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GOVERNMENT OF SINDH
Agriculture and Livestock Departments

SINDH AGRICULTURAL GROWTH PROJECT

Integrated Pest Management Plan (IPMP)

August 2013

PAKISTAN

SINDH AGRICULTURAL GROWTH PROJECT (SAGP)

PEST MANAGEMENT PLAN (PMP)

1.Introduction

1.1Pakistan is a federation of four provinces, including the Sindh – the province of immediate concern. Sindh is the second largest province of Pakistan in terms of population and the third in area. Sindh's population is about 44 million (24%) out of Pakistan's total of 184 million according to the latest estimates[1], and its area is about 14 million ha (18%) out of Pakistan's 80 million ha. Majority (51%) of Sindh's population lives in rural areas. The province's hinterland is the southern most part of the Indus valley and it harbors the largest city and the main seaport of the country - Karachi.

1.2 Sindh Province has 3.8 million ha cropped area of Pakistan's 22.4 million ha cropped area, representing 17 percent of country's total cropped area. About 30-35 percent of Sindh's population lives below poverty line, and a majority of the poor are rural. Landholding patterns in Sindh are highly skewed from national norms, with a median farm size of around 11.33 hectares, as compared with 2.83 hectares in Punjab. According to one estimate in 2005, wealthy landlords in Sindh, who held farms in excess of 100 acres and who accounted for less than 1 percent of all farmers in the province, owned 150 percent more land than the combined holdings of 62 percent of small farmers with landholding less than 5 acres. Large landowners dominate production of the four major crops in Sindh—rice, wheat, sugar cane, and cotton.

1.3The SAGP will focus on horticulture—particularly chilies (92 percent of national production), onions (33 percent), dates (about 50 percent), and milk production because these commodities have a small farmer focus, have significant involvement of women in production and processing. Horticulture is largely unregulated, includes more private sector actors than the major crops, and has received little donor attention in the past, albeit with the exception of mangos and bananas—the two most profitable horticulture crops, which are often grown by large landowners. The SAGP will also have some intervention in the rice value chain, which will target a cluster of small and medium sized producers to help them reduce the post-harvest damage and loss from poor practices.

1.4 In horticulture, farmers may link with either traders or processors. In these three major value chains, several private sector traders and processors operate who actively seek high-quality products for domestic and international markets. Despite their presence, 25 percent of Pakistan's fruits and vegetables produced annually go to waste between the farm and the consumer. Only four percent of Pakistan's total fruit and vegetables are exported and at far lower prices due to poor quality and the reliance on traditional low end markets. In milk production, losses climb to about 30 percent in the summer due to lack of infrastructure and equipment. The introduction of good agricultural practices (GAP) and modest investments in relatively simple technology could substantially increase the quality of production and the potential for increased trade and higher incomes.

1.5The Government of Sindh (GoSindh) has highlighted commercial agriculture and market linkages as priority investments for the sector and has prioritized investments in support of small and medium farmers as well as in value chains that will positively impact women. This project responds to the Country Partnership Strategy (CPS) (FY2010-13); and aims at improving private sector participation in marketing infrastructure, facilitating reform in local marketing regulations and policies to enhance competitiveness.The SAGP would contribute to improving infrastructure to support growth in the Pakistan CPS and its Progress Report (CPS-PR). Under the CPS-PR, the Bank would continue providing support for irrigation investment programs with investments to boost agricultural productivity and value addition. The project therefore complements the activities of the following on-going Bank-supported operations: Pakistan Poverty Alleviation Fund; Sindh Water Sector

[1] Pakistan Economic Survey 2012-13; June 2013.

Improvement Project Phase I; Sindh On-farm Water Management Project (SOFWMP); and Sindh Skills Enhancement Project.

1.6 An integrated social and environment assessment (ISEA) for the SOWM was prepared in greater details. As the overall impacts of the SOWMP on the environment were expected to be positive and accordingly SOFWMP was classified it as a category B project under its operational policies (OP 4.01), the same category is proposed to be retained for the SAGP.As also, the preparation of an Environmental Management Plan (EMP) was mandated (OP 4.01 - Annex C), and the EMP recommended measures to mitigate possible adverse impacts on the environment, including the potential induced impacts of increased pesticide use, a Pest Management Plan (PMP) was prepared in compliance of the Bank's procedures (BP 4.01 - Annex C), and had formed a part of the EMP; this PMP is being used as a basic document from which a shorter but updated version of the PMP has been prepared for the SAGP. *It is mentioned at the outset that the PMP does not recommend procurement of any pest control products or methods nor does the project envisage any such procurement.*

2.Current Pest and Pesticide Management Approaches

2.1 The pest problems first emerged with the introduction of high yielding and fertilizer responsive crop varieties in the country in the decade of 60s and 70s. For example, the introduction of delta pine cotton, IRRI – 6 rice, and Mexican wheat varieties brought in their wake pests which caused colossal damage to crops. In the late 50s, plans were conceived to spot spray the diseased crops.Various crop rotations are in vogue in different parts of Sindh; rotation mostly practiced is wheat-cotton in upper Sindh on the left bank of the Indus river canal command area, while in the southern parts, it is rice-wheat and sugarcane. Considerable area around large towns is planted with vegetables while fruit orchards (mainly mango and banana) are scattered all over. Floriculture is also getting popular to meet the demands of the Karachi city.

Main Agricultural Pests/Diseases by Crop

2.2 **Major Field Cops**. In Sindh, ground plant protection measures (mostly pesticide sprays) are employed on 24% of the cropped area of all field crops including vegetables and orchards[2] as compared to 21% on the national basis. However, plant protection on cotton and sugarcane account for 69% and 15% respectively of their cropped area in the province. Pests/diseases on these crops are amply mentioned in the comprehensive PMP for SOFWM. However, these two crops are not relevant under the SAGP, therefore, pests/diseases for these crops are skipped. In the case of rice, 28% of the cropped area in Sindh is sprayed with pesticides. Stem borers and white backed plant hopper (*Sogatellafurcifera*) are the main pests of the rice crop. The diseases caused include: leaf blight, brown leaf spot, stem rot, and smuts.

2.3 **Vegetables and Horticultural Crops.** Main crops under focus in the SAGP under these categories are chilies, onions and dates.

> **Chilies and Onions**. Among various insect pests; thrips, aphids, mites and fruit borers in chilies, and thrips in onion are of prime importance. The minute looking thrips are soft bodied insects, polyphagous, and occur throughout the year. Both nymphs and adults lacerate the leaf tissues and feed on the oozing sap. Usually young leaves are preferred, but buds and flowers also get infested. The infested leaves become shortened, curl upwards, and crinkle. Under severe infested conditions the leaves shed and hence plant growth is affected. Mites are also tiny insects that live on tender foliage, buds and fruits by sucking the plant sap. These are found mostly on the lower surface of leaves in a protective web. Under severe infestation of chilies the leaves curve downwards and fruit turns brownish with hardened skin. Aphids are also tiny insects and can infest the crops at any time during the growing season. They look like minute dark specks and tend to gather around the shoot tips, flower buds and all over young foliage. Aphids also leave sticky excreta on leaves that they have been feeding on, which could help in the development of fungal molds. Aphid infestation results in stunted or deformed growth. Fruit or pod

[2] Pakistan Agricultural Census, 2000.

borers are highly polyphagous and cosmopolitan in distribution. These normally start infesting chilies crop around flowering time. Young larvae are associated with younger shoots and leaf tissues, as well as grown up larvae feed on leaves and fruits by piercing and sucking resulting in holes. The weedicides /herbicides are not usually used to control weed in IPM program because in Sindh majority of small farms remove weeds and feed to farm animals as cheap fodder. This is best method to control weeds in Sindh conditions. However, pest and disease control needs attention. In chilies pests may be effectively controlled through plain water sprays/ neem oil-water sprays. However, in rare instances third generation eco-friendly insecticides such as Acetamiprid, and diafenthiuron that could be used, In some literature, Imidacloprid,and Emamectin are wrongly categorized as eco-friendly, but in fact these are not eco-friendly and should not be used; particularly the latter Emamectin which is highly toxic to bees and aquatic arthropods. Similarly, third generation fungicides such as Difenoconazole, mancozeb, could also be used as last option. In Onion plain water spray or neem-oil spray is best to control thrips. However, occasionally onion crop is attacked by bulb fly, and certain lepidopterous pests then the pesticides of chloropyrophos, Imidacloprid or any third generation pyrethroid available in the market may be used.

