World Bank Loan Funded Turpan Water Conservation Project
Xinjiang Uygur Autonomous Region, P.R.China

Pest Management Plan


Prepared by: Environmental Expert Panel for World Bank Loan Funded Project in Turpan Prefecture, Xinjiang Uygur Autonomous Region

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Executing Agency: World Bank Loan Project Office under Water Resources Bureau of Turpan Prefecture, Xinjiang Uyghur Autonomous Region

Evaluation Agency: Environmental Expertise for World Bank Loan Project in Turpan Prefecture, Xinjiang Uyghur Autonomous Region

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8.2 MONITORING ACTIVITIES DURING THE SUPERVISION PERIOD

8.3 MONITORING AND SUPERVISION PLAN

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATESC</td>
<td>Agricultural technology extension and service center</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical oxygen demand</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>GB</td>
<td>Chinese National Standard</td>
</tr>
<tr>
<td>IPM</td>
<td>Integrated pest management</td>
</tr>
<tr>
<td>NH$_3$-N</td>
<td>Ammoniacal nitrogen</td>
</tr>
<tr>
<td>PMO</td>
<td>Project management office</td>
</tr>
<tr>
<td>PMP</td>
<td>Pest management plan</td>
</tr>
<tr>
<td>TP</td>
<td>Total phosphorus</td>
</tr>
</tbody>
</table>
Introduction

The World Bank Loan Project of Water-saving Irrigation in Turpan Prefecture (hereafter as the Project) aims at upgrading the irrigation patterns in Turpan Prefecture (hereafter as Turpan) by means of varieties of hydraulic construction, so that the backward irrigation will have a basic change for the better, the water demands in agriculture will be reduced, the water supply for industrial development will be better ensured and there will be less exploitation of the ground water to alleviate the problem of ground water over-use.

1.1. Project Components

(1) Engineering Construction

(1-1) Projects of reservoir construction: Meiyaogou Reservoir, Ertanggou Reservoir and Alagou Reservoir;

(1-2) Projects for the construction and improvement of canals: Ta’erlang Branch Canal, Alagou Main Canal and anti-seepage in Ertang Branch Canal;

(1-3) Projects of water-saving in Turpan City, Shanshan County and Tuokexun; and

(1-4) Protection of karez well system in Wudaolin.

(2) Management and Capacity Building

(2-1) Project for the integrated management of water resource and environment in catchments; and

(2-2) Institutional capacity building: (i) project monitoring and evaluation, (ii) information management system, (iii) program of operation and maintenance, (iv) development of water users association, (v) office equipments and vehicles, and (vi) policy formulation and research.

1.2. Agricultural Project

1.2.1. Brief Introduction

The agricultural project is that of water-saving irrigation. The Project will cover 10,760 ha in Turpan City and 2 counties under the administration of Turpan Prefecture. After the completion of the project, the traditional irrigation nowadays (surface irrigation) will be replaced by drip irrigation and low-pressure irrigation. The details are illustrated in Table 1.2-1, 1.2-2 and 1.2-3.
Table 1.2-1. Distribution of the Water-saving Irrigation Project in Turpan City

<table>
<thead>
<tr>
<th>Project Townships</th>
<th>Area of Water-saving Irrigation (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grape drip irrigation</td>
</tr>
<tr>
<td>Ya’er</td>
<td>333.33</td>
</tr>
<tr>
<td>Aidinghu</td>
<td></td>
</tr>
<tr>
<td>Qiatekele</td>
<td></td>
</tr>
<tr>
<td>erpu</td>
<td></td>
</tr>
<tr>
<td>Sanpu</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>333.33</td>
</tr>
</tbody>
</table>

Table 1.2-2. Distribution of the Water-saving Irrigation Project in Shanshan County

<table>
<thead>
<tr>
<th>Project Townships</th>
<th>Area of Water-saving Irrigation (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Grape drip irrigation Cotton drip irrigation Melon + cotton drip irrigation Greenhouse</td>
</tr>
<tr>
<td>Qiketai</td>
<td>481 210.7 270.0</td>
</tr>
<tr>
<td>Tuyugou</td>
<td>667 180.0 486.7</td>
</tr>
<tr>
<td>Lukexin</td>
<td>557 200.0 224.0 133.3</td>
</tr>
<tr>
<td>Dikan’er</td>
<td>474 331.3 142.5</td>
</tr>
<tr>
<td>Lianmuxin</td>
<td>133.3 133.3</td>
</tr>
<tr>
<td>Dalangkan</td>
<td>572 306.8 264.9</td>
</tr>
<tr>
<td>Dongbazha</td>
<td>13.3 13.3</td>
</tr>
<tr>
<td>Pizhan</td>
<td>394 90.6 302.9</td>
</tr>
<tr>
<td>Chengzhen</td>
<td>46.7 46.7</td>
</tr>
<tr>
<td>Total</td>
<td>3338.3 1512.7 572.9 1118.1 133.3</td>
</tr>
</tbody>
</table>

Table 1.2-3. Distribution of the Water-saving Irrigation Project in Tuokexun County

