be prepared in advance.
● Agricultural control

Selecting and breeding resistant varieties is the most economical and effective approach in fighting against rice diseases and pests. High-yield and disease-pest-resistant varieties should be selected in accordance with the local actualities.

We should choose seedling beds with windscreen, good soil quality, medium fertility and an exposure to sunlight, at the same time the drainage and irrigation should be convenient and the terrain should be high. It should be avoided to be empty around, shady, low-lying or water around. Seedling beds should be ploughed and done under dry conditions and paddy field weeded. We also need to ensure surface flatter and furrow deeper, upper sticky and lower loose, a moderate hardness, and an appropriate border. In addition we should improve the structure of soil, increase the permeability, apply decaying manure, and use less or none fertilizer with sulfur. Lastly, we should enhance the management, uncover the film and irrigate seedlings according to the weather after the emergence to ensure a certain temperature and humid conditions.

The sowing time, seeding quantity and seeding age will be determined based on the characteristics of the variety. When the average daily temperature stays in more than 12 ℃, we can sow seeds in the open field evenly. It will be better if it is sunny in next 3 ~ 5 days, which is good for adjusting the time of pre soaking and germination for the sprout to turn green. After sowing, we should gently depress the pedal for the grains falling into soil, which is good for vertical bud and taking root. In bud, taking roots and vertical seeding are the core, and we should keep the ground wet and avoid
too early watering, and give an irrigation in time when there is frost. When the only leaf expands, we should irrigate it shallowly. When there are 2-3 leaves we should provide irrigation in order to reduce temperature difference and keep warm from frost. When fertilizing, we should give proper amount of base fertilizer, and topdressing should be a small-amount and many-times fertilizing with increasing the quantity slowly and improving the ratio of phosphorus and potassium by step. After good seedling emergence, we should spray fertilizer of taking root by using manure or ammonium sulfate mixed with water. After the second leaf extends, we will fertilize the “ablactation” and pay more attention to fertilization when it rains continuously, the leaf grows slowly or becomes yellow.

According to local cultural habits, bringing the breeding period and the planting period forward can reduce the occurrence of rice blast, ustilaginoidea virens and other diseases.

We should manage field irrigation water according to the characters of rice-growing scientifically. It means that seedlings will be planted with low water, turn green with water within inches and tiller with little water. When the plants are cool enough, we need to sun the field; When the plants send up ears, we need to keep the water within inches; When the plants produce seeds, we need to keep the field wet. All these measures can improve the capability of disease resistance of rice while reducing the occurrence of rice disease.

In the way of fertilizing, applying enough base-fertilizer and early top-dressing can strengthen the ability of anti-disease. Fertilizing late or fertilizing bias nitrogen fertilizer at rice boot stage must be avoided. When fertilizing, the amount of nitrogen fertilizer should be reduced in the later life
of plants, and the amount of appropriate phosphorus and potash should be increased under the same conditions of total nitrogen fertilizer, which can improve the disease resistance of rice while reduce the occurrence of rice disease and the loss of output.

The early found seeds with rice false smut should be got rid of immediately, and after harvest, heavily infected fields should be plowed deeply, so that parts of sclerotia and flase smut in the soil can be decomposed so as to reduce the amount of residual bacteria source. Before spring planting, we should clean up debris in the field to reduce the source of bacteria

- **Biological and physical control**

Biological pesticide should be used against banded sclerotial blight and rice false smut.

### 3.5.3 Overground Diseases and Pests of Facility Vegetables

Major disease and pests: gray mold, powdery mildew, tomato late blight, tomato leaf mold, cucumber downy mildew, whitefly, Liriomyza sativae, and aphid, etc.

1. Pest control objective and control index

   - Strictly enforce and follow the regulations of safety interval before harvesting vegetable and ban on high toxicant chemicals
   - Reduce the use of pesticides by 5 ~ 10%
   - Vegetable pesticide residues do not exceed the national standards
   - Eliminate pesticide poisoning in the production
   - Pay attention to the quality of application of pesticides. Make low-volume and fine spraying treatment to increase the adhesion amount.
● Conduct soil sterilization and greenhouse sterilization during non-production period. Clear away diseased remains to reduce pathogenic bacteria quantities and infection sources.

● Keep the temperature and moisture at a suitable level to reduce quantities of diseases and insect pests.

● Bring the loss rate caused by diseases and pests under 5%.

(2) Pest control strategy and method

● Control strategy. First of all, do a good job in making predictions and forecasts. Once pest and disease strike, agricultural control measures should come first followed by physical and biological controls. Only when all the other control measures are ineffective and the pest monitoring result shows that the damages have exceeded economic threshold value, can pesticides be used. When applying pesticides, attention should be paid to the selection of pesticides to mitigate pest resistance and avoid environmental pollution.

● Agricultural control and biological regulation. Plantation of disease-pest resistant varieties is the most economical way to combat tomato leaf mold, tomato late blight, cucumber downy mildew, and cucumber powdery mildew. Measures such as greenhouse sterilization before plantation, high temperature sterilization and removing diseased leaves, diseased fruits, and old leaves at stem base can effectively reduce infection sources. Adopting high ridge or semi high ridge cultivations along with rational close planting and timely pruning can increase plant’s disease-resistance. The following measures can be used to control high humidity diseases such as cucumber downy mildew, tomato gray mold, and tomato late blight, including adopting the cultivation method of double ridges mulching and irrigation under
mulching, conducting rational irrigation, enhancing water and fertilizer management, limit the use of nitrogen fertilizer, limit watering in diseased field, and watering in the morning in sunny weather and sealing greenhouse immediately after watering to increase temperature and to keep the greenhouse stuffy. Timely removal of residual petals and stigmas after tomato fruit setting can effectively control tomato gray mold. Crop rotation: the conversion period between open ground and sheltered land is the crucial period in controlling diseases and pests. Effective measures should be taken to control pest strikes, for example, providing healthy and strong seedlings mutually. Such cultivation measures should be taken such as rational intercropping, multiple cropping, or protective cultivation. For example, early spring maize intercropping with mulching onion can prevent root maggot from damaging onion; green Chinese onion intercropping with cabbage can reduce the occurrence of cabbage aphid; and cultivation of early spring onion in low tunnel can avert Plutella xylostella damage.

● Biological control. Farm-oriented antibiotics such as TF120 and polyoxin can be selected to control plant damping-off, downy mildew, powdery mildew, and blight. Kasugamycin can be used to control tomato leaf mold, and cucumber angular leaf spot. Some biological agents such as Bt emulsion, nucleopolyhedrosis virus, and beauveria bassiana can be used to control cabbage caterpillar and plutella xylostella. Pest natural enemies can be used as well, eg. encarsia formosa gahan versus trialeurodes vaporariorum.

● Physical control. Installing insect proof net in vegetable farming can provide protections against pests, diseases, rain, wind and light and it can also retains moisture. Trapping is also frequently used in physical control, e.g.
using yellow mucilage glue board to trap Trialeurodes vaporariorum and aphid, and using black light lamp, frequency-vibrating lamp, sex pheromone, and sugar-vinegar liquid to trap plutella xylostella adults.