There are implications of these crop pests the on pesticide use patterns in vegetables particularly onions. Aphids, mites and thrips are all notorious for developing resistance to most insecticides which tends to put farmers on a "Pesticide Treadmill" with high concentrations and more frequent uses. Therefore it is desirable for an IPM strategy to include a pesticide resistance management strategy as well.

- **Dates. The date** palm and its fruits are subject to attacks by several insect pests such moths and beetles (such as Caroub moth, caused by *Ectomyelois ceratoniae.* and rhinoceros beetle scientifically called *Oryctes rhinoceros* Linné.), and red palm weevil (RPW), scientifically called *Rhynchophorus ferrugineus* Oliv. RPW is also called the Indian palm weevil and lasser fruit borer. To control these pests pesticides of pyrathroid group may be used. Besides insect infestations, some of these diseases (bending head) are believed to be caused *Thielaviopsis paradoxa* and *Botryodiplodiatheobromae fungi. Red palm w*eevil attacks the trees from wound spcially t*he site sucker remo*val at the base. It is best controlled by immediately treat*ing the sucker removal s*ite/wound with used mobile oil alternatively by bitter cucumber paste. Fruit moth is occasional pest and through pest scouting if found a threat then it may be controlled through use of any third generation insecticide available in th*e market.*

  *It may be us*eful *to mention here the imp*lications of these crop pests on pesticide use patterns. Aphids, mites and thrips are all notorious for developing resistance to most insecticides which tends to put farmers on a "Pesticide Treadmill" with high concentrations and more frequent uses…Hence the need for an IPM strategy or a resistance management strategy (if the option is to go with pesticide use)

Epidemics

2.4 Instances worth mentioning are, the cotton leaf curl virus infestation in upper Sindh in 1999 (estimated loss in yield, up to 30%), white backed plant hopper attack on rice in 1976, 1985 and 2001 with estimated loss up to25% in those years, and *Pyrilla* attack on sugarcane in 80s in lower Sindh (sugar recovery was lowered by 25%). No estimates are available for the chilies, onions and date crops due to epidemic, although Sindh state figures suggest wiping out of almost 50% of chilies production due to viral disease in certain years, for example its production was down to 46,000 MT in 1993 from the previous year's production of 113,000 MT indicating almost 60% reduction. Similarly, chilies production of Sindh in 2002 (76,600 MT) was 50% down from the previous year and 48% down in 2007 (56,600 MT) as compared to the 108,800 MT onions produced in 2006.

Crop Losses

2.5 Reliable data on crop losses due to insect pests and diseases is generally not available. Various reports in the public sector archives put losses in crop production due to insects at 20-30%. The first incidence of white backed plant hopper as a major pest in 1976 caused losses of up to 60% paddy yield in Sindh.

2.7Post-harvest losses (PHL) are significant in the case of grain cereals: for example, wheat and rice which are stored for long durations, the national average storage loss is estimated at 3.5% over a period of 5 months and could be as high as 15% if stored for 2-3 years. However in the case of horticultural and vegetable crops of the SAGP, post harvest losses area huge, both in terms of quantity and quality of production affected. According to some informal estimates, PHL in Sindh could be as high as 35%in the case of dates, 15% in the case of onions and chilies. Alflatoxin contamination is reported to affect80% of the chili crop.

Pesticide Use

2.7 The use of pesticides have steadily increased in the country from about 250 metric tons (MT) in the mid 1950s, to about 670 MT in 1980 when pesticide business was transferred to the private sector. Pesticides consumption was 3,672 MT in 1981, 20,213 MT in 1991, and 47,592 MT in 2001. It kept on increasing until the middle of first decade of the 21st century (129,598 MT in 2004), but started declining persistently (105,164 MT in 2005), albeit with fluctuating consumption thereafter. In 2008, the consumption of pesticides was reported at 39,186 MT; in 2009 it was 40,643 MT but jumped to 73,632 MT[3] in 2010.

2.8 On the basis of three-years moving averages of the pesticide use in the country, the decline in the use of pesticides from 2005 to 2010 has been considerable; from 104,298 MT to 51,557 MT respectively at an annual decline rate of 12.9%. Prior to this period, the pesticide use had increased at an annual rate of 14.5% from 1992 to 2005. Cotton is the singular largest crop whereupon pesticide use is the highest; 51% of the entire cropped area for all crops in 2000, 64% in 2005, 55% in 20102 and 47% in 2011. In Sindh also, cotton accounted for about 50% but dropped to 32% in 2000, increased to 83% in 2005 and steadily came down to 60% in the years of 2010 and 2011. The latest figures of these recent years show that fruits and vegetables account for 21-22% of all cropped areas in Sindh (more or less similar to the national average usage of 15-22% on fruits and vegetables). However, a striking difference is that in 2000, Sindh's fruits and vegetable sector has accounted for 49% of pesticides use as compared to 20% at the national level. The reductions could be attributed to the various reasons, including the introduction and adoption of IPM practices and genetically modified (GM) crops, as for example Bt-cotton in particular, diminishing return to the costly pesticides, and to lesser extent on the awareness of the externalities of pesticides.

2.9 The excessive use of pesticides has disturbed the agro-ecosystems in the region. Pesticides have been instrumental in the killing of non-targeted and friendly organisms, including birds, and have also induced pest resurgences. In some cases, resistance to pesticides has developed and outbreaks of secondary pests have been witnessed. There have also been deleterious effects of pesticide use on human health, natural resources and the environment.

Safety: Storing and Disposal

2.10 Adequate comments are provided in the original PMP of SOFWM Project on the pesticides formulation facilities and their practices in the country. While country law provides for the storage places to: (i) be away from populated areas; (ii) be properly ventilated; (iii) have protected electric installations; (iv) have firefighting equipment; (v) be equipped with protective and safety clothing; and (vi) have emergency showers and eyewash facilities; these requirements are seldom met. Also the rules for disposal are also generally disregarded. There are also accountability issues of six thousand tons of out-dated pesticides lying in different stores in Pakistan as most of the containers leak and contaminate soil. The usual practice in factories is to dig holes and bury the contents. Preventive measures are not adopted to decompose the poisonous material. It used to be a common observation about a decade ago that end users do not dispose off the empty papers, cardboard or plastic packs by enclosing them in weatherproof containers and glass containers are not crushed in sacks, as required by law. A survey conducted by the National Fertilizer Development Center (NFDC) in 2002 had revealed that about 48% of pesticide users simply threw away pesticide packing, 34% buried it, and surprisingly 3% washed and reused

[3] All figures on pesticides consumption reported are taken from Agricultural Statistics of Pakistan.

it. However vigorous campaigns be the public and private sectors on the safe disposal as well the introduction IPM practices and education since then could have had some positive impacts as well.

2.11 During the preparation of SOWMP's PMP, an emerging issue was raised in that the inventory of outdated pesticides needs to be updated and safe disposal arranged. However, the implementation documents of the said SOWMP do not provide adequate information whether any progress was made on this issue. Further, this issue needs to be examined in the historical perspective. The quantity of outdated pesticides was reported by the Plant Protection Department of the Federal Ministry of Agriculture, as of 1999, in the Agri Stat Book. The issue is about three decades old when pesticide sales and distribution, then handled by the provincial public sector extension departments, was privatized in 1984. Much of the stocks of pesticides were depleted, sold out or held at remote areas; yet because of poor bookkeeping by the extension agents, were not properly accounted for. In all likelihood, no such stock can exist after three decades. However, public sector auditing kept such stocks outstanding against the extension agents. It is therefore recommended that inventory should to be updated and a policy decision be taken at the appropriate government level waiver off the outstanding stock that exist on paper only. Similar situation is not possible in the Project areas because agriculture extension department does not handle any pesticide anymore for sales and distribution to the farmers.