<table>
<thead>
<tr>
<th>Project Townships</th>
<th>Area of Water-saving Irrigation (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Chinese red dates Apricot Cotton Windbreak Greenhouse</td>
</tr>
<tr>
<td>Guolebuyi</td>
<td>1027.1 189.3 125.1 44.9 667.8</td>
</tr>
<tr>
<td>Xiaxiang</td>
<td>348 11.1 336.9 330.8 336.9</td>
</tr>
<tr>
<td>Yilahu</td>
<td>355.3 330.8 24.5</td>
</tr>
<tr>
<td></td>
<td>684.7 655 29.7</td>
</tr>
<tr>
<td>Bositan</td>
<td>312 290.5 21.5</td>
</tr>
<tr>
<td></td>
<td>681.6 660.1 21.5</td>
</tr>
<tr>
<td>Total</td>
<td>3408.7 1465.6 125.1 660.1 153.2 1004.7</td>
</tr>
</tbody>
</table>

1.2.2. Project Features
The Project will be implemented in Turpan City and 2 counties under the administration of Turpan Prefecture. As is illustrated in Table 1.2-1, 1.2-2 and 1.2-3, the project will be constructed in almost all the townships under the administration of the said city and counties. This implies that the project will be scattered in a large area but an individual project area will be relatively small.

1.3. Concept of Integrated Pest Management (IPM)

IPM in agriculture can be practiced in 3 closely related steps, i.e. prevention, monitoring and intervening. In this strategy, varieties of pest control measures are inter-complemented, such as agricultural measure, physical measure, ecological measure and chemical measure. Therefore, IPM is related with ecological and management methodologies. The purpose is to effectively reduce or even eliminate the use of pesticide in favor of natural environment and ecological environment.

The Project will support IPM in the following aspects:

- With IPM, the pests will be kept below the tolerable level of economic loss, but it does not mean that the pests will be eliminated;

- Whenever possible, non-chemical measures will be used for pest control, so that the total population of the pests is kept at low level; and

- When it becomes necessary to use pesticide, all the efforts will be made to minimize the possible impact of the chemical control on the beneficial life-forms, human beings and ecological environment. The pesticide and its application measure will be carefully selected and practiced.

1.4. Purpose of IPM in the Project

Under the precondition that the quantity and quality of the agricultural production are assured, water-saving irrigation will be practiced in the Project to reduce the per-hectare water use. As is presented in Chapter 1.2, the water-saving irrigation in the Project will cover 10,760 ha, including 4,600 ha in greenhouses. Generally speaking, cultivation in greenhouse implies heavier load in pest control than in open farmland. Therefore, the project implementation will probably result in changes in the input quantity and application measures of agricultural chemicals such as chemical fertilizers, pesticides and herbicides. The Project will pay attention to the potential impacts thus generated and try to alleviate the impacts by extending more effective agro-chemicals and application measures in the agricultural production. In addition, pest control technology with more environment-sound features will be imported, developed and extended, so that both the cultivation area and yield of green-food production will be pushed forward at the same pace of water-saving irrigation in Turpan.
The pest management plan will be implemented throughout the water-saving irrigation project areas in Turpan. Physical and biological measures for pest control will be extended so as to lower the dependence on chemicals. Nowadays, the plant protection stations/center and agricultural technology extension and service stations/center at county and prefecture levels are extending IPM throughout Turpan.

To sum up, the implementation of the pest management plan will accelerate the use of biological and ecological measures in pest control so as to lower the dependence on chemicals. Therefore, it is necessary to formulate pest management plan for the project.

**Present Situation of Pest Management in Turpan**

**Prefecture**

**Existing and Foreseen Problems of Pests**

Table 2.1-1. Agricultural Production in the Project Area

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area</th>
<th>Main Pests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mu</td>
<td>ha</td>
</tr>
<tr>
<td>Grapes</td>
<td>27690.45</td>
<td>1846.03</td>
</tr>
<tr>
<td>Cotton</td>
<td>23495.10</td>
<td>1566.34</td>
</tr>
<tr>
<td>Melon + cotton intercropping</td>
<td>16771.50</td>
<td>1118.10</td>
</tr>
<tr>
<td>Chinese red dates</td>
<td>21984.00</td>
<td>1465.60</td>
</tr>
<tr>
<td>Apricot</td>
<td>1876.5.00</td>
<td>125.10</td>
</tr>
<tr>
<td>Greenhouse</td>
<td>69612.00</td>
<td>4640.80</td>
</tr>
<tr>
<td>Total</td>
<td>161429.55</td>
<td>10761.97</td>
</tr>
</tbody>
</table>

**Present Situation of Pest Control in the Project Area**

2.2.1. Grapes

(1) Chemical Control

Nowadays, the pests in the vineyards in Turpan are managed under the combination of prevention with control. The concrete measures include:
(1-1) Prevention: Before the budding, the vines are sprayed with calcium polysulfide (liquid of 200 times), which is effective to prevent varieties of pests in vineyards.