- Chemical control. On the basis of understanding pest occurrence regularity in greenhouse vegetables, we should make early diagnosis and early treatment and use the right pesticide. In order to lower humidity in greenhouse and increase coverage of pesticide, we should smog method and dust method in applying pesticides. Protective and therapeutic chemical agents should be applied in due time in accordance with the pest degree. Various chemical agents should be applied alternatively in view of the drug resistance of pathogenic bacteria. For example, Procymidone and chlorothalonil can be used to control tomato gray mold; Bordeaux mixture and kasugamycin to control tomato leaf mold, ridomil and chlorothalonil to control tomato late blight and cucumber downy mildew, and antimycin (TF120) to control cucumber powdery mildew. Thiamethoxam, midacloprid, and antiaphid spray can be used to control aphid, greenhouse trialeurodes vaporariorum.

3.5.4 Soil-borne disease in facility vegetables

Major disease and pests: phytophthora blight, pepper root rot, eggplant verticillium wilt, and Cucurbits Fusarium Wilt, etc.

1) Disease and Pest Control Objective and Control Index
- Strictly enforce and follow the regulations of safety interval before harvesting vegetable and ban on high toxicant chemicals
- Reduce the use of pesticides by 5 ~ 10%
- Vegetable pesticide residues do not exceed the national standards
● Eliminate pesticide poisoning in the production

● Pay attention to the quality of application of pesticides. Make low-volume and fine spraying treatment to increase the adhesion amount.

● Conduct soil sterilization and greenhouse sterilization during non-production period. Clear away diseased remains to reduce pathogenic bacteria quantities and infection sources.

● Reduce the losses caused by diseases and pests over 5%.

(2) Pest control strategy and method

Control Strategy: Mainly rely on agricultural control, physical control, and biological control along with effective and low toxicant pesticides.

● Agricultural control: Disease-resistant varieties should be selected in consideration of the local actualities. Such techniques as grafting and changing root should be adopted to increase disease resistance. Continuous cropping should be avoided while the practice of crop rotation is encouraged. For example, eggplant, pepper and melons can be rotated with rice, maize, Leguminosae, and Cruciferae. New soil or sterilized soil should be used when cultivating seedlings. When conducting large-sized transplanting, high ridge cultivation should be adopted. Attention should be paid to rational application of fertilizers and the application of potassium fertilizer. The application of potassium fertilizer can increase disease resistance, yields and quality. Heavy soil should be applied with organic fertilizers to make improvement and increase permeability and water seepage.

● Biological control: American trichoderma harzianum T-20 and Israeli trichoderma harzianum T39 and trichoderma strains agents registered at home
and abroad could be used to control soil-borne diseases such as Phytophthora, Pythuim, Fusarium, and Verticillium.

- **Physical control**: Steam sterilization can kill bacteria and solve the problem of soil-borne germs on the one hand, and it can kill subterranean pests-insects such as eggs, nematode, and grub. In addition, it is likely to increase the proportion of soil crumble structure and improve soil permeability.

  Before sterilization, the soil should be loosened covered with canvas or with high temperature resistance plastics and keep the soil on a sealed condition. Normally, for each square meter, 500Pa high temperature steam is needed per hour. Straw reactor technology should be promoted.

- **Chemical control**: Effective low toxicant pesticides will be used on the basis of agricultural, biological, and physical controls and in consideration of the features of greenhouse soil-borne diseases. Before the occurrence of pepper phytophthora blight, Metalaxyl Mn-Zn, Kelu, Famoxate should be used. Thiophanate-methyl, benomyl, or carbendazim suspending agent should be sprayed or watered at the early stage of pepper root rot. As for eggplant greensickness, after fix planting and seedling recovery, Weijunjing, ie 500 times bacillus subtilis solution, could be used to irrigate the root. Or Dacotech, mildothane, and carbendazim could be used to water the root during growth period, flowering period, and fruiting period. Lvxiang 1, i.e., 95% hymexazol, hydroxyisoxazole, Difenoconazole, TBZ (thiabendazole) could be used to irrigate root at early stage of melon blight.
3.5.5 Peanut Diseases and Pests

Major diseases and pests. Peanut scab, brown spot, reticulate mottling, black spot, root rot, aphid, and grub.

(1) Disease and pest control objective and control index

● Strictly enforce and follow the regulations of application safety interval and ban on high toxicant chemicals.
● Reduce the use of pesticides by 5 ~ 10%.
● Reduce losses caused by diseases and pests over 5%.
● Eliminate pesticide poisoning in the production.

(2) Disease and pest control strategy and methods

Control Strategy. Including promotion of resistant varieties, optimization of field cultivation techniques, strengthening field management, providing trainings to farmers, combined use of agricultural, biological, physical and chemical controls.

● Agricultural control. Selection of disease-resistant varieties. Seeds should be selected under strict standards and sunbathed thoroughly before storage. Before sowing, seeds should be sunbathed 1-2 days before husking. Rational crop rotation should be conducted to reduce accumulation of bacteria sources. Practice has shown that alternating peanut plantation with maize has achieved good effect in mitigating various diseases and pests. The field should be cleaned, deeply plowed, and sunbathed. Organic fertilizers, P, K fertilizers should be applied to increase disease-resistance. Mulching plantation techniques should be extended.

● Biological control

Natural enemies should be protected and made good use of.
There are many natural enemies for aphid, such as ladybug, Chrysopa perla, hoverfly. When the ratio between ladybug and aphid is 1 : 100 ~ 120, the damage of aphid can be efficiently controlled.

● Physical control

Pests such as cockchafer, mole cricket could be trapped with black light lamp or frequency-vibrating lamp making use of their phototaxis. Cutworm and prodenia litura could be killed with high pressure mercury lamp, sugar-vinegar solution, and sex attractants.

● Chemical control

Combination of chemical agents could be used in view of the specific pests. Thiophanate-methyl mixed with difenoconazole or tebuconazole or hexaconazole could be used to fight against scab and brown blotch. This could not only prevent the occurrence of these diseases but also deter the disease-resistance of pathogenic bacteria. Pesticides with strong selectivity such as pymetrozine should be promoted and applied. Soil insects could be controlled by means of mixing seeds with chemical agents.

3.5.6 Potato pests and diseases

The main plant diseases and pests of potatoes are: potato late blight, early blight, ring rot, virus disease, ladybird, aphids and underground pest, etc

(1) Control index and goals of pest management

● Strictly execute and abide by the regulation of applying pesticide safety interval and that of highly toxic pesticide banned for potatoes.

● The amount of chemical pesticide is reduced by 5 ~ 10%.

● The loss rate of plant diseases and insect pests should be controlled under 10%
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● The loss of the Late blight should be reduced by more than 5%.
● Put an end to productive pesticide poisoning accidents
● Keep a farmland biodiversity, and reduce the number of plant diseases and insect pests

(2) Strategy and methods of pest control

● Prevention and treatment strategies.

An integrated control will be carried out on the basis of promoting high yield plants, choosing no diseases tubers and disease resistance varieties, combining with monitoring prevention to eliminate center disease plants and to strengthen the control of medicament as well as to improve the cultivation technology.

● Agricultural control

Collection and treatment of seed potatoes.

Choose varieties with stronger ability of resistance to pests and diseases. Strictly select seed potatoes which are disease-free, virus-free with high quality.