Externalities of Pesticide Use

2.12 The cost of pesticide use is much more than the cost of the pesticide itself. The social cost is enormous which is generally disregarded while determining the economic gains in terms of higher crop yields. These costs include: occupational poisoning, food residues, drinking water contamination, pest resistance, loss of biodiversity, cost of prevention and abatement measures and the cost of awareness campaigns. Further, there are health related issues; such as (a) ***Sickness Incidence of Pesticide Applicators,*** pesticide-related sickness is very common in the cotton zone as about 63% of households report sickness during the spraying season, mortalities are about 1 per 400 households while main reported ailments were vomiting, dizziness, and breathing problems; (b) ***Sickness in Women Cotton Pickers,*** about 87% women pickers complain of a variety of symptoms like headache, nausea, vomiting, skin irritation, general weakness, fever, dizziness, stomach pain, and blisters; (c) ***Industrial Worker Poisoning,*** about half of the labor force, working in the pesticide plants report sickness by inhaling pesticide emissions; and (d) ***Pesticide Residue in Food Chain,*** fruits and vegetables are contaminated with pesticide residues to the extent of 40% and 63%-70% of these are above the Maximum Residue Limit (MRL)[4]

2.13 **Other externalities**. Pesticide residues also found in irrigation and drinking water, cotton seed, oil, lint and cattle feed, cottonseed cake, animal milk, and soil. Increased pesticide resistance is resulting in additional applications of pesticides to maintain expected crop yields. The consequences are lower yields and higher production costs. Pesticide use is affecting biodiversity too but it is little understood and appreciated. Some examples are: pollinator damage (honey bee poisoning), soil fauna, wildlife and birds.

2.14 **Monetization of Pesticide Externalities**. Clearly there are substantial costs that the society has to bear on account of harmful effects of pesticides. Periodic research needs to be carried out on the economic costs of pesticide-related externalities. An assessment made in 2000 shows (Annex 1) that the external costs of pesticide use in Pakistan amounts to about Rs. 11.7 billion annually[5].

Integrated Pest Management (IPM)

2.15 No single method of pest control is adequate to give satisfactory results in all situations. Therefore an integrated approach needs to be adopted. For this purpose, Integrated Pest Management (IPM) is the best available alternative. IPM has no standard definition, but is commonly referred as a diverse mix of approaches to

[4]indicated by two different studies at about mid 1990s and 2000.
[5]Ahmed (2002), "External Costs of Pesticide Use in Pakistan", quoted in PMP of SOFWM.

manage pests; keep them below damaging levels by using control options that range from cultural practices to chemicals. Technologies involved, such as use of bio-pesticides (derived from *neem, dhatura* and *aak* that are local tree/bushes and tobacco), augmentation releases of predators/parasites, development of pest resistant species, crop rotation, cultural practices, and balanced use of fertilizers.

Integrated Plant and Soil Nutrient Management (IPSNM)

2.16 The concept of Integrated Plant and Soil Nutrient Management (IPSNM) entails the management of both organic and inorganic plant nutrients for optimal production of the cultivated crop, forage, and tree species while conserving the natural resource base that is essential for the long-term sustainability of the agro-ecosystems and the environment. Organic fertilizers bring about many useful changes in the chemical, microbiological and physical properties of soil that enhance soil fertility. The effect is long-term and not immediate, and, therefore, farmers hesitate to use organic fertilizers. High levels of organic residue incorporation especially in fine textured soils, improves its structure as indicated by several of the parameters such as soil porosity, pore size distribution, bulk and particle densities, aggregate stability, water holding capacity, aeration, infiltration, and hydraulic conductivity. The recycling of soil derived nutrients is also improved through proper organic residue management.

Good Agriculture Practices (GAP) and Participatory Development Technology (PDT)

2.17 The Good Agricultural Practices (GAP) can be introduced as the main focus of all extension activities to all areas of the production and post harvest handing of produce. While there are no specific GAPs established within the Sindh province or Pakistan for any crop, there are internationally recognized standards that can form the basis of a set of codes of practice that can be slowly introduced to farmers. It is unlikely that all farmers would be in a position to enact all the practices that were required by the most demanding market outlets. However, the more GAP elements that a farmer could adopt, the greater would be their gain in productivity and the quality of the produce finally sent to market. The main vehicle to be employed for implementing GAP is though the Farmer Field School (FFS) approach, which also is the principal methodology for delivering the IPM programs. As for example, cultural practices, crop rotations, use of organic or bio-fertilizers, pest scouting are salient aspects of the FFS curriculum that would be an integral part of the GAP curricula. Similarly Participatory Development Technology (PDT) approach, which although is the main investment vehicle of the SAGP for the farmers and producers to improve their productivity of the target crops, is through the FFS. The focus of all PTD groups is on new technologies and methods of crop protection, cultivation, irrigation and improved cultural practices. Through the PTDs the farmers apply a number of new technologies, along with IPM, in perennial and annual horticulture. Some of the important elements in PTD are to compare the traditional methods of crop protection practices with the IPM based new technologies. The details of FFS and PDT, along with FFS curricula development are given in Annex 2.

Research and Development

2.18 Research and development on IPM, initiated in Pakistan in 1971 and actively pursued since then. Several projects have been funded by the national and provincial governments and international agencies. A resume of such projects and main activities are available in the PMP of SOFWMP that also gives a comprehensive background on the concept of Training of Facilitators (ToF) and Farmer Field Schools (FFS) and its application in Pakistan. In Sindh, two research development schemes on IPM were also implementation: (i) “Introduce IPM and Biotechnology System and Strengthening of Tissue Culture Laboratory sponsored by the Agricultural Research Institute, Tandojam” (2001-04), and (ii) Adaptation of IPM Approach for Cotton in Sindh” that was sponsored by Cotton Research Institute, Sakrand. The National Agricultural Research Center (NARC) had also sponsored IPM programs in Sindh during 2001 and 2002 whereby 4 ToFs and 118 FFSs were established in which about 13,000 farmers were trained. These trainings took place in seven districts, namely, Khairpur, Sukkur, Noshero Feroze, Nawabshah, Sanghar, Hyderabad and Mirpurkhas. Sindh Agriculture Extension Department under Community IPM & IPNM Project, trained 90 IPM facilitators and 6500 Farmers in Khairpur,

N. Feroze, Shaheed Benazirabad, Sanghar, Matiari, Thatta, Badin and Mirpurkhas districts on cotton, Tomato, Okra, Chilies and Wheat Crops.

National Integrated Pest Management Project (Nat-IPM)

2.19 Currently, the focal point of all IPM activities in Pakistan is the NARC. With a view to up-scaling its ongoing IPM activities, NARC has been implementing a national IPM project that was approved in 2001-02 by the federal government for a total outlay of Rs 950 during the 10 years perspective plan, 2001 to 2011. It was executed by the Nat-IPM Coordinator at NARC in collaboration with Provincial Coordinators/District Officers (Agriculture) in four provinces, Department of Plant Protection, Karachi, Federal and Provincial Agriculture Extension and Research Institutes, and Universities of Agriculture at Faisalabad, Tandojam and Peshawar. The main objective of the project is expanded and sustainable implementation of IPM in Pakistan, rationalizing the use of pesticides while maintaining production levels, and increasing farmers' profit. The specific targets laid down, initially were: (i) training of 500 extension staff and 55,000 farmers in IPM technologies through 20 ToFs and 840 FFSs; (ii) development of 840 village organizations in 20 districts of Pakistan; (iii) studies to recommend policy options to reduce indiscriminate/overuse of pesticides; (iv) training of 250 teachers of colleges and universities in IPM philosophy; (v) establishment of IPM information network and website, and issuance of newsletter; and (vi) training of public sector professionals and students (200) in IPM related research and development. No update is available yet on the achievement of the targets and outcomes of the Nat-IPM.