(1-2) Good results of pest prevention and control are achieved on the basis of pest monitoring and timely action. According to the features of climate and pest incident in Turpan, the pests in vineyards are managed 3 times annually. They are:

- **The 1st control in early spring:** For the vineyards that suffer from serious damages by spotted leafhoppers, chemical control is practiced in late April. The pesticides include 25% Actara WDG (7500-10000), 70% imidacloprid WDG (7500-10000), 10% imidacloprid WP (1500-2000), 3% acetamiprid EC (2000), 5% Natural Pyrethrin EC (800-1000), 10% Matrine-Nornicotine EC and other efficient low-toxicity chemical pesticides or bio-pesticides.

- **The 2nd control from late May to early June:** This period should pay attention to the control of the 1st generation of spotted leafhopper nymphae. The pesticides are the same as those in the spring. To control Eriophyes vitis from late May to early June, the pesticides include 0.3% Azadirachtin (800-1000) and 10% Liuyangmycin (1000-1500).

- **The 3rd control from middle September to early October:** Before the vines are buried for over-wintering, control measures should be taken to lower the basic population of the pests in over-wintering. The pesticides are the same as those from late May to early June.

Note: Turpan ATESC recommends to alternatively or rotationally use pesticides to prevent drug resistance. The pesticides of organic compound should be used only once in a growing season. In the period from late June to grape harvesting, no pesticide is used in a vineyard.

(2) Pest Prevention and Control by Farming Practices

(2-1) Viniculture management is strengthened, fertilizers (especially barnyard manure) and water is timely applied and the production load is reasonably distributed, so that the vines are growing healthy for higher resistance to pests.

(2-2) Reasonable and timely de-budding and pruning is practiced to reduce the leaves at the lower part for better conditions of aeration and light.

(2-3) Timely weeding in the growing season is to damage the ecological conditions of pest incident, while regular cleaning in winter are helpful in reducing the population of the over-wintering pests.
(3) Physical Control

Spotted leafhopper adults are strongly attracted by yellow color. Yellow boards are very effectively in trapping spotted leafhopper adults. The environment sound measure is featured with safety use, low cost and easy operation. Yellow boards can be hung by 300–450 pcs/ha immediately after the soil over the vines is removed. This technology has been extended to most of Turpan Prefecture.

(4) Biological Control

The measure of biological control against vinicultural pests nowadays in Turpan is the protection and utilization of the natural enemies.

2.2.2. Cotton

(1) Chemical Control

When pest incident is relatively serious, the pests are controlled by brushing the pesticide liquid over the stems, dropping the liquid into the flower or other measures. For the farmland that is rather seriously infected with Bemisia tabaci in the late growing season, the pesticides to be used include 1.8% Abamectin (2000), 25% Actara WDG (7500~10000), 70% imidacloprid WDG (7500~10000) and 3% acetamiprid EC (2000).

(2) Pest Prevention and Control by Farming Practices

Autumn ploughing and winter irrigation are practiced to lower the basic population of the over-wintering pests. The crop should be timely sown. The management of fertility and water should be strengthened and the growing rhythm should be properly controlled, so that the crop can grow healthy with higher resistance to the pests. In addition, measures of timely trimming and pest egg elimination are taken.

(3) Physical Control

Yellow boards (40x50 or 40x60 cm) coated with grease or machine oil are erected at intervals of 40–60m along the boundaries of a farmland. They are hung 30 cm above the plants. The grease or machine oil is regularly renewed for higher sticky effect on wing aphids.

(4) Biological Control

Turpan is very rich in the resources of natural enemies against cotton pests. They include Chrysopa carnea, ladybugs and spiders. In the early growing season, aphids can be effectively controlled by the natural enemies. Therefore, chemical control in
the early growing season should be avoided (if applicable) to protect and utilize the natural enemies.

2.2.3. Melon-Cotton Intercropping

According to the surveys, there are following major pests against sweet melons in Turpan: (i) diseases: downy mildew, powdery mildew, Phytophthora root rot, Fusarium wilt of melon and virus diseases; (ii) insect pests: aphids, spider mites and Gryllotalpa; (iii) weeds: Orobanchaceae.

(1) Chemical Control

Before plant setting, pesticide is sprayed to kill the over-winter pest adults. When the adults begin to act in late April, 90% Crystal Trichlorfon (1000) or 50% Dichlorvos (1000) is sprayed. In the hatching period in late May, 90% Trichlorfon (1500~2000) is applied to the root. For late varieties, another application is done 10 days after.

(2) Pest Prevention and Control by Farming Practices

The farmland is kept clean. Weeds are cleared and the farmland is deep ploughed. These are effective measures to damage the habitat of the over-wintering pests.

(3) Physical Control

- In early spring, scattered insect pests can be caught manually; and
- Due to the fact that adult would lay eggs at wet place rather than dry place, lime, sawdust or rice hull ash can be spread around the sweet melon to prevent the adult from laying eggs close to the melon.

(4) Biological Control

The protection and utilization of the natural enemies is strengthened.

2.2.4. Fruit Trees

(1) Chemical Control

Pesticides are timely applied at the peak of adult formation. The pesticides to be used include 5% Avermectins (5000) or 25% pyridaben (3000).

(2) Pest Prevention and Control by Farming Practices
The plantation is kept clean. The old bark is removed and burned in winter or early spring to kill the over-wintering larvae.