After seed potatoes being brought out of pits, they must be dried for 3~4 days. 1-2 days before sowing, seed potatoes should be cut into more than two pieces, and we must ensure that each piece has 1-2 eyes. Second, we should select seed potatoes strictly and eliminate the tubers with rot disease. Third, knives should be disinfected, and if there are potatoes with rot disease which must be eliminated. Before cutting potatoes, we need to prepare 0.1% potassium permanganate water or 75% ethanol and put two cutters into the potassium permanganate water or disinfect the cutters with rubbing alcohol.
Crops selection and soil preparation

Selecting the soil that has deep foundation and loosened structure, and bean-wheat-potato rotation should be used as a major rotation pattern in three years. After previous crops have been harvested, a timely sub-soiling need to be done which usually happens every three years to break up the plow pan and at the same time to provide a suitable soil environment for root growth and tuber expansion.

The center disease plants must be pulled out in time along with the potato tubers when they are found by early monitoring, and must be taken away from the farmland and buried, and then the hole within 3-5 m around should be disinfected with scattering slaked lime.

Take measures such as ridge culture, interplant, and formula fertilization. Continuous cropping or interplanting with solanaceae class and cruciferae crop should be avoided, but rotating crops is needed. After harvest we should plough the soil as deep as 30 centimeters, and expose the insect pests to soil surface to freeze them to death, to air dried or be pecked by natural enemies. Apply rotted organic fertilizer.

● Biological and physical control

To promote an apply physical, biological prevention and control measures such as Frequency Trembler Grid Lamp, yellow template, sex attractant etc. to trap and kill the pests, and at the same time to ensure the ecological safety. Promote potato microbial bacterial manure.

● Chemical prevention and control

Potato Late Blight
The first is to choose resistant varieties, the second is to choose disease-free potatoes, and the third is to take pesticide prevention.

At an early stage, we can spray 58% Fubol wettable powder (diluted 600-800 times solution), 64% oxadixyl wettable powder (diluted 500 times solution), 72.2% Previcurn water aqua (diluted 800 times solution), 50% thiram (diluted 500 times solution), 3% polyoxins wettable powder (diluted 300 times solution), 75% chlorothalonil wettable powder (diluted 500 times solution), or 1:1:20 bordeaux liquid at an interval of once every 7 ~ 10 days and continuous 2 ~ 3 times.

**Potato Early Blight**

The first is a crop rotation with non-solanaceae crops, the second is to apply base fertilizer adequately and apply more phosphate as well as potassium fertilizer to improve premonition, the third is the pesticide prevention.

At an early stage, we can spray 1:1:150 bordeaux liquid, 80% zineb (diluted 600-800 times solution), and 75% chlorothalonil (diluted 600-800 times solution) at an interval of once every 5 to 7 days according to actual infection with a total of 3 ~ 4 times for prevention and treatment.

**Potato Ring Rot**

Ring rot mainly is spread by seed potatoes with strains which are primary infection sources, meanwhile stripping and slicing is a major way to spread.
Comprehensive measures should be taken for prevention of pests, such as selecting resistant varieties, removing infected plants and choosing low-toxic pesticide.

At seedling stage and adult-plant stage, infected plants will be pulled out to get a centralized processing.

We can spray 72% agricultural streptomycin (diluted 4000 times solution), or 2% kasugamycin wettable powder (diluted 500 times solution), or 77% Kocide wettability particle wettable powder (diluted 500 times solution), or 25% Cuaminosulfate agent(diluted 300 times solution), or 50% DT wettable powder(diluted 500 times solution) to a field with pests or other diseases.

**Potato virus diseases**

So far, there is no effective agentia but to prevent pests and diseases with agricultural technologies.

Choosing virus-free seed potatoes. At an early stage, we can spray 1.5% TS emulsion (diluted 500 times solution), or 20% virus A wettable powder (diluted 500 times solution), or 5% Jun suqing wettable powder (diluted 500 times solution), or dimethoate emulsion (diluted 500 times solution) at an interval of once every 7 to 10 days and continuously spraying 2 ~ 3 times.

**Henosepilachna vigintioctomaculata**

Before larva disperse, we can pray 2.5% kung fu (diluted 3000-4000 times solution), or 40% dimethoate ec (diluted 1000 times solution), or 2.5% deltamethrin (decis) creme (diluted 3000 times solution), or 20% fenvalerate
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(SumiCidin) creme (diluted 3000 times solution), or 50% phoxim emulsion (diluted 1000 times solution) in order to prepare.

Aphis

Spray 50% pirimicarb wettable powder (diluted 2000-3000 times solution), or 0.3% Kushenin pesticides (diluted 1000 times solution), or Nicotine and Toosendanin ec (diluted 10000 times solution), or 10% imidacloprid wettable powder (diluted 2000 times solution), or 2.5% deltamethrin creme (diluted 2000-3000 times solution), or 20% fenvalerate creme (diluted 2000-3000 times solution) for prevention and control.

(7) Soil insects

Soil insects mainly contain cutworm, grubs, wireworm and mole cricket, etc.

Table 4 chemical pesticide banned in pollution-free agro-products

<table>
<thead>
<tr>
<th>Kinds of pesticides</th>
<th>The name of pesticides</th>
<th>Disable crops</th>
<th>Disable reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorganic arsenic pesticides</td>
<td>Arsenic acid calcium, arsenic acid lead</td>
<td>All crops</td>
<td>High-toxic pesticide</td>
</tr>
<tr>
<td>organoarsenic fungicide</td>
<td>zine methanearsonate, methyl arsine acid ammonium iron (TianAn), urbacid, asomate</td>
<td>All crops</td>
<td>High residual</td>
</tr>
<tr>
<td>organoarsenic</td>
<td>Fentinactate, Triphenyltin acetate, fentin</td>
<td>All crops</td>
<td>High residue</td>
</tr>
<tr>
<td><strong>Sustainable Agricultural Development Project of Liaoning China with World Bank Loans</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td><strong>fungicide</strong></td>
<td><strong>Hydroxide, stannic chloride</strong></td>
<td>teratogenesis</td>
<td></td>
</tr>
<tr>
<td>organomercurial fungicide</td>
<td>ethylmercuric chloride, phenylmercuric acetate</td>
<td>All crops</td>
<td>High-toxic, high residual</td>
</tr>
<tr>
<td>Organic heterocyclic</td>
<td>Bis-A-TDA</td>
<td>All crops</td>
<td>teratogenesis</td>
</tr>
<tr>
<td>Organic fluorine and inorganic fluorides</td>
<td>calcium fluoride, sodium fluoride, sodium fluoroacetate, sodium fluoroacetamide, sodium hexafluoroaluminate, sodium fluosilicate</td>
<td>All crops</td>
<td>High-toxic, high poisonous, easy phytotoxicity</td>
</tr>
<tr>
<td>organochlorine insecticide</td>
<td>DDT (dichloro-diphenyl-trichloroethane), hexachloro-cyclohexane soprocid, lindane, aldrin, dieldrin, sodium pentachlorophenate, chlordane</td>
<td>All crops</td>
<td>High residual</td>
</tr>
<tr>
<td>organochlorine caricide</td>
<td><strong>DiCofol</strong></td>
<td>Vegetables, Fruiter, tea</td>
<td>High residual</td>
</tr>
<tr>
<td>Halogenated class fumigation pesticides</td>
<td>Dibromoethane, dibromochloropropene</td>
<td>All crops</td>
<td>Carcinogenic, teratogenic and mutagenic</td>
</tr>
<tr>
<td>organophosphorus insecticide</td>
<td>Phorate, disulfoton, monocrotophos, parathion, parathion-methyl, methamidophos, flolimat, sulfotep, coumaphos, isocarbophos, phosphamidon, demeton, isofenphos-methyl, fenamiphos, isofenphos-methyl, Jia Quan sulfur ring phosphorus</td>
<td>Vegetables, Fruiter, tea</td>
<td>Highly toxic, high poison</td>
</tr>
<tr>
<td>organophosphorus fungicide</td>
<td>Kitazin, Kitazin P</td>
<td>Rice</td>
<td>Different odor</td>
</tr>
<tr>
<td>Carbamate pesticides</td>
<td>Carbofuran, aldicarb, methomyl</td>
<td>All crops</td>
<td>high poison</td>
</tr>
<tr>
<td>Dimethyl amidine class insecticidal acaricide</td>
<td>Chlordimeform</td>
<td>All crops</td>
<td>Chronic toxicity, carcinogenic</td>
</tr>
<tr>
<td>Organic nitrogen fungicide</td>
<td>Iminoctadine</td>
<td>All crops</td>
<td>high poison</td>
</tr>
<tr>
<td>pyrethroid insecticides</td>
<td>All pyrethroid insecticides</td>
<td>Rice</td>
<td>Toxic to the fish</td>
</tr>
<tr>
<td>Replace benzene class insecticidal sterilization</td>
<td>Quintozene, Blastin, benomyl</td>
<td>All crops</td>
<td>Secondary phytotoxicity Or carcinogenic report in the foreign country</td>
</tr>
<tr>
<td>Diphenyl ether herbicide</td>
<td>Nitrofen, chlornitrofen</td>
<td>All crops</td>
<td>chronic toxicity</td>
</tr>
</tbody>
</table>
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At the time of dog days of summer and autumn ploughing or before planting, 50% phoxim emulsion 400 ~ 500 g and 3% phoxim grain 1.5 ~ 2 kg, mixed with 50 kg fine soil or sand per mu will be put into the furrow for polish or sowing covering.