3.Policy, Regulatory Framework, and Institutional Capacity

3.1 At present the Ministry of National Food Security and Research is controlling agency for the import and production of pesticides, while the department of Plant Protection (Karachi) is responsible for the registration and regulation of Pesticides. The rules and regulations for Pesticides manufacturing, import and usage are stated in the Agriculture Pesticide Ordinance Government of Pakistan 1971 and the Agriculture Pesticides Rules Government of Pakistan 1973. These rules and regulations are based on guidelines from Food and Agriculture Organization (FAO). The Ordinance was amended later with respect to import of Pesticides and punishment for defaulters. To assist and advise the Federal Government on the technical aspects of the Pesticide Ordinance, the Agricultural Pesticide Technical Advisory Committee (APTA) was established. It comprises representatives from Universities, Government Departments, Pakistan Agriculture Research Council and Central Cotton Committee.

Integrated Pest Management as a Coping Strategy

3.2 The IPM approach is defined as a knowledge-intensive process of decision making that combines various strategies (biological, cultural, physical and chemical) tomanage pests. The IPM program adopted by the Federal Government aims in the first instance at improving sustainable agricultural production by reducing the use of chemical pesticides, and promoting the adaptation of IPM strategies to field and horticultural crops through Farmer Field School (FFS) methodology. The Ten Year Perspective Plan (2001-11) has also emphasized IPM as follows:

> *"It has been estimated that around 25 percent of crop outputs are lost due to attack of pests and diseases. Although the application of pesticides has increased over the years, its indiscriminate use should be avoided as it kills useful insects and predators, and causes environmental degradation. In order to reduce pesticide application ad promote biological control of insects and pest, Integrated Pest Management (IPM) programs will be undertaken. Adulteration of pesticides will be controlled through strict implementation of the Pesticide Act."*

Laws, Rules and Regulations

3.3 The first law called The Agricultural Pesticide Ordinance, 1971 was promulgated. The Agricultural Pesticide Rules under the law were framed in 1973. The 1971 Ordinance is a comprehensive law for regulating

imports, formulation, sale, distribution, and use, and establishing of institutions, ensuring quality control, and prescribing penalties for offences. It was amended in 1979 to let pesticide business transition from public sector to private sector, thereafter in 1992 to allow pesticide imports under generic names, and lastly in 1992 to strengthen the punishment provisions for adulteration.

Institutional Framework

3.4Under the Act and Rules, an Agricultural Pesticide Technical Advisory Committee (APTAC) was established to advise the Federal Government on all matters relating to agricultural pesticide use and approve the registration of pesticides on the recommendations of the APTA Sub-Committee. The former is headed by the Secretary, Ministry of Food, Agriculture and Livestock, and the latter by the Plant Protection Adviser and Director General, Department of Plant Protection, Karachi. At the federal level, the Department of Plant Protection is responsible for the registration of pesticides, monitoring of import, and assuring quality control, while at the provincial level, the Provincial Agricultural Extension Departments are responsible for standardization of doses, registration of distributors and dealers, and quality control through its inspectors and pesticide laboratories.

3.5**Registration of Pesticides**. Registration is carried out in three categories: (i) under trade name for which efficacy trials are done in the field for 2 years and registration takes place over a period of 2-3 years; (ii) under generic name for which government analyst's report is considered sufficient; and (iii) importation of pesticides registered in countries of manufacture on the basis satisfactory documentary proof. By 2000, a total of 2,116 pesticides were registered: 498 products trade names, 792 under generic names, and 826 on the basis of registration in the country of manufacture.

3.6 **Banned Pesticides**. In 1994, twenty three (23) pesticides were deregistered and their use banned in the country (Annex 3). Four products have been recommended for de-registration on the basis of WHO hazard classes Ia (extremely hazardous) and Ib (highly hazardous). Pakistan also subscribes to FAO/UNEP code of conduct and has placed 17 products on FAO/UNEP Prior Informed Consent (PIC) list. However, despite the restrictions, banned pesticides are still in use on a limited scale as these are smuggled from the neighboring countries.

3.7 **Enforcement Experience**. Implementation of the laws is generally poor. Although an adulterator can be given a punishment of 7 year imprisonment and a fine of Rs. one million, no such punishments have ever been awarded. Fines, at maximum, have been of the order of a few thousand rupees. Inspectors draw samples and have them tested in laboratories. Data show that a very small percentage of samples are sub-standard or adulterated whereas the fact is that the proportion is much higher. The problem of adulteration and use of spurious pesticides generally is due to import of sub-standard products, formulation of pesticides using less active ingredient, adulteration by distributors during re-packing, adulteration by pesticide dealers, and preparation of totally spurious material and labeling them as pesticides.

4.Rationale for the Pest Management Plan

Adverse Environmental and Health Impacts

4.1 The detailed PMP of the SOWMP gave a good rational on the indiscriminate use of pesticides affecting the environment adversely, disturbing the ecosystem balance, resulting in the loss in biodiversity, as well direct effects on human and animal health, based a national pesticide survey conducted by NFDC in 2002. The results of these are shown in the following two tables:

Environmental Problems on National Basis

	Freq (Number)	Percentage	Cumulative
Soil Pollution	245	5	5
Water Pollution	253	6	11

Environmental Pollution	1,276	28	39
Health Hazard	1,102	24	63
Fish Pond	92	2	65
Animal Health	429	10	75
Habitual Change	1,100	24	99
Others	10	0	100

Source: NFDC National Pesticide Survey 2002

Different Types of Sickness Symptoms Reported

Symptoms	Freq (Number)	Percentage	Cumulative
Headache	456	15	15
Dizziness	621	21	36
Irritation of skin, eyes, nose. Throat	706	24	60
Vomiting	435	15	75
Blurred vision	138	5	80
Heart trouble	187	6	86
Cancer	158	5	91
Fatality	15	1	92
Other	247	8	100

Source: NFDC National Pesticide Survey 2002

World Bank Procedures

4.2 For any Bank funded project, whereby an increased use of pesticides is apprehended, the Bank's policies and procedures require that a Pest Management Plan (PMP) should be prepared. Under the SAGP, the labor intensive fruit and vegetable crops that would enhance the livelihoods of small landholder and tillers are expected to have increased cropped area higher crop yields as well, which could result in correspondingly higher use of pesticides, unless mitigation measures on the effective use of IPM practices are promoted and farmers are encouraged to employ them. Therefore a PMP is considered to be an integral part of the SAGP.

Emerging Issues

4.3 A number of issues that emerge from the discussion on pesticides and IPM. The 12 issues drafted in the SOWMP's PMP, as relevant to Sindh, are appended in Annex 4. Gists of those issues that are relevant to this PMP are. (a) Review of Registration Procedures, (b) Amendment of Existing Legislation to Strengthen Enforcement, (c) Enhancement of the Awareness of Stakeholders, (d) External Costs of Pesticides (e) Deepening of IPM Philosophy in Educational Institutions, (f) Training of Farmers with due focus on gender, (g) Enhancement of Coordination among Donors/Decision Makers, and (h) WTO Implications.