(3) Physical Control

- Straw bundles are attached to tree trunks and main branches to attract over-wintering pests, which are removed and burnt before the pests come out the next spring.

- Sex traps are hung in the plantations at the rate of 225 pcs/ha or one set per 30 trees.

- Oriental fruit moths can be attracted by black light lamp as well as smells of sugar, vinegar and liquor. The ingredient proportion of the attracting liquid is 5 shares of brown sugar, 20 shares of vinegar, 3 shares of liquor and 80 shares of water.

(4) Biological Control

The protection and utilization of the natural enemies is strengthened.

2.2.5. Greenhouses

(1) Chemical Control

To control the pests in greenhouses, pesticides with efficient low-toxicity and low residues are selected (or the pesticides that are allowed in green-food production). The application measures include spraying, fumigating and root application.

Considering the fact that some of the pests such as Bemisia tabaci and cotton aphids take greenhouses as over-winter shelters, efforts of pest control are made at these places in winter and spring to reduce the basic population of the pests. The pests on vegetables are controlled mainly by fumigating and supplemented with spraying, while root application can be practiced over the pests on flowers.

(2) Pest Prevention and Control by Farming Practices

The farming practices in pest control include (i) the use of disease resistant varieties, (ii) seed disinfection, (iii) extension of grafting and transplanting technology in watermelon cultivation, (iv) more barnyard manure, reasonable irrigation and proper cultivation management for healthier plants with higher resistance to pests, and (v) technical extension of cultivation on ridges and drip irrigation under plastic film mulching in greenhouse cultivation.
(3) Physical Control

In greenhouse cultivation, pests can be controlled with physical measures such as (i) the extension of pest-proof nets, (ii) yellow board trap (for controlling aphids, Bemisia tabaci, whiteflies and leaf miners), and (iii) silver-gray film to drive aphids.

(4) Biological Control

.metamodel

Downy mildew and some of the other pests in greenhouses can be controlled by ecological measures such as high-temperature fumigation.

Natural enemies can be released in greenhouses. For example, predatory mites can be released to control harmful mites, while Encarsia Formosa can be used to control whiteflies.

**Total Use of Pesticides**

2.3.1. General Description

According to the relevant regulations in China, high-toxicity pesticides are forbidden in the cultivation of vegetables, fruits and other crops. However, investigations show that some of the virulent pesticides forbidden in policy are still in use by some of the farmers. Herbicides are widely used. But some farmers are still short of the knowledge that herbicides can impact soils and ground water.

2.3.2. Management of Pesticides

In June 1982, Ministry of Agriculture, Animal Husbandry and Fishery and Ministry of Public Health (PRC) co-promulgated Regulations on the Safe Use of Pesticides. In the field investigations and interviews, it was observed that most of the farmers did not manage pesticides according to the relevant regulations. For instance, pesticide is stored close to food; pesticide is placed accessible to a child; protection clothing and gloves are not used when applying pesticides, sprayers and other equipments or facilities are not properly used or managed.

These indicate that the policies and regulations on the safe use of pesticides have not been extended in Turpan. Therefore, technical training and information publicity is required for the safe use of pesticides.

**Overall Evaluation of the Present Situation of Pest Management**

The ecological environment in Turpan is complex and varieties of crops are cultivated. Due to the very dry and hot conditions, the pest incident in Turpan is much less than in the other places. For the same crop, therefore, the quantity of pesticide use in
Turpan is much less than in the other places. As early as in 2002, Turpan was recognized as one of the national production bases for pollution-free grapes. In 2008, Turpan City and Shanshan County were recognized by Ministry of Agriculture (PRC) as national bases for standardized production of green-food seedless grapes, and Shanshan County was further recognized as national bases for standardized production of green-food honey melon. From 2007 to 2008, grapes, honey melons, water melons, chili peppers, cucumbers, tomatoes and others agricultural products from Turpan were frequently recognized as Grade-A green-food products.

Insect pests are the major pests in Turpan agriculture. Therefore, insecticide is the main pesticide used in Turpan. There are following problems in the management of insect pests in Turpan:

- Dependence on chemical control. This is true especially for large areas of monocultured cops such as cotton;
- Harmful chemicals and their packing materials are often not properly managed. There exist some potential hazards in this aspect;
- At limited individual cases, the use of high-toxicity chemicals is observed;
- The enforcement of the legal regulations on the sales and good labeling practice for agricultural chemicals is insufficiently implemented;
- The farmers and even some technicians are not sufficiently aware of the importance of IPM; and
- The awareness of safety use of pesticides is not sufficient.