During the full incidence period of imag, the crops or the tree with pests should be sprayed with 50% phoxim emulsion (diluted 1000 times solution), or 90% crystal trichlorfon (diluted 1000 times solution), or 2.5% deltamethrin (decis) creme (diluted 1000 times solution), or 20% fenvalerate creme (diluted 3000 times solution).

3.6 The using principles of chemical pesticide

In allusion to the current situation that chemical prevention and control is still an effective emergency measure to deal with crop diseases and pests in project areas, the project will be carried out in a strict accordance to the standard of the world bank which refers to the latest the World Health Organization's Recommended Classification of Pesticides by Hazard and Guidelines to Classification, and various laws and regulations related to pesticide production, sale and use made by Chinese governments.

Taking the current production level of project areas into consideration, chemical pesticide use standard of pollution-free food is taken as the chemical pesticide use standard in project areas, and prohibited or no registration pesticide, as well as pesticide of I kind of world health organization will not purchased.

Based on the promotion of agricultural control, biological control and material control, we will provide more knowledge of the production, sale and
use of chemical pesticide to agricultural technology promotion personnel, pesticide production enterprise, pesticide dealers, agricultural associations, cooperatives and ordinary farmers to improve chemical safety and effectiveness of the prevention and control, and then realize the sustainable development of agriculture. Chemical pesticides banned in the production of pollution-free agricultural products is provided in table 4.

### 3.7 The using principles of biological pesticide

<table>
<thead>
<tr>
<th>Pesticide name</th>
<th>Toxicity classification</th>
<th>Target species</th>
<th>risk assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kasugamycin, penicillin</td>
<td>low toxicity, III</td>
<td>cladosporium fulvum, Cucumber Angle spot, Pepper scab</td>
<td></td>
</tr>
<tr>
<td>Bacillus</td>
<td>low toxicity, III</td>
<td>plutella xylostella, oriental, tobacco budworm, European corn borer</td>
<td></td>
</tr>
<tr>
<td>beauveria bassiana</td>
<td>low toxicity, III</td>
<td>European corn borer</td>
<td></td>
</tr>
<tr>
<td>trichogramma</td>
<td>low toxicity, III</td>
<td>European corn borer</td>
<td></td>
</tr>
<tr>
<td>Polynactin</td>
<td>low toxicity, III</td>
<td>Aphid, etranychid</td>
<td></td>
</tr>
<tr>
<td>Pyrimidine nucleoside antibiotic</td>
<td>low toxicity, III</td>
<td>Alternaria brassicae, Vegetables powdery mildew, anthracnose, downy mildew, alternaria solani</td>
<td></td>
</tr>
<tr>
<td>plutella xylostella granulosis virus</td>
<td>low toxicity, III</td>
<td>Plutella xylostella</td>
<td></td>
</tr>
<tr>
<td>polyoxins</td>
<td>low toxicity, III</td>
<td>Cucumber downy mildew, Sphaerotheca fuliginea</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Substance</th>
<th>Toxicity Level</th>
<th>Disease/Organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sophocarpidine, polyoxins</td>
<td>low toxicity, III</td>
<td>Sphaerotheca fuliginea</td>
</tr>
<tr>
<td>agricultural antibiotic</td>
<td>low toxicity, III</td>
<td>Vegetables damping off, peronospora tabacina, Sphaerotheca fuliginea, pestilence</td>
</tr>
<tr>
<td>Toosendanin, cnidium lactone</td>
<td>low toxicity, III</td>
<td>Plutella xylostella, cabbage caterpillar, Oeobia undalis and other lepidoptera pests</td>
</tr>
<tr>
<td>nicotine</td>
<td>low toxicity, III</td>
<td>Plutella xylostella, beet armyworm, Bemisia tabaci gennadius and so on</td>
</tr>
<tr>
<td>Streptomycin + Terramycin</td>
<td>low toxicity, III</td>
<td>Cabbage soft rot, Pseudomonas solanacearum, cabbage leaf spot</td>
</tr>
<tr>
<td>Terramycin</td>
<td>low toxicity, III</td>
<td>Cabbage soft rot</td>
</tr>
<tr>
<td>Validamycin</td>
<td>low toxicity, III</td>
<td>Corn spot, melon damping off</td>
</tr>
<tr>
<td>Nuclear polyhedrosis virus</td>
<td>low toxicity, III</td>
<td>Cotton bollworm</td>
</tr>
<tr>
<td>Abamectin</td>
<td>low toxicity, III</td>
<td>Plutella xylostella, Tetranychus urticae Koch, RKN</td>
</tr>
<tr>
<td>Bacillus thuringiensis</td>
<td>low toxicity, III</td>
<td>Orthoptera, Coleoptera and Diptera pests</td>
</tr>
</tbody>
</table>

Compared with chemical pesticides, biological pesticide has the following advantages:

(1) The toxicity of biological pesticide is usually lower than traditional pesticide;
(2) Strong selectivity. They work only on the objective diseases and insects or few closely-related organisms, instead of human, birds and other insects and mammals;

(3) Low residue, high efficiency. A small amount of biological pesticide can have effective effects and usually can be rapidly decomposed, thus on the whole avoids the problems of environmental pollution caused by traditional pesticide

(4) Hard to generate insecticide resistance

(5) As a component of IPMP (Integrated pest management programs), it can greatly reduce the use of the traditional pesticide without an influence on crop yield.