5. Implementation of the PMP of SOFWM Project

Background – Main Objective and Strategy

5.1 In the productivity enhancement component of the SOFWM Project, an "Integrated Pest Management Plan" was financed with an estimated cost Rs.33.1 million. The Sindh Agricultural Extension Department had prepared a PC-1; the primary objective of it was to train 10,500 farmers in pest and pesticide management, with particular emphasis on IPM practices. This initiative was further complemented by a National IPM Project that has been executed by NARC. From its overall target of training 55,000 farmers nationwide, Sindh also got its due share. The main element of the strategy is an eco-system based system of agricultural crop management that does not exclude the use of pesticides but at the same time promote an integrated approach to use all available options for

controlling pest population for sustainable productivity with no adverse effect on human beings, animals and the environment. The ToF/FFS training system through its strategy of making farmers self-reliant by acquiring basic knowledge of crop management was designed to achieve the objectives of the IPM Plan[6]. This IPM Plan also introduced the concept of Integrated Plant and Soil Nutrient Management (IPSNM), which promotes not only long-term sustainability of the agro-ecosystems and the environment but, inter alia, also pro-IPM strategies such as improved crop rotations, better managing plant-soil-pest-predator interactions and maximizing crop, soil and animal biodiversity to reduce diseases and pest outbreaks. About 25 demonstrations of one hectare plots each were planned to promote IPSNM.

5.2 **Pesticide Residue**. In the ToF/FFS system of training, control plots, where prevalent practices of pesticide use are undertaken and experimental plots where farmers practice IPM, are laid out. Samples of pesticide residue on crops, particularly cotton, rice, fruits and vegetables, would be collected from both kinds of plots and the quantity of pesticide residue determined. This would help establish the usefulness of adopting IPM practices. The work of pesticide residue determination would be contracted out to existing research laboratories that possess the desired facilities (National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro,). Monitoring of pesticide residue would be carried out throughout the project period and information disseminated widely to help bring down the level of residue to below the Maximum Residue Limit (MRL). Post-harvest use of pesticides, particularly on vegetables would also be monitored. An analytical study on the work done would be prepared in the last year of the project period.

Performance of the previous PMP

5.3 As IPM Plan was a component of the SOFWMP, it was implemented by the DG Agriculture Extension whereas SOFWMP was being executed by DG Agricultural Engineering and Water Management; the latter being a different directorate. The target of training farmers through FFS on IPM, as revised, was 4650. This target was fully achieved following the training of 90 farmers during April-June, 2012. The target of training of 300 farmers on 'safe use of pesticide' through FFS was 300 was also accomplished. The target of 150 refresher courses for facilitators was achieved as well in second quarter 2012, as 98 facilitators were trained at Hyderabad in 4 batches, adding to the 52 refresher courses conducted earlier. The pesticide residues, analysis of 150 samples of soil, human blood of cotton and chili pickers and animal milk, was planned, for which 110 samples were collected by the end of June, 2011 and the remaining 40 samples in June 2012. The results were received of all 150 samples.

5.4 The IPM Plan successfully followed a participatory process learning approach for farmers through FFS in strengthening capacities on IPM and FFS. The program activities have been carried out as per the work plans in different crops in three AWBs. The crops were selected based on their importance and also the need and scope for the use of IPM for their improved production and reduction in the use of pesticides. Activities implemented in each zone are based on the local disease/insect-pest problems and needs.

5.5 **Review of Policy and Laws** was initiated as the discussion for amendments in the Agricultural Pesticide Ordinance 1971 is underway with the Agriculture Department of the Sindh Government.

5.6 **Awareness and Dissemination of Information**. Under this sub-component, different types of campaigns like media, seminars and printed materials on IPM approach through organizing seminars, workshops and field demonstration, etc., were carried out. These activities covered pesticide handling usage, storage and disposal, type of pesticide application equipment, protective measures and ecologically friendly methods and promotion of bio-pesticides.

[6] Details of the specific objectives and elements of the strategy of the Sindh IPM Plan are available in the PMP of the SOFWM Project.

6. The Proposed Integrated Pest Management Plan (IPMP) of SAGP

Background

6.1The Agriculture Department, Sindh has prepared a PC-1 ("Planning Commission Proforma 1") for the Sindh Agriculture Growth Project (SAGP) that has two major parts: Agriculture and Livestock, with a total estimated cost of PKR 11,411 million. The "Pest Management Plan (PMP)" is embedded mainly in the Agriculture part (PKR 8,255 million estimated to finance all project activities and investments for the productivity enhancement of crops targeted under the SAGP. While there is no separate cost estimated for the PMP, Integrated Pest Management (IPM) and Integrated Plant and Soil Nutrient Management (IPSNM) are the core capacity building measures of the line departments for promoting of good agriculture practices (GAP) that include both IPM and IPSNM. The PMP presented here highlights those activities designed in the Agriculture part of the Sindh SAGP PC-1 that has major and substantial relevance to the IPM and IPNSM, in addition to suggesting specific areas and topics of IPM that have not been specified in the PC-1 but can be included while designing and implementing the operational plan of the SAGP. The horticultural crops selected for this project include dates, chilies and onions, besides the field crop of rice. The three principle activities of the SAGP that will focus on the needs of each crop include: (1) Extension, (2) Productive investments; and (3) Research.

Objectives

6.2 The main objectives of the Pest Management Plan are threefold:

- Promotion of IPM: To minimize pesticide usage while increase the productivity of agricultural crops targeted in the SAGP through Integrated Pest Management (IPM), Integrated Plant and Soil Nutrient Management (IPSNM) and Good Agricultural Practices (GAP), because they include the rational use of chemical pesticides, promote cultural practices and the use of nutrients from organic resources;

- Management of Pesticides: To monitor the pesticides management such as their usage before, during and after, and the level of pesticide residues on targeted crops in normally-treated and IPM-treated areas and to disseminate information to stakeholders on the usefulness of undertaking IPM practices.

- Capacity Building: To raise awareness of all stakeholders about the IPM approach to crop management, and train extension agents and farmers through FFS system to become practitioners of IPM.

Strategy

6.3 The main elements of the strategy would be to promote IPM practices in Sindh, which do not absolutely exclude the use of pesticides yet it promotes an integrated approach to use all available options for controlling pest population with no adverse effect on human beings, animals and the environment that eventually results in attaining sustainable productivity. IPM practices aim at increasing the complexity and diversity of the insects and animals within an agro-ecosystem to encourage its sustainability. IPM practices do not envision agricultural fields devoid of insect life but they essentially from part of an eco-system of agricultural crop management.

6.4 The traditional agricultural extension and research systems are not equipped well enough to deal with the complex situations emerging in the crop management area. There is a dire need for these services to meet the new challenges. Farmers need to upgrade their basic knowledge of crop management with GAP, while extension agents need to perceive themselves into facilitators of change.

6.5 The strategy calls for sensitizing the decision makers and key officials also on the importance of IPM, particularly on the promotion of GAP and the rational use of pesticides.

6.6 The Farmers Field Schools (FFS) methodology would be adopted to introduce, promote and implement, among others, GAP and IPM approaches. The key elements of FFS entail training of facilitators (ToF) or lead facilitators (LF) whereby such training system focuses on each trainee, whether a farmer or an extension agent (Government, NGO or specific gender focused) or a researcher, first practices the skills under an expert advice from a lead trainer to reach a minimum level of competency, and then practices further until the trainee has mastered the skills. Thereby such facilitators of change, having undergone ToF they would have acquired knowledge about environmental conservation, public health, social participation, and organization, and become. Further, farmers are trained by facilitators through group participation, known as FFS in comparing new techniques in systematic field evaluations. Therefore it is essentially a field-based participatory training where extension agents and farmers work together for the duration of a cropping season. The expected output of such training is that farmers become more self-reliant and are able to evaluate new technologies by themselves, whereas extension agents are enabled to facilitate the change processes. The latter group carries out dialogues with farmer on public interest issues, including environmental conservation and health; whereas research institutions, with feedback from extension groups as well as direct observation, are enabled to provide technologies that can be tested in the field by farmers.

6.7 The concept of Integrated Plant and Soil Nutrient Management (IPSNM) would be also incorporated into the GAP because it complements the IPM practices. The strategy for IPSNM would include:

a) improving crop rotations by growing legumes as food crop or live mulch (cover crop);
b) maximizing organic matter production through green manure, cover crops and agro-forestry;
c) enhancing natural processes of nutrient recycling through managing plant-soil-pest-predator interactions;
d) providing soil cover (mulch, cover crops) to supply nutrients, reduce weeds and labor, and enhance functions of soil biota and plant roots;
e) selecting and breeding crops with higher nitrogen use efficiency, resilience to deficiencies and nitrogen fixing capacity; and
f) Maximizing crop, soil and animal biodiversity to reduce diseases and pest outbreaks.