**Policy, Management-Supervision Framework and Institutional Responsibility**

**Domestic Policies of Plant Protection and IPM**

The domestic policies of plant protection and IPM are illustrated mainly in the following documents:

1. Regulations of the People’s Republic of China on Pesticide Administration (the State Council, Nov 2001);
2. Regulations on the Safe Use of Pesticides (Ministry of Agriculture, Animal Husbandry and Fishery and Ministry of Public Health, June 1982);
(3) Measures for Implementing Regulations on Pesticide Management (Ministry of Agriculture, July 2004);

(4) Regulations on the Management of Non-Pollution Agricultural Products (Ministry of Agriculture and General Administration of Quality Supervision, Inspection and Quarantine, Apr 2002);

(5) Standard for the Safe Use of Pesticides (GB 4285-89, Ministry of Environmental Protection, Sep 1986);

(6) Standard for the Safe Use of Pesticides (GB 8321.2-1987, Ministry of Environmental Protection, Sep 1986);

(7) Guidelines on the Use of Pesticides in Green-food Production (NY/T393-2000);

(8) Maximum Residue Levels of Pesticides Permissible in Food (GB2763-2005);

(9) Determination of Organophosphorus Pesticide Residues in Food (GB/T 5009.20-2003); and

(10) Directory of the 37 Items of Virulent and High-Toxicity Pesticides Forbidden in Xinjiang (June 2008.

Management-Supervision Frame and Institutional Responsibility

3.2.1. Management-Supervision Frame in Turpan
ATESCs at prefecture and county levels are responsible for the technical extension and services and information publicity on agricultural production and pest management in the respective administration scopes; and

Turpan Agricultural Law Enforcement Bureau is responsible to guide and supervise the sales of agricultural chemicals and to carry out the legal enforcement of the relevant regulations.

3.2.1. Institutions of Pesticide Residue Detection in Turpan Prefecture

Fig 3.2-2. Intuitional Chart of Pesticide Residue Detection in Turpan Prefecture

Turpan takes agriculture as her leading industry. It is also famous in the production of grapes, honey melons and other quality fruits with local specialty. Therefore, Turpan has been paying attention to pest management. To enlarge the acreage of green-food cultivation in recent years, Turpan has made progress in IPM and the quantity of agro-chemical use is decreasing. However, because the number of technical staff in all levels of agricultural extension and service institutions in Turpan is limited, the research and extension of physical and biological measures in pest control is progressing very slow. The measures of physical and biological control in use nowadays are simple and not comprehensive. Thus, the effect is not so satisfactory. In addition, the information publicity and application of IPM are deficient.

To solve the above problems, the following actions are proposed:

- Technical training will be strengthened to upgrade the professional capacity of all levels of technicians;
- Basic knowledge of pest control will be extended on the basis of local situation and farmers’ need;
- Training materials of practical technology in both Chinese and Uyghur languages will be prepared, printed and distributed. And they will be supplemented with video materials and devices necessary; and
The agricultural sector will intensify the support to IPM research for the major crops.

System for the Distribution and Use of Agricultural Chemicals

The production, distribution and use of the agricultural chemicals listed as dangerous substances are managed and supervised by the industrial and commercial institutions as well as quality supervision bureaus of prefecture and county levels in Turpan. Any company or enterprise that produce or distribute agricultural chemicals must be awarded with stipulated certificate. These companies and enterprises include:

- The management units of agricultural production materials within the framework of the Supply and Marketing Cooperatives;
- Plant protection stations;
- Stations of soils and fertilizers;
- Institutions of agricultural technical extension and service;
- Forest protection stations;
- Enterprises of agricultural chemical production;
- Turpan Prefecture Agricultural Research Institute; and
- Other units in line with the stipulations of the State Council.

Objectives and Key Points of Pest Management Plan in the Project of Water-saving Irrigation in Turpan Prefecture

Objectives

The objectives of formulating the pest management plan include:

- Pushing forward the research, development and extension of biological control technology and gradually reducing the dependence on pesticides and other agricultural chemicals;
- Preventing farmers from any use of virulent agricultural chemicals;
Key Points of Pest Management

The key points in the pest management plan include:

(1) At the same time when the project of water-saving irrigation is implemented, information publicity will be strengthened on the pest control with biological measures and the use of low-toxicity pesticides. Efforts will be made in reducing the impacts of pesticides on regional ground water, soils and other environmental factors;

(2) The environment-sound measures of pest control will be integrated into the training program of the Project and be demonstrated throughout the project area; and

(3) The production base of non-pollution and green-food agricultural products will be enlarged.

Recommended Measures of IPM in the Project

Objectives

(1) Using pesticides of low-toxicity and environment-sound features;

(2) Reducing the accessibility of farmers to agricultural chemicals with low quality or poor labeling practice;

(3) Pushing forward the safe use and management of agricultural chemicals;

(4) Accelerating the awareness, recognition and application of IPM;

(5) Reducing environmental pollution due to improper use of pesticides; and

(6) Reducing the health risks due to the application and management of pesticides.

Recommended Measures of IPM

5.2.1. Farming and Physical Measures
As is illustrated in Chapter 2.2, the farming and physical measures for pest control include:

(1) Rotational cropping to damage pest habitats;

(2) Viniculture management is strengthened, fertilizers (especially barnyard manure) and water is timely applied and the production load is reasonably distributed, so that the vines are growing healthy for higher resistance to pests;

(3) Reasonable and timely de-budding and pruning is practiced to reduce the leaves at the lower part for better conditions of aeration and light;

(4) Timely weeding in the growing season is to damage the ecological conditions of pest incident, while regular cleaning in winter are helpful in reducing the population of the over-wintering pests;

(5) Autumn ploughing and winter irrigation are practiced to lower the basic population of the over-wintering pests;

(6) Leaves and branches that are infected with pests are timely removed and burnt;

(7) Pest traps are arranged such as in greenhouses.