PMP project in Liaoning province should promote and apply biological pesticides greatly, reduce the use of chemical pesticide to realize agricultural safe and sustainable development. Toxicity of biological pesticide used in the project and risks are listed in table 6 (according to the classification guide and classification of pesticide recommended by WHO)

4 Implementation plan of PMP

4.1 Arrangements and management of PMP complementation institutions

In order to ensure a successful implementation of PMP, the project will formulate a strict management system and carry on a strict management and assessment of people participating in the project, the use of fund, the activities and achieved effects, etc.
According to the established plan of PMP, we establish a leadership team of PMP, a technical advisory panel and an implementation team.

The leaders come from provincial agricultural development bureau and people in charge of county and town project offices, who are responsible for supervising and coordinating staff of PMP, assessing and evaluating the implementation of project and the use of funds etc.

Technical advisory panel is composed of Academy of Agricultural Sciences of Liaoning province and Shenyang agricultural university as a leader, and excellent plant protectors in other districts and counties, who are responsible for the establishment of implementation plan, the compilation of technology documentation for PMP, technical trainings, technical guidance and the assessment of achieved effects of PMP, etc. The implementation team is composed of provincial agro-technology extension stations and plant protection stations as a leader, and agro-technology extension stations, plant protection stations, farming associations, cooperatives and large growers from counties related, who are responsible for the specific implementation of PMP.

(1) Staff management of PMP

The existing scientific and technical personnel in project area will be optimized to form a technical team of PMP with intelligence and capability to formulate a post-responsibility system for people participating in the project, and ensure their annual work time, mission and their anticipated goals etc., and thus administer rewards or punishment according to their performance, meanwhile a performance appraisal system will be carried out among
members participating in the project to give full play to staff’s working activeness.

(2) Funds management

PMP fund should be used in strict accordance with related rules of world bank loan and corresponding rules of Chinese governments, and be used on the principle of special funds for special purpose and regular audits with a special account of PMP, meanwhile an embezzlement and unwarranted diversion of and fund must be avoided, at the same time supplies purchased for PMP should be conducted a scientific assessment with a public bidding, in the end, the materials and subsidies provide for farmers must be registered and given a return visit.

(3) Implementation management of PMP

Each project region needs to make PMP implement annual plan, regularly holds a meeting composed of the principal of farmers, association (cooperation) representatives of local governments and PMP work associations made of leaders from science and technology administration departments. At the meeting, a summary and a report on the operation of PMP will be made to solve and adjust existing problems.

Project management office need to submit the interim summary report in the middle of the project and acceptance report in the end.

At the same time, project management offices in project areas need to compile a short report of PMP implementation, and pass it to provincial department of world bank loan project to report actual implementation, achievements and existing problems, and meanwhile take different forms,
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energetically promote the achievements in project areas, and accelerate the demonstration and promotion of the achievements.

4.2 Implementing tasks of PMP

Task 1: Determination of the PMP (IPM) plan in each region

According to the overall PMP plan of Liaoning province, combining with major plants and actual occurrence of main diseases and insect pests in respective project region got by visiting farmers, we will work out comprehensive control plans for six regions and pass the final plan to the project technology team for review, and then the implementation will be verified by the leading group.

- The PMP in Changtu
- The PMP in Lianshan district
- The PMP in Lingyuan
- The PMP in Sujiatun District
- The PMP in Zhangwu
- The PMP in Xiao Dong livestock

Task 2: related training of IPM and PMP

Departments that offer trainings include:

- Academy of Agricultural Sciences of Liaoning province, plant protection station of Liaoning province, Shenyang agricultural university and other research institutes
- Agricultural demonstration bases
- Trained agriculture technology extension stations in counties (city), villages and towns.
- Pesticide vendors
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- Other national and provincial organizations that can offer trainings
- FAO

The major training contents are following:

- Comprehensive management and implementation of plant diseases and insect pests in the region
- Laws and regulations about the use of pesticide and other things related
- Identification of main plant diseases, occurrence rules and identification of major natural enemies.
- Control strategies and integrated control techniques of major plant diseases
- The option of pesticide and safe usage technology
- Safe store and disposal of agricultural chemicals and packaging wastes
- Application method of chemical pesticide and requirements for safety
- Maintenance and management of spraying equipments
- Monitoring the implementation, if there is something wrong with it, a second training is needed.

The people that will need to be trained may include:

- Entry-level technician in the region
- Technical staff of farming associations, cooperatives and other related technicians
- Pesticide vendors
- Common farmers

Task 3: Establish and improve the system of monitoring, forecasting and prevention of major crop plant diseases and insect pests.
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An efficiently all-round and rapid response warn& control system covering all project regions in Liaoning province will be established to make emergency measures of prevention for major diseases and pests, which takes provincial plant protection station as the core, Academy of Agricultural Sciences of Liaoning province and Shenyang agricultural university, and plant protection stations and quality supervision stations in counties (city), villages and towns as the main body.

Provincial plant protection station has the capacity of macro-coordination and monitoring and plays a role of central guide. Experts of Academy of Agricultural Sciences of Liaoning province and Shenyang agricultural university will coordinate with plant protection stations to predict plant diseases in a scientific way, timely diagnose and analyze major diseases and pests and then offer suitable and efficient prevention measures.

Task 4: Application of biological pesticide and physical control

Set standards of purchasing various biological pesticide and physical control material scientifically, so do the variety. Competitive Bidding Purchasing is regarded as principle, and others are regarded as assist. Purchasing should follow the principle of effective competition, fairness, justice and so on.

Enrich the number of evaluation experts, strengthen the field management of evaluation experts, and further standardize behavior of the evaluation experts. Hanle the reports and complaints of supplier according to law, while strengthen punishment of violations and discipline. Strengthen the coordination among administrative supervision, auditing organs and other functional departments, promote special examination and regular inspection,
and ensure the reasonable use of special funds of the World Bank and procurement can actually be distributed to the farmers.

Task 5: Construct the demonstration area and improve public participation enthusiasm.

The construction of demonstration areas is an effective way to speed up the PMP performance. 3 ~ 5 demonstrations in each project area are required to be constructed with a total of 20 ~ 30 demonstration stations in Liaoning province, meanwhile the location, scale and major corps should be of definitely determined.

Crop pest management in demonstration stations should be carried out according to the PMP plan of Liaoning province, and is required to show introduced new varieties and new technology of agricultural, biological, physical and chemical control.

Within 1 ~ 2 years, demonstration areas try to get remarkable economic and ecological benefits, driving force to peripheral regions. At the same time technical trainings and demonstration meeting should be held in these areas at regular intervals to expand the area of demonstration and its influence among common farmers, to accelerate the construction speed of project, and finally to realize PMP and a sustainable development of agriculture.

5 Work plan and cost arrangement

5.1 Work plan

The project (PMP) will last 5 years, that is, from 2013 to 2017. Work arrangements are as follows:

In 2013:
Leadership team, technical implementation team, core demonstration areas, and the implementation plan will be established, meanwhile the occurrence of crop diseases and insect pests in each region will be monitored, key technologies of biological control will introduced and demonstrated, related instruments and products used for pest control will be purchased and applied, and finally many corresponding people will accept trainings.