6.8 The Participatory Development Technology (PDT) being the main investment mode at the farmer level for the targeted crops, also aims at improving crop productivity, would be implemented through the FFS. The focus of all PTD groups is on new technologies and methods of crop protection and improved cultural practices, among others, that are also the core of IPM practices. Through the PTDs the farmers apply a number of new technologies, along with IPM, in perennial (such as date palm) and horticultural crops (chilies and onions). Important ingredients in the PTD approach also entail comparing the traditional methods of crop protection practices with the IPM based new technologies

Activities Proposed for the IPMP

6.9 **Review of Policy and Laws**. The Sindh province, based on the IPM experience, would continue work on formulating its own pesticide policy. As reported in the background of this PMP, review of policy and laws was initiated under the PMP of SOFWMP whereby the discussion for amendments in the Agricultural Pesticide Ordinance 1971 has been underway with the Agriculture Department of the Sindh Government. Further work on these aspects, such as policy development, reforms, amendments or update for IPM/GAP, will be addressed in the Strategic Planning for Agriculture Sector component of the SAGP.

6.10 **Awareness Programs**. To disseminate awareness programs, adequate resources are provided in the SAGP to use all media that include print and electronic media, newspapers, agricultural department's monthly magazine, seminars, workshops, exposure visits of farmers/project staff, field demonstrations, etc. The main areas that would be covered for the promotion of GAP, IPM and IPSNM practices would relate to human health, like pesticide handling, usage, storage and disposal, other health hazards, types of pesticide application

equipment, protective gears, eco-friendly alternatives and promotion of bio-pesticides. The capacity building on IPM will be mainstreamed into the overall capacity building component of the project.

6.11**Farmer Field Schools (FFS)**. About 50 Lead Trainers or Trainers of Facilitators (LT/ToF) and 125 Extension Facilitators (EF) and well over 110,000 farmers would be trained. While most LTs would focus on the Participatory Development Technology (PDT) aspects, such as varietal suitability, production technologies, post-harvest handling and marketing requirements, some of these LTs would be commodity specific; 3 for dates and 1 each for onions and chilies. Apart from them, 4 IPM managers, based at the district headquarter level commodity clusters, would coordinate and monitor the inclusion and due emphasis on the IPM/IPSNM and related practices and technologies in the FFS agenda. The 50 LTs/ToFs would train 125 EFs in different commodity/crop zones. An estimated total 6,800 FFS groups will be formed over the course of the implementation period, each comprising from 15-20 producers. As the PDT items are demand driven and the nuclear FFS group formation would be PTD and GAP, the number of FFS may vary in the phasing or in eventual totals if there is a lag in demand, or low demand persists for certain technology items. During the curriculum development (see Annex 2, section 2.8), safe pesticide management and use would be a principal chapter of the IPM related topics.

Details can be seen in the following table:

		Crop				
	General	**Chili**	**Onion**	**Rice**	**Dates**	**Total**
No. of Lead Trainers (LTs/ToFs)/a	40	1	1	5	3	50
Extension Facilitators (EF) trained		38	40	37	10	125
Lead Farmer Facilitators (LFF) trained		950	1,050	925	250	3,175
FFS Groups		2,068	2,224	2,000	532	6,824
No. of farmers per group		15	15	20	15	16.5
Targeted farmers		31,020	33,360	40,000	7,980	112,360

/a. LT in General category will support and train EFs and LFF on need and campaign basis for specific crops, and the trained LT/EF will train 25-30 LFFs, while facilitators are expected to organize a minimum of 2 FFS groups.

6.12 **Integrated Plant and Soil Nutrient Management (IPSNM)**. The IPSNM approach uses both organic and inorganic fertilizers in proper proportion accompanied by sound cultural management practices and seeks to both increase agricultural production and safeguard the environment for future generations. Research has proved that neither inorganic fertilizers nor organic fertilizers alone can achieve a sustainable productivity of soils as well as crops under highly intensive cropping systems. The application of organic fertilizers needs to be encouraged to increase the soil water holding capacity in view of the ever increasing water scarcity. Institutional capacity on the IPSNM will be strengthened by short refresher courses for the officials of the Plant Protection Directorate of the Agricultural Extension Department and District Officers (Agriculture) that would be arranged through the Sindh Agricultural University/National Centre of Excellence in Analytical Chemistry University of Sindh, Jamshoro, the various ARIs and resource persons from other credible institutions in Sindh.

6.13 **Pilot Demonstrations on IPSNM**. A pilot scale demonstration, in a cluster of FFS groups, would be undertaken in the project area to promote the use of organic fertilizers/residues, composting and mulching. Since the activity would initially affect farmer income and only benefit him in the longer term, suitable financial incentives would be provided to the farmers under the project to compensate them for the losses incurred. About 10-15 demonstration one acre plots for each of three horticultural crops to promote IPSNM would be laid out, and their results would be monitored by the IPM managers and their teams PIMU.

6.14 **Pesticide Residue.** Under the FFS system, samples of pesticide residue on each of the commodity such as rice, dates, onions and chilies, would be collected from the control and IPM treated plots and the quantity of pesticide residue determined. The control plots are where prevalent practices of pesticide use are undertaken and experimental plots where farmers practice of IPM are carried out. This would help establish the usefulness of

adopting IPM practices. The work of pesticide residue determination would be contracted out to existing research laboratories that possess the desired facilities (National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro,). Monitoring of pesticide residue would be carried out throughout the project period and information disseminated widely to help bring down the level of residue to below the Maximum Residue Limit (MRL). Annual monitoring will be conducted for all project interventions that focus on on-farm productivity enhancements. Post-harvest use of pesticides, on the produce of commodities would also be monitored. An analytical study on the work done would be prepared in the last year of the project period.

Implementation Responsibility and Institutional Arrangements

6.15 The Director General (DG), Agriculture Extension Sindh will be responsible for agricultural extension activities of the SAGP with major focus on FFS approach, in which IPM, IPSNM and GAP activities would be the principal capacity building measures whereby the core investments under the PDT activities would also be carried out. The Directorate of Plant Protection (PP) under the DG will help implementing the IPM related activities. The Director PP who is assisted in his work by a Plant Protection Officer and three Agricultural Officers at the headquarter level, will have additional support of 4 IPM Managers under the SAGP, who would be placed at the district headquarters level project implementation units (PIUs). In the field, District Governments handle this work through a hierarchical setup: Deputy Director , Agricultural Extension at District level; Assistant Director at Taluka level, Agricultural Officer at Sector level, and Field Assistant at the Union Council level. Thus the actual frontline workers who would implement the activities are Sector Agricultural Officers and Union Council Field Assistants.

6.16 Research in pest management is carried out at the following five research institutes:

Agricultural Research Institute, Tandojam
Sindh Horticulture Research Institute, Mirpur Khas
Wheat Research Institute, Sakrand
Rice Research Institute, Dokri
Quaid e Awam Research Institute, Larkana

6.17 The horizontal linkages in the area of pest management between agriculture research and extension and vertical linkages between DG Extension and District Government are not strong. There are two main reasons for this: firstly, the operational budget for pest management, both for extension and research, is very small and there is little research or extension work that could to be shared; and secondly, Extension and Research officials report directly to their superiors and horizontal collaboration is only on a needs basis. In such a situation, the role of the existing Research-Extension Coordination Committee becomes much more important. It would be the endeavor of the government to ensure that this committee meets regularly on a monthly basis. IPM Managers and Deputy Directors (Agriculture Extension) would be actively associated with these committees.