The pest management plan will be formulated on the basis of the actual situation of cropping structures and pest incidents. With the extension of physical and biological measure in pest control, dependence on chemical pesticides will be lowered.

**Biological Measures**

In addition to the current practices of biological measures in pest control (such as the use of natural enemies) as are illustrated in Chapter 2.3, the other measures hereby recommended include:

(1) To improve crop varieties for higher resistance to pests; and

(2) To interplant suitable crops to drive away the pests that are against the major crop.

**Proper Use of Agricultural Chemicals**

Nowadays, chemical control serves as the major measure in pest management in Turpan. Therefore, at the same time when the project of water-saving irrigation is implemented, the use of pesticides should be controlled in the project area so as to reduce the impacts of agricultural chemicals on the environment and public health. The concrete measures recommended will include:
(1) Through technical demonstration, to make the farmers convinced that biological measures can also effectively control the pests;

(2) Through information publicity, to make the farmers know that the use of biological measures is effective in cost efficiency;

(3) Through technical training, to extend the basic knowledge for the safe use of pesticides (e.g. proper use of protection clothing etc.);

(4) To set up emergency system of plant protection to deal with pest epidemic;

(5) When the pest population is up to the critical threshold, to organize pest control with efficient low-toxicity pesticides;

(6) To properly control the dosage of pesticide use with the concept that the pests will be kept below the tolerable level of economic loss, but the control does not mean that the pests will be eliminated;

(7) To apply pesticides with high-efficiency, low-toxicity and low residues in case of need;

(8) To keep the pesticide application at safety intervals;

(9) To properly use the pest control facilities for higher efficiency (e.g. backpack sprayer and nozzle size);

(10) To store pesticides at safety places (e.g. not access to child and far away from food); and

(11) To properly manage the packing materials of pesticides.

In the pest management under the frame of the project implementation, chemical measures must be combined with farming measures, physical measures and biological measures. The use of pesticides must be abided by the principles of cost efficiency, safety and effectiveness. The pesticides to be used must be of high-efficiency, low-toxicity and low residue features. The greenhouses within the frame of the Project will be used mainly for vegetable cultivation. The insecticides to be used in the Project are recommended in Table 5.1-1:

Table 5.1-1. Insecticides Recommended for the Vegetable Cultivation in the Project

<table>
<thead>
<tr>
<th>No.</th>
<th>Major Insects</th>
<th>Low-toxicity Insecticides Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pieris rapae, Plutella xylostella</td>
<td>indoxacarb SC (150/L)</td>
</tr>
<tr>
<td>2</td>
<td>Spodoptera litura</td>
<td>Spodoptera litura nuclear polyhedrosis virus</td>
</tr>
</tbody>
</table>
### Pest Management in World Bank Loan Project of Water-saving Irrigation in Turpan Prefecture

#### Integrated Pest Management

6.1.1. IPM for the Main Crops

(1) Goals and Objectives of Pest Management

The overall goals of pest management are (i) the insect pests are controlled and (ii) the use of chemical pesticides is reduced. The objectives will include:

1) To reduce the loss due to insect pests (less than 5%);
2) To reduce the use of chemical pesticides by more than 10% in 3~5 years;
3) To eliminate intoxication accident due to improper storage of pesticides or improper management of the packing materials;
4) To forbid the use of virulent pesticides (WTO Class-1) and to avoid the incident of the related diseases such as cancer; and
5) To keep the pesticide residue in agricultural product below the thresholds designated by WHO and national authorities.

(2) Principles and Measures of Pest Management

(2-1) Principles:

1) To strength the monitoring and forecast of pests and diseases;
2) To apply suitable measures of pest control, especially farming, physical and biological measures; and
3) To minimize the use and dosage of chemical pesticides.
(2-2) Measures

1) The monitoring and forecast of pests and diseases will be strengthened. 7~10 days before action, the plant protection stations at county and prefecture levels should provide the farmers with information of pest control (including the techniques, suitable time and precautions). At the same time, the above stations should also give timely notices to the plant protection station and institutions in the neighboring counties for joint action and better effect.

2) Pest Prevention and Control by Farming Practices

- To cultivate disease resistance varieties. This is an effective measure to reduce the use and dosage of chemical pesticides;
- To cultivate crops at proper time in a season;
- To improve cropping patterns (including deep ploughing to bury plant garbage, rotational cultivation, timely seeding) to depress pest population;
- To upgrade the health of plantlets. Seeds are selected and poor plantlets are discarded to avoid pest infection;
- To keep farmland health by removing infected crop residues;
- After harvest, the rain-fed farmland should not be deep ploughed to avoid pest over-wintering in soils. The suitable ploughing depth is 26~33 cm; and
- Soil fertility should be built by means of rich basal manure and proper application of chemical fertilizers. More Ca fertilizer but less N and P fertilizers is helpful for upgrading the resistance to insect pests. The crops should be timely irrigated. Advanced irrigation such as drip irrigation can effectively reduce the disease inter-infection among the crops.