In 2014:
According to the monitoring results of plant diseases and insect pests, fore-warning index will be published in time, key technologies of biological control continue to be introduced and demonstrated, related instruments and products used for pest control continue be purchased and applied, suitable technical specifications of prevention and control will be preliminarily established in respective area, and technical trainings of pest prevention will be held for farmers in different seasons of crop growing.

In 2015:
Fore-warning index will be published in time, key technologies of biological control continue to be introduced and demonstrated, suitable technical specifications of prevention and control will be established in respective area, and technical trainings of pest prevention will be held for farmers in different seasons of crop growing.

In 2016:
Technical specifications of IPM will be demonstrated and promoted in each region, the control effects will be evaluated, the quality of crops products will be monitored, and continuous technical trainings of IPM will be given to farmers.
In 2017:

All technologies and products of disease and pest control will be spread in all regions, at the same time all the tasks and acceptance checks will be completed.

**5.2 Farmers’ training**

The training of farmers is a key component of PMP and a guarantee of its various goals, with aims of helping farmers in project areas establish principles and approaches of continuous application of IMP technology and concept, enhancing their knowledge of IMP, their technical ability of plant protection, and their consciousness of environmental protection and participation in IMP activities in order to control pests safely and effectively, reduce the pesticide residue in agricultural products, realize the sustainable development of production, diversity of ecosystem as well as the growth of living standard. The training consists of the following three parts: the first is the training of grassroots technicians so as to let them provide a training to farmers around; the second are various farmer field schools to help farmers identify and analyze problems met during their actual production, and to improve their quality and initiatives; the third is a mobile training.

**Table 7  training plan**

<table>
<thead>
<tr>
<th>Training items</th>
<th>Training contents</th>
<th>participants</th>
<th>Training types</th>
<th>Trainin g times</th>
<th>Number of participants</th>
<th>Enforceme nt institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training of instructors</td>
<td>Latest IPM, PMP, new techniques on the prevention and control</td>
<td>People in charge of agro-techniqu e extension at county and township</td>
<td>Mobile training</td>
<td>2 times per county every year</td>
<td>500 people</td>
<td>Project management office</td>
</tr>
</tbody>
</table>


### Participatory trainings: farmer field schools are established with instructors in charge of agricultural technology extension at township level as well as farmer technicians with professional training and rich experience in
management of diseases and pests, the instructors teach farmers how to identify and control pests according to the problems raised by farmers, and the actual occurrence of pests appearing in local crops and forestry in different stages, then the instructors provide applicable solution and direction so as to improve farmers technical knowledge and their ability of organization, communication and management.

Mobile trainings: A team of experts coming from agricultural scientific research institutions, colleges as well as institutions of agricultural management and promotion will go to farmer field schools and towns to provide a training to local farmers, local farmer technicians, people in charge of agro-technique extension and local pesticide dealers on latest IPM, pollution-free prevention and control of pests, safe application of pesticide and policies about pesticide sale.

Participants: farmers, farmer technicians, people in charge of agro-technique extension at county and township levels, pesticide dealers, technicians in plant protection, etc. Detailed training plan is provided in table 6.

5.2.1 Training of grassroots technicians

The training refers to that of people in charge of agro-technique extension at township level as well as farmer technicians with professional training and rich experience in management of diseases and pests, after training they teach farmers how to identify and control pests according to the problems met by farmers, and the actual occurrence of pests appearing in local crops and forestry in different stages so as to improve farmers technical knowledge and their ability of organization, communication and management.
Crops under IPM are corns, various vegetables, peanuts, potatoes, and paddy, the training should be arranged in a key period of production according to the features of these crops, after training, annual 100 grassroots agricultural technicians must make themselves master of IPM and become proficient in pest-control techniques.

5.2.2 Farmer field schools

As a tool to help farmers to comprehend and put into use of IPM, and a new way for farmers’ education and the extension of technology, a farmer field school exists in every town according to local agro-types and generally consists of 25 farmer students, it requires its students to meet and have a focusing learning for 5 to 6 hours a week or 5 to 6 hours a month. For the first training, each group should have a support with grassroots technicians, generally speaking, these technicians should be IPM-trained people in charge of local agro-technical extension and experts from provincial and municipal research institutions.

From 2013, every town will host 5 farmer field schools (85 as a total for 17 towns) with each school giving a training to 30 farmers, meanwhile, every project county will organize 2 to 3 schools with 150 farmer students at a time (more than 15 schools for six project counties per year), finally, 35,000 farmers will get a training during the project.

5.2.3 A mobile training team

Farmer field schools are not enough for project areas, for IPM-trained grassroots technicians can only give a training to farmers around, and qualified grassroots technicians are too insufficient to train mass farmers. While a mobile training team can give presentations to many a farmer with a
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flexible topic, training method and member constitution, including various experts from agricultural research & teaching institutions as well as agricultural extension institutions.

5.3 Fund allocation

The total fund for PMP in Liaoning province is 15,401,800yuan, and the detailed budget is given in table 8.

<table>
<thead>
<tr>
<th>Province</th>
<th>Instruments for physical control</th>
<th>Subsidy for biological control</th>
<th>Farmers training</th>
<th>Demonstration &amp; promotion of resistant varieties</th>
<th>Expert technical assistance</th>
<th>Monitoring and evaluation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liaoning</td>
<td>385.9</td>
<td>580.3</td>
<td>174.45</td>
<td>304.65</td>
<td>44.88</td>
<td>50.00</td>
<td>1540.18</td>
</tr>
</tbody>
</table>

(1) The PMP in Liaoning province covers 12272.7hm² with a fund of 12,708,500yuan, which is mainly used to purchase instruments (including solar insecticidal lamps, etc.), to provide a subsidy for biological prevention & control as well as demonstration & promotion of resistant varieties, including 378 sets of instruments at a cost of 3,859,000yuan, 5,803,000yuan as a subsidy for biological prevention & control, and 3,046,500yuan as a subsidy for the demonstration & promotion of resistant varieties with an area of 7363.62 hm². Detailed budget for PMP in Liaoning province is given in table 9.

<table>
<thead>
<tr>
<th>County</th>
<th>Control area</th>
<th>Instruments</th>
<th>Subsidy for biological control</th>
<th>Subsidy for varieties</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hm²</td>
<td>sets</td>
<td>10000yuan</td>
<td>10000yuan</td>
<td>10000yuan</td>
</tr>
<tr>
<td>Sujiatun</td>
<td>1672</td>
<td>113</td>
<td>124.59</td>
<td>83.61</td>
<td>64.09</td>
</tr>
<tr>
<td>Xiaodong</td>
<td>2787</td>
<td>17</td>
<td>27.30</td>
<td>139.36</td>
<td>54.04</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>County</th>
<th>Farmers training</th>
<th>Technical assistance</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Person-month</td>
<td>10000yuan</td>
<td>Person-month</td>
</tr>
<tr>
<td>Sujiatun</td>
<td>125.00</td>
<td>37.50</td>
<td>1.70</td>
</tr>
<tr>
<td>Xiaodong</td>
<td>78.00</td>
<td>23.40</td>
<td>3.00</td>
</tr>
<tr>
<td>Zhangwu</td>
<td>108.50</td>
<td>32.55</td>
<td>5.00</td>
</tr>
<tr>
<td>Changtu</td>
<td>90.00</td>
<td>27.00</td>
<td>3.50</td>
</tr>
<tr>
<td>Lingyuan</td>
<td>90.00</td>
<td>27.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