Monitoring and Evaluation

6.18 Monitoring would involve establishing a baseline of the current status of crop yields, agronomic practices particularly cropped area sprayed (number of sprays and quantity of pesticides used), knowledge and adoption of IPM measures; and observing the adoption rates IPM/IPSNM and related activities (GAP/PDT) and measuring the impact of project interventions on the target crops disaggregated by farm type and gender, by over the project period. Mid-term and post-project evaluations would also be carried out. The following key monitoring indicators are suggested: quantity of pesticide used; number of sprays and area sprayed by crop; pesticide residues on fruits and vegetables; and the use of banned pesticides, if any. Pesticide residue studies would be carried out for crops where on-farm productivity enhancements are planned on an annual basis, with a baseline study establishing the indicative baseline numbers for selected pesticides for each crop (chili, onion, dates and rice) for the province.

Cost

6.19 The following costs associated with implementation of this IPMP in terms of pesticides usage and residue monitoring shall be included as part of the studies for component C of the project. The awareness raising activities shall be streamlined with the capacity building components of the project.

Item	Amount (USD)
Baseline Pesticide Residue Study	20,000
Annual Pesticide Residue Survey (4)	40,000
Soil Testing for IPSNM	10,000
Total	70,000

Recommendations

6.20 IPM work done so far in the country has been mainly donor driven and on a pilot scale. The National IPM project is going on for the past decade was the first major indigenous endeavor funded through the public sector development program. Consideration has been given to have an independent provincial IPM project; however before fully embarking upon such a project, it would only be appropriate to wait for the implementation experience and ex-post evaluation of the National IPM Project. Beside this, the key recommendations concerning the promotion of IPM are:

(i). **Monitoring of Pesticide Use and Residue**. The work of testing pesticide residue on agricultural crops, particularly fruits and vegetables, should eventually be done on payment basis by existing research laboratories. Samples would be collected from control and experimental plots of the on-going and future Nat-IPM programs under the ToF/FFS system, or from such plots which may come into existence from year 2 of the SAGP in association with FFS groups. The test results would thus establish the usefulness of adopting IPM practices. Monitoring of pesticide use and residues would be carried out throughout the project period and efforts made to bring down the level of residue to below MRL. After establishing a baseline of pesticide usage, post-harvest use of pesticides, particularly on vegetables and rice would also be monitored;

(ii). **Integrated Plant and Soil Nutrient Monitoring and Management**. A pilot scale operation would be undertaken in the project area to promote the use of organic fertilizers/residues in association with the FFS-initiated producers groups. About 10-15 such groups per commodity groups would be to establish an equal number of one acre demonstration plots to promote IPSNM in their farming practices. Soil testing of the demonstration plots would be would be carried out to determine the physical and chemical properties and macro and micronutrients of soil. The activities to be demonstrated would inter alia include: use of organic fertilizer, green manuring, mulching, weeding, nitrogen fixing by legumes, composting, and worm culture. The plots would be maintained for two years (see para 6.13 also); and

(iii). **Awareness Raising/Dissemination of Information**. Printed brochures, pamphlets, and booklets on various aspects of IPM and IPSNM would be prepared and distributed widely through FFS groups. Apart from these SAGP initiated groups of producers, the circulation of the departmental agricultural magazine should be increased to reach maximum number of stakeholders, which, among others, would include government officials, particularly of the newly established district governments and their lower tiers, water user groups (WCAs, FOs), educational institutions, pesticide manufacturers and sellers, farmers, NGOs, and women. Seminars at district and provincial levels for discussing project achievements would also be held. The main areas that would continue to be covered for the wider audience would relate to human health, like pesticide handling, usage, storage and disposal, other health hazards, types of pesticide application equipment, protective gears, eco-friendly alternatives to pesticides including bio-pesticides, and promotion of IPM and IPSNM practices. The awareness raising on IPMP will be streamlined into the general capacity building for the project.

Annex 1

PAKISTAN
SINDH AGRICULTURAL GROWTH PROJECT (SAGP)

PEST MANAGEMENT PLAN (PMP)

Ahmed (2002), "External Costs of Pesticide Use in Pakistan"

Externality Category	**Rs. in Millions**
Health:	**833.0**
Applicators	42.0
Pickers	765.0
Industry	0.6
Distribution	25.0
Pesticide Residues:	**110.0**
Production:	**7,034.0**
Pesticide Resistance	5,667.0
Animal Loss	1,304.0
Wild Honeybee Loss	63.0
Biodiversity Loss:	**3,745.0**
Total Externality Cost (Annual)	**11,742.0**

Source: Ahmad 2002

Annex 2

PAKISTAN

SINDH AGRICULTURAL GROWTH PROJECT

PEST MANAGEMENT PLAN

Farmers Field Schools, Participatory Development Technology

and FFS Curriculum Development

Farmer Field Schools (FFS)

A2.1The methodology used to deliver extension to target beneficiaries would be the Farmer Field School (FFS) approach. Although the FFS methodology has been used previously by provincial extension services all over Pakistan, closer examination of the methods employed indicate that what is often represented as FFS is, in fact, the long established Training and Visit model that has been shown to be a far less effective extension tool. A number of FFS's were visited during the course of the project preparations and in every case, the extension officer was instructing farmers on some aspect of production system under discussion. It was also apparent that these meetings were taking place near an extension centre or some communal focal point, rather than in a farmer's field.

A.2.2 The core of the FFS approach is Learning by Doing. Farmers are not given a prescriptive agenda. They meet regularly at a prescribed interval in a farmer's field and choose amongst themselves the topics for discussion. The role of the Extension Facilitator (EF) is to help guide the group in deciding what to examine and how to go about it, not to teach. If the farmers have a problem, they are encouraged to experiment and seek solutions to those problems through a process of constructive investigation. In this way, farmers are empowered to seek answers to their own problems. Where this is not feasible, the EFs can take a lead role and propose alternative methodologies. However, in order to facilitate greater sustainability to the whole extension approach, the Project intends to train Lead Farmers (LFs) as well as EFs to lead the FFS. The Extension Facilitator and the Lead Farmers would regularly attend training sessions with Master Trainers (MT), to ensure that both the EF and the LF were aware of both technical and group support functions. Facilitators would encourage groups to consider key aspects such as varietal suitability, post-harvest handling and marketing. Both EFs and LFs would also be schooled in leading problem-solving exercises.

A.2.3 The optimum size for a FFS is 15 to 25 participants. The number of meetings held by each group would be determined by the cropping calendar and could range from weekly at certain periods to monthly in others. One Lead Farmer could facilitate two FFSs and would be paid a small stipend to do so. The LF would also receive a bicycle, which they would pay for, out of their stipend. The LF would also be issued a number of tools and equipment, such as moisture meters, sprayers and soil testing kits that would allow them to demonstrate better production technologies to members of the group. Any novel equipment demonstrated to the group would be available for purchase by a group member at subsided cost. The Extension Facilitator would supervise up to four LFs and would be issued with a motorcycle, which would be paid for by the EF over the depreciation period of the machine. Some of the tools issued to the LF would also be issued to the EF. Each FFS would be expected to run for approximately three hours and would not be held at a frequency of more than once a week, at the peak of the cropping calendar. Marketing activities would naturally occur at the end of the season. The key likely areas of exposure of the farmers through the FFS approach are outlined below.

A.2.3.1 **Cultural Practices** - The focus of all cultural practices would be to introduce GAPs to all activities along a crop's production and post-harvest management chain. This would include varietal selection, cultural practices such as weeding and spraying, and the correct application of fertilizers. Due consideration would be given at all times to the effects of such practices on the quality of the produce and the environment.

A.2.3.2 **IPM** - IPM extension would focus on developing an environmentally sensitive approach to pest management. Although the FFS approach is rooted in the principles of farmers defining and answering their own problems, there are skill sets that would greatly aid them in defining their problems. In the field of IPM there are four steps that go to make an effective IPM program, which are (i) Monitoring; (ii) Setting Action Thresholds; (iii) Prevention (cultural & mechanical) and (iv) Control, including pheromone traps, biological controls and targeted spraying. Lead Farmers and Extension Facilitators would be trained in how to lead farmers are guided discussions to effectively implement IPM within their GAPs.