3) Physical Measures

- Yellow boards can be used to trap whiteflies and aphids;
- Black light lamps can be used to trap moths, beetles and locusts; and
- Sugar + vinegar liquid can be used to trap moths.

4) Biological Control

- The use of biological pesticides such as nicotine;
The use of natural enemies such as Trichogramma parasitic wasps; and

The use of sex trap to control cotton bollworm, Prodenia litura and Spodopetera exigua.

5) Chemical Control

Proper use of insecticides under the combination of other measures is an effect and cost-efficient approach to higher effectiveness and good harvest. The pesticides of high quality should be featured with high efficiency, low toxicity and safety to human beings, animals and crops. The principles of pesticide management include:

- It is forbidden to use virulent and high-residue pesticides;
- Specified insecticide is used to control specified pests;
- Insecticide is sprayed only when the damage is up to the threshold;
- Insecticide is sprayed at proper dosage;
- Insecticide is replaced by environment-sound measures if applicable; and
- Standard for the Safe Use of Pesticides (GB 4285-89) should be highly respected.

6.1.2. Principles in Selecting Insecticides for the Project of Water-saving Irrigation in Turpan Prefecture

In the pest management under the frame of the project implementation, it is necessary to combine the application of insecticides with farming measures, physical measures and biological measures. The use of pesticides must be abided by the principles of cost efficiency, safety and effectiveness. The Project Management Office will cooperate with the plant protection stations and institutions to work out a list of efficient low-toxicity insecticides

**Insecticide to be Procured by the Project**

No project fund will be used to procure insecticide.

**Environment, Occupation and Health Risks**

6.3.1. Environment Risks
The risks of pesticide use against the environment in the Project mainly include:

1) Pesticide residues can deteriorate soil quality;

2) The pesticide residues in soil can pollute the water body nearby, which will potentially increase the pesticide residues in the aquatic lives in the water;

3) The overflow drain in spraying pesticides can pollute the drinking water resources nearby;

4) Over-use of pesticides can reinforce the drug resistance in pests; and

5) The use of high-toxicity pesticides can generate adverse impact on non-target species, in particularly honey bees, birds, livestock and natural enemies).

Measures to mitigate the above risks will include:

1) Pesticide spraying will properly operated and monitored. No toxic chemicals will be sprayed at the place close to water source. In addition, the local community will be informed of such operation;

2) The spraying equipments procured must be safe in operation; and

3) Varieties of pest control measures (i.e. farming, physical, biological and chemical measures) will be taken on integrated basis to avoid drug resistance in pests.

6.3.2. Health Risk

The risks of pesticide use against health and the mitigation mainly include:

1) Operator must be equipped with protecting mask when applying pesticide with fumigation. Otherwise, the operator would be hurt;

2) If the protective clothing or gloves are broken, the operator would be hurt in spraying pesticides; and

3) If spraying pesticides at the place close to drinking water source, the water body can be polluted.

6.3.3. Mitigation Measures
1) The local communities will be trained with pest control technology. The chemical control measures will be demonstrated among the farmers and the pesticide dealers;

2) It should be avoided to use chemical substance that is harmful to health whenever possible;

3) It is forbidden to use broken protective clothing;

4) The boxes of chemical substances must be properly locked. They should be kept at the place not accessible to child;

5) The packing materials of pesticides must be properly managed; and

6) The management and supervision over pesticide use must be strengthened.

**Capacity Building for Pest Management in the Project of Water-saving Irrigation in Turpan Prefecture**

**Policy Issue**

The following measures will be taken to push forward the pest management in the project:

1) To reduce the use of chemical insecticide. To strictly enforce the laws legal regulations relevant. To punish illegal sales or use of forbidden pesticides;

2) Proposals will be submitted to the Government for intensifying the management and supervision of pesticides;

3) To stop the use of pesticides with low-efficiency, high-toxicity and/or high residues;

4) To highly respect the following regulations:

∂ FAO guidelines for the sales and use of pesticides;

∂ FAO Guidelines for the packaging and storage of pesticides;

∂ FAO Guidelines on good labeling practice for pesticides; and

∂ FAO Guideline on the management of pesticide packing materials.
5) To highly respect the national emission standards for pesticide pollutants (Ministry of Environmental Protection); and

6) To mobilize financial support from the Government of Turpan Prefecture to the research on pest control.

Management Target

7.2.1. Upgrading the Awareness of Policy Implementation

Through the project implementation, the awareness of implementing policies on pest management will be upgraded. This is reflected in the following aspects:

1) The use of chemical insecticide will be reduced throughout the project area;

2) Any pesticide that is not officially registered is forbidden throughout the project area;

3) It is forbidden to use virulent pesticides (WTO Class-1) throughout the project area. In case of need, only pesticides with low toxicity can be used;

4) FAO regulations for the restrictions on pesticide distribution and application will be highly respected (or the legal regulations relevant in China);

5) FAO Guidelines for the packaging and storage of pesticides will be highly respected (or the legal regulations relevant in China);

6) FAO Guidelines on good labeling practice for pesticides will be highly respected (or the legal regulations relevant in China);

7) FAO Guideline on the management of pesticide packing materials will be highly respected (or the legal regulations relevant in China);

8) When FAO guideline or legal regulation relevant in China is not available for certain project item(s), the project will formulate and implement the corresponding guideline; and

9) Pest management plan in the World Bank Loan Project of Water-saving Irrigation in Turpan Prefecture will be implemented.