(2) The training contents of this project are as follows: the PMP and its complementation, relevant policies about pesticide application; identification of major pests, the rule of pests’ occurrence as well as their natural enemies; major strategies and integrated technologies for pests’ prevention and control; techniques about the selection and safe application of pesticide; safe storage and disposal of agricultural chemicals and their packing wastes; the application of chemical pesticide as well as requirements of safety protection; the maintenance and management of spraying equipments, etc. The average training item involves 581.50 person-month with a total cost of 1,744,500 yuan, the average technical assistance 18.7 person-month with a total cost of 448,800 yuan, the sum of farmers training and technical assistance is 2,193,300 yuan, detailed budget for farmers training and technical assistance is given in Table 10.
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<table>
<thead>
<tr>
<th>Lianshan</th>
<th>90.00</th>
<th>27.00</th>
<th>2.50</th>
<th>6.00</th>
<th>33.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>581.50</td>
<td>174.45</td>
<td>18.70</td>
<td>44.88</td>
<td>219.33</td>
</tr>
</tbody>
</table>

(3) The monitoring of project will last for 5 years with the 17 towns in 6 counties as the first-year key emphasis in work. During the work, basic data investigation will be carried out in 34 villages with 2 of them selected by each town, the budget for the investigation in each village is 1500 yuan, thus the total will be 51,000 yuan. The follow-up investigations are as follows: investigation in crops yield, amount of pesticide, the growth and decline of natural enemies, etc. with annual 1000 yuan for each village and 85,000 yuan as a total for 5 years; the detection of pesticide subsides in agro-products with 1000 yuan each sample and 255,000 yuan as a total for annual 3 samples of each town lasting for 5 years; investigation in pesticide poisoning with annual 600 yuan for each town and 5,1000 yuan as a total for 5 years; other types of training, the monitoring cost of instruments for physical prevention as well as the subsidy for biological control and resistant varieties being 5,8000 yuan. In the end, the total budget for monitoring work is 500,000 yuan, and the detailed budget is given in table 11.

<table>
<thead>
<tr>
<th>Table 11</th>
<th>Detailed prevention and control</th>
<th>unit (10000 yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>Range</td>
<td>Budget</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Basic data investigation</td>
<td>17 towns and 34 villages in 6 counties</td>
<td>5.1</td>
</tr>
<tr>
<td>2. Follow-up investigation (yield, amount of pesticide, natural enemies, etc.)</td>
<td>Random investigation of 17 towns and 17 villages (1-2 times a year)</td>
<td>8.5</td>
</tr>
<tr>
<td>3. Pesticide subsides</td>
<td>Random investigation of 17 towns and 34</td>
<td>25.5</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th></th>
<th>villages (3 times a year)</th>
<th>5.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Pesticide poisoning</td>
<td>Random investigation of 17 towns and 34 villages (once a year)</td>
<td>5.8</td>
</tr>
<tr>
<td>5. Others (monitoring of training, instrument purchase and 17subsidy’s hand-out)</td>
<td>Random investigation of 17 towns and 34 villages (once a year)</td>
<td>50.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

### 6 Monitoring and evaluation of PMP complementation

POCAD should arrange specialized management personnel and professional technicians who are responsible for the monitoring and evaluation of PMP, some or maybe all of the monitoring and evaluation work can be entrusted to other relevant professional management institutions by administrative institutions of PMP if necessary. The technical advisory team will participate in the monitoring and evaluation work of PMP, and be responsible for technical advisory and training, as well as the acceptance inspection of 6 project counties.

**6.1 Responsibility of monitoring and evaluation personnel**

Establishing a sound working system, and respective sub-PMP monitoring and evaluating work system based on the technical criteria, regulations, requirements and annual monitoring and evaluating plan of PMP.

Establishing an inspection tickler system, cooperating with the institutions of planning, statistics and finance of PMP, inspecting the progress of PMP works, the input of capital and material, as well as the results so as to find problems in time and put forward advices for improvement as well as provide reference for future work.
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Completing annual monitoring report of PMP, evaluating and adjusting planning report during the midterm, and completing or cooperating higher management institutions to complete the acceptance inspection of PMP as well as completing the inspection report.

6.2 Procedure of monitoring and evaluating work

With the approval of PMP, its management personnel, professional technicians, accounting and statistical personnel will begin to design specific working system, make monitoring and investigation forms, determine sample farmer households for investigation, sample villages and data measuring spots, and finally collect and submit data from each project area.

Carrying out monitoring and evaluating work of fund allocation, inspecting and analyzing the aspects, amount and results of investment, and finally giving year-end reports.

Carrying out monitoring and evaluating work about producers’ consciousness of IPM, productivity and ecological benefits, meanwhile personnel in charge should make a wide investigation in fundamental condition of agriculture, and a good sample survey of villages and towns, and finally make a contrastive analysis to find the economic and ecological benefits of PMP

When the plan being adjusted during midterm, the original plan of PMP, its complementation and its initial effects should be evaluated and analyzed so as to put forward the necessity of midterm adjustment as well as detailed adjusting plan.
When PMP completed, management institutions at all levels should carry out an overall inspection over the completion of their own PMP, hand in a complete acceptance report, and cooperate higher management institutions to finish acceptance inspection as well as corresponding acceptance reports.

POCAD will put forward a general annual report and a midterm evaluating report of PMP based on the reports and data from all the 6 counties in combination with typical investigations, and cooperate corresponding institutions to complete acceptance report after the complementation of PMP.

6.3 Contents of monitoring and evaluating work

The coverage of PMP

The coverage of PMP in each county will be checked with the following checking contents: crop types of comprehensive control, location of control, what kind of IPM techniques and what kind of products taken.

The number of farmers trained by PMP

Training quality and effects, as well as the number of farmers trained by PMP will be checked in to secure the number and time of training. Finally, a survey of trainees on training effects will be carried out.

The amount of instruments for physical prevention and control

The amount, the quality and the application of instruments for physical prevention will be checked in to make sure where and how each instrument is used.

The coverage of biological prevention
The quantity and quality of biological pesticide will be inspected, and the coverage of biological products will be calculated so as to secure a reasonable application of supplies.

The changes of pesticide consumption

A follow-up investigation in the variety, the quantity and safe application of pesticide will be carried out before, during and after the complementation of PMP, then the results will show the change of variety and the application times of pesticide, as well as the change of pests’ natural enemies and pesticide poisoning incidents before and after the complementation of PMP.