A.2.3.3 **OFS&WM – On-Farm Soil & Water Management**; efficient use of available water would be a major theme. There is scope to look at alternative irrigation technologies such as drip to see if the investment in infrastructure would yield beneficial results for participating farmers. OFS&WM extension would work with farmers to minimize the effects of inappropriate irrigation frequencies through the introduction of moisture meters and measured inflows of water.

A.2.3.4 **Post-Harvest Handling & Quality** – This activity would seek to improve the harvesting techniques and subsequent post-harvest handing to produce to ensure that optimum quality was maintained at all times. Washing, sorting and grading practices would be considered, along with improved packing techniques. Removal of field heat and maintaining a conducive environment for the produce, whether for drying, curing or processing, would raise the standard of the final produce leaving the farm.

A.2.3.5 **Marketing** – Embedded within the FFS timetable would be a time to discuss marketing issues. The ideal time to do this would be at the end of the cropping calendar, but the group itself would eventually decide this. Horticultural crops are often produced on a commercial basis and farmers use a variety of channels to sell their crops. The marketing sub-activity with the FFS would seek to maximize the returns a farmer could expect from selling their produce, either within their existing contractual arrangements or by seeking more advantageous marketing avenues, such as collective marketing strategies. However, no particular model would be favored, with the choice left to the participants. Marketing activities could include organized meetings between farmers and traders to discuss issues related to varieties, quality, quantity, timing and price. Exchange visits to other production areas and markets would also be beneficial to both farmers and traders, especially regional markets. Finding and opening new markets, based on existing production or tailoring varieties or processing to suit the demands for new markets would be actively promoted.

A.2.3.6 **Producer Marketing Organizations (PMO).**Subject to sufficient demand, the extension activity would foster the development of PMOs that could emerge from formal or non-formal farmer organizations. PMOs increase off-farm incomes and support business development when their members have had the benefit of market orientation, have input suppliers are mobilized, market linkages are developed and a greater awareness of markets has been created among producers. The project extension activity, may use innovate ways to leverage experience and resources resulting from Farmer Field School trainings. The FFS producer groups could be clustered to form a Produce Market Organization, comprising 10 FFS groups. The PMO could be organized to sell directly to wholesalers and processors, or to traders, but would gain greater bargaining power due to their size and greater volume of produce to sell. Individual PMOs could be eventually organized into district level PMOs. The PMO formation would help producers negotiate better access to markets, while also providing members with information, training, and the development of quality assurance standards. Importantly, the PMO would play an advocacy role, with a stronger collective voice, and offer better access to research, extension, inputs and market services. The PMO could be further strengthened to become an apex body for the horticulture sector.

Participatory Technology Development (PTD)

A.2.4 After a single cropping season, for those farmers that are interested, PTD is a possible next step, allowing farmers to further their knowledge of plant ecosystems through discovery-based learning. After FFS graduation, farmer sub groups can select their priority crops and identify their limiting factors. A Common Interest Group (CIG) could emerge as a part of discussions on "what next". Each CIG or PTD unit comprise of a number of farmer with common interest in a specific issue(s) for their crop. In this manner, the momentum of the FFS is not lost and farmers are constructively encouraged to continue meeting and problem solving together.

A.2.5 PTD is an approach, which involves farmers in developing agricultural technologies that are appropriate to their particular situation, local bio-climatic conditions and resources. It is a practical process in which farmers identify a specific problem, bring their knowledge and practical experience to test a number of options, including new technologies and interact with facilitators to solve their problem with the most suitable technologies available. In this way, farmers and the facilitators are able to identify, develop, test and apply new technologies and practices. PTD seeks to reinforce the existing creativity and experimental capacities learned by farmers through FFS, and help them keep control over the process of generating innovations. As it is a 'bottom up' approach, as with FFS, facilitators do not come to the farmers with off-the-shelf options and packages, but rather help them to find better solutions for themselves, which fit their resources and situations. The LF and EF therefore facilitate the process of innovation of technology most suitable for farmer's localized need.

A.2.6 This field-based participatory research and extension method, which is an extension of the FFS approach, not only results in enhanced agricultural yields but also increases farmers' confidence. Even more importantly, it provides an opportunity to share experiences, which may include successes and failures. It creates social cohesion and a spirit of collective action amongst rural farmers; PTDs would be a self-managed group. This extension activity would provide basic training at the initial stage to orientate the farmers in research and technology development and could provide initial agricultural inputs, technical guidance and facilitation of the processes with farmers. Unlike FFS, PTDs farmers specify the objective, develop criteria to verify indicator, identify the key elements to be address and pinpoint the suitable time to address the issues, hence PTD farmers get together based on the problem calendar instead of regular sessions. In this way, farmers utilize their time more efficiently compared to routine FFS.

A.2.7 The main focus of all PTD groups is on new technologies and methods of crop protection, cultivation, irrigation and improved cultural practices. Through the PTDs the farmers apply a number of new technologies in perennial and annual horticulture, along with IPM. Activities on pesticide safe management and use would also be incorporated in the curriculums with respect to the crops and pests farmers will need to use pesticides. The issues and problems are then discussed in groups and corrective measures are taken after consultation with facilitators. Some of the important elements in PTD are to compare the traditional methods of crop protection practices with new technologies; old against new varieties, and test the quality of crops and products in the farmer's own environment.

Curriculum development for the FFS

A.2.8 Although the core of the FFS approach is learning by doing, there is a need to ensure over the period of a single FFS cycle, groups of farmers are exposed to the best agricultural practices that pertain to the crop they are growing, taking into consideration the variety used, resources available and the degree of mechanization available to the farmer. This required knowledge forms the basis of Good Agricultural Practice (GAP). The skill in delivering this GAP to farmers is to ensure it is woven into the fabric of the FFS in such a way that Lead Farmer (LF) and the Extension Facilitator (EF) are able to introduce GAPs and allow farmers to experiment with the ideas and techniques being proposed, while not seeming to lead them in what have up to now been traditional training for delivering extension.

A.2.9 To begin this process, a curriculum has to be developed by the Department of Agriculture, supported by technical expertise drawn from all relevant sources. This process can be achieved by running a series of concentrated workshops where specialists can gather and flesh out what should form the basis for GAP's in any

particular crop. It must be borne in mind that these GAP's would be transmitted to LFs and EFs by Master Trainers (MT) and for this reason it is advisable to have MT's present as the GAPs are developed. There are nine universal steps that form the core for any curriculum development:

a) Determine the scope and limitations of the farming system.
b) Identify the elements of the GAP that need to be communicated.
c) Select and sequence the delivery of the GAP information based on the seasonal calendar and the structure of FFS delivery.
d) Develop performance objectives linked to the GAP.
e) Develop a likely instructional schedule, linked to the crop calendar.
f) Structure delivery in a 'learning by doing' approach.
g) Develop instructional material appropriate to the environment and the educational level of the target audience. This material should augment the FFS session, not form the core of it.
h) Develop Monitoring and Evaluation (M&E) criteria that would allow the project to test if the curriculum was effective.
i) Implement the curriculum embedded in the FFS

A.2.10 Any material developed would need to be tested with target farmers to see that it was being understood and as the material was disseminated during the FFS activities, the M&E finding would need to feed back into any of the steps above to take corrective action needed to improve the GAP curriculum.

Annex 3

PAKISTAN

SINDH AGRICULTURAL GROWTH PROJECT

PEST MANAGEMENT PLAN

Banned Pesticides (Active Ingredients)[7]

1. BHC
2. Binacryl
3. Bromophos ethyl
4. captafol
5. Chlordimeform
6. Chlorobenzilate
7. Chlorthiophos
8. Cyhexatin
9. Dalapon
10. DDT
11. Dibromochloropropane + Dibromochloropropene
12. Dicrotophos