In addition, all levels of project units are encouraged to push forward IPM through the project implementation.

7.2.2. Reinforcing the Construction of Plant Protection Facilities at Grass-root Levels
Through the project implementation, the construction of plant protection facilities at the grass-root levels will be reinforced. This will be reflected in the following aspects:

1) The technical training on plant protection will be strengthened covering the project farmers and the technicians of all the levels;

2) In the project implementation, the technicians of plant protection will be professionally upgraded in IPM technology and the project farmers will be enriched with IPM basic knowledge; and

3) Through the project implementation, the cooperation among all levels of plant protection stations and institutions in Turpan will be strengthened in favor of the implementation of the pest management plan.

**Infrastructure, Management Capacity, Institutional Arrangement and Cooperation**

The project will intensify the management of the sales and use of pesticides through strengthening the construction of plant protection infrastructure. This will be reflected in the following points:

- The technical training on plant protection will be strengthened covering the project farmers and the technicians of all the levels;

- The Project Management Office will arrange a full-time staff responsible for supervising the implementation of the pest management plan;

- Turpan will set up and strengthen cooperation with national pest research institutions, in which Turpan will be enriched with pest control knowledge and upgraded in IPM capacity; and

- The cooperation among all levels of plant protection stations and institutions in Turpan will be strengthened in favor of information exchange and resource share.

**Technical Training and Personnel Resource Development**

Measures of capacity building and personnel resource development for intensifying pest management are proposed as follows:

1) The control measure against new pest(s) and new measures of pest control will be available from county experts and technicians of plant protection, the technical staff such as from Turpan Agricultural Technology Extension and Service Center, Turpan Agricultural Bureau and Turpan Prefecture Agricultural Research Institute);
2) All levels of agricultural extension and service staff in Turpan will be regularly trained for higher professionality in favor of the effective implementation of regulations on pesticides;

3) Agricultural technical staff will provide the farmers with regularly technical training and service by means of such as farmer schools, so that new measures of pest control will be timely extended to the farmers. In case of need, senior experts of pest control will be invited or contracted for upgrading training; and

4) Training materials of practical technology in both Chinese and Uyghur languages will be prepared, printed and distributed. And they will be supplemented with video materials and devices necessary.

Training of Farmers

The training of farmers aims at upgrading their capacity of safe and effective control of pests. The contents of training will include:

- How to identify ordinary pests and diseases on grapes and cotton and in greenhouses. What are the incident regularities?
- What loss can a pest or disease generate?
- The natural enemies against pests’
- Measures of field sampling;
- Thresholds of pest control;
- Varieties of measures of pest control and IPM (including farming, physical, biological and chemical measures);
- Proper storage of pesticides, and proper management of pesticide packing materials;
- The methods of pesticide application and the proper use of protective clothing;

The trainers can be demonstration farmers/households, all levels of capable technicians and experienced pesticide dealers.
Monitoring and Evaluation of the Pest Management in Project of Water-saving Irrigation in Turpan Prefecture

Local Monitoring Activities during the Project Implementation

The items to be monitored will include:

- IPM in the area of the project implementation;
- Models of pesticide use;
- Yield of agricultural production;
- Changes in the agricultural eco-system; and
- Other indicators.

The above items will be monitored by the ATESC staff of both prefecture and county levels in Turpan in the project implementation. It is expected that the World Bank dispatch experts as soon as possible to help the ATESCs set up monitoring system and contribute corresponding technical training. The training can include the implementation and analysis in the monitoring system as well as the sampling procedures.

Monitoring Activities during the Supervision Period

During the supervision period by the World Bank, the following external monitoring activities will be conducted:

- Registration of pesticides;
- The use of Class-1 pesticides;
- Policy publicity; and
- Implementation of the local monitoring procedures and assistance in result analysis.
Monitoring and Supervision Plan

8.3.1. Monitoring of Insect Pest Management

The monitoring will be conducted by the ATESCs of both prefecture and county levels under the cooperation between the project offices and the clients. Once incident of insect pests is observed, it should be timely reported and timely action is also required.

8.3.2. Monitoring Plan

Project offices will be responsible to make sure that regular monitoring and management will be conducted. In the peak period of insect pest incident, ATESCs will be responsible for monitoring the pest control according to the pest management plan under the framework of the Project.

8.3.3. Responsibilities

All levels of local ATESCs will be responsible to guide, supervise, monitor and train the integrated pest management in Turpan.

The project office together with the stakeholders will be responsible to monitor and timely report the pest incident and take corresponding actions according to the IPM plan.

8.3.4. Technical Request

All levels of local ATESCs in Turpan will be responsible to provide technical measures of plant protection as requested.

8.3.5. Budget

Pest management should be integrated into the daily management of the project offices. The budget thus required should be included in the overall budget of the project offices and ATESCs in the budget lines of pesticide reasonable use, forecast and monitoring, training, information publicity and management expenditures.