Pesticide residues

Before, during and after the complementation of PMP, the quantity of natural enemies, the quality of air and underground water, and pesticide residues in agro-products will be inspected and evaluated to realize an ecological effect.
### Annex 1  Plan of pest control

### A  Mitigation measures

<table>
<thead>
<tr>
<th>Items</th>
<th>Potential effects on environment and health</th>
<th>Suggested mitigation measures</th>
<th>Institutions/staff in charge</th>
<th>Budget cost (10000yuan)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. publicity of IMP 2. IMP of grains, vegetables &amp; oil plants 3. application of resistant varieties 4. PMP (the training of instructors, farmer field schools, mobile training team)</td>
<td>1. improper and over storage or application of pesticide 2. poisoning caused by application of high-toxic pesticide 3. poisoning caused by improper storage of remainder pesticide 4. disease epidemic and increase of pesticide caused by farmers’ lack of recognition of resistant varieties 5. lack of PMP consciousness, lack of knowledge and capacity of PMP</td>
<td>1. improving the monitoring and forecast of pests, and the supervision of pesticide 2. a comprehensive pest control based on agricultural measures with an import of biological and botanical pesticide as well as insecticide lamps to reduce chemical pesticide 3. purchasing instruments for physical and biological control 4. a ban of pesticide of WHOI types (1A,1B) 5. trainings for farmers on how to store and use pesticide to improve their using and storing capacity 6. cooperating with local quality supervision institutions to enforce the supervision of pesticide sale and application 7. trainings for farmers, technicians, pesticide dealers on PMP provided by county project offices</td>
<td>1. county project offices 2. technicians from county technology promotion stations 3. farmers from cooperative institutions and demonstration households 4. technicians from county plant protection stations 5. planting cooperative and major producers 6. training institutions of provincial project offices 7. experts for mobile trainings</td>
<td>1490.18</td>
<td>The coverage of IPM is 12272.7hm², and the budget cost is 13,157,300yuan; the cost of training is 1,744,500yuan, and the total average is 581.50 person-month,</td>
</tr>
</tbody>
</table>
### B Monitoring

<table>
<thead>
<tr>
<th>Mitigation measures</th>
<th>Monitoring index</th>
<th>Monitoring location</th>
<th>Monitoring methods</th>
<th>Monitoring frequency</th>
<th>Party in charge</th>
<th>Cost (10000yuan)</th>
</tr>
</thead>
</table>
| 1. IPM              | 1. number of major resistant varieties  
2. area of resistant varieties  
3. distribution of resistant varieties  
4. area of other agro-prevention measures                                                                                                             | 17 towns of 6 counties               | 1. A field and to-the-door questionnaire with arranged investigators                | Once a year          | County and provincial project offices                                            |                  |
|                     | 2. Biological control  
3. physical control                                                                                                                                           |                                      | 2. A field and to-the-door questionnaire with arranged investigators                | Once a year          | County project offices                                                            |                  |
|                     | 5. variety and quantity of biological pesticide  
6. where and how biological pesticide is used  
7. where and how many insecticide lamps are used  
8. application of insecticide lamps  
9. incidence of a disease                                                                                                                                   | 34 village of 17 towns in 6 counties |                                                                                  |                      |                                                                                 |                  |
|                     | 10. the application of high-toxic pesticide  
11. change of natural enemies  
12. detection of air and underground water  
13. crop yield and quality, pesticide residues, poisoning incidents  
14. legal certificates of pesticide dealers                                                                                                             | 34 village of 17 towns in 6 counties | 3. Inspection of air, water and agro-products based on national standard  
4. investigation in natural enemies and pesticide by county plant protection stations                                                                 | Once a year          | County project offices and corresponding inspection institutions                  | 50.0             |
| 4. Pesticide residues |                                                                                                                          |                                      |                                                                                   |                      |                                                                                 |                  |
| 5. trainings        | 15. the number of training and the number of farmers participating in IPM                                                                                   | 17 towns of 6 counties               | 5. signing signatures after training  
6. training roster                                                                                                                                             | Once a year          | County and provincial project offices                                            |                  |
### C Institutional construction and training activities

<table>
<thead>
<tr>
<th>I Institutional construction</th>
<th>Parties involved</th>
<th>Arrangements</th>
<th>Party in charge</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Supervision groups for PMP</td>
<td>Supervision group consists of staff from provincial project offices and provincial agricultural institutions</td>
<td>Supervision groups are established with the startup of project and supervise the implementation of PMP.</td>
<td>Provincial project offices</td>
<td></td>
</tr>
<tr>
<td>2. Advisory panel for PMP</td>
<td>Advisory panel consists of staff from provincial institutions of scientific research and technology promotion</td>
<td>Advisory panel is established with the startup of project and give support to the implementation of PMP.</td>
<td>Provincial project offices</td>
<td></td>
</tr>
<tr>
<td>2. County project offices</td>
<td>County project offices consist of staff from COCADs</td>
<td>County project offices are established with the startup of project and give support to the implementation of PMP.</td>
<td>OCADs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II Training activities</th>
<th>Participants</th>
<th>Training methods</th>
<th>Training contents</th>
<th>Time arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Training of grassroots technicians</td>
<td>Farmers in demonstration sites, Pesticide dealers, Technicians from plant protection stations and technology promotion institutions, Provincial scientific research institutions, County project offices</td>
<td>Mobile trainings, Participatory trainings, Presentation trainings</td>
<td>PMP Techniques of PMP, Application and management of pesticide</td>
<td>2013 ~ 2017</td>
</tr>
<tr>
<td>2. Farmer field schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Team for mobile training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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### D  Time arrangements

<table>
<thead>
<tr>
<th>Activities</th>
<th>1st year</th>
<th>2nd year</th>
<th>3rd year</th>
<th>Etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
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<td></td>
<td>Q1</td>
<td>Q2</td>
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<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>A Mitigation measures</td>
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</tr>
<tr>
<td>1. The promotion of PMP technology, including the introduction of biological and botanical pesticide</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>2. Providing trainings to farmers on how to store and use pesticide to improve their using and storing capacity</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>3. Providing PMP and capacity trainings to farmers from demonstration sites, technicians from technology promotion stations, pesticide dealer and staff from county project offices</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>B Monitoring</td>
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</tr>
<tr>
<td>1. The promotion of PMP technology, including the introduction of biological and botanical pesticide</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>2. Providing trainings to farmers on how to store and use pesticide to improve their using and storing capacity</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
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<td>3. Providing PMP and capacity trainings to farmers from demonstration sites, technicians from technology promotion stations, pesticide dealer and staff from county project offices</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>C Enforcement of institutions</td>
<td></td>
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<tr>
<td>1. Establishing supervision groups &amp; advisory panel</td>
<td>x</td>
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<tr>
<td>2. Establishing county project offices</td>
<td>x</td>
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</tbody>
</table>
## Annex 2 Public inquiry

Each county project office held public inquiries from July, 20, 2012 to secure an earnest implementation and optimum efficiency of PMP, the parties involved are COCADs, agricultural administrative institutions of each county, agro-technology extension institutions at county or town levels, some agricultural cooperative institutions, and all the 90 agro-technology demonstration households in our province, the questions put forward and corresponding replies are listed as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Parties involved</th>
<th>Feedbacks</th>
<th>Reply</th>
</tr>
</thead>
<tbody>
<tr>
<td>From July, 20, 2012</td>
<td>COCADs</td>
<td>If PMP can be carried out as planed, if fund priority will be given to the research and promotion of PMP, if the consciousness of policy implementation will be improved</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Agricultural administrative institutions</td>
<td>If the capacity of IPM and basic plant protection will be improved</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Agro-technology extension institutions</td>
<td>If grassroots technicians in charge of agro-technology extension will be provided with professional training and perfect themselves in IPM, if technology innovation, demonstration and promotion of science and technology will be improved</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Agricultural cooperative institutions</td>
<td>If more support and trainings will be given to professional and agricultural cooperative institutions and corresponding farmers, if more trainings and inspections on pollution-free products will be improved</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Agro-technology demonstration households</td>
<td>If the identification of major pests, a reasonable strategy of control, a safe application of pesticide, the training and demonstration of new technology will be given</td>
<td>Yes</td>
</tr>
</tbody>
</table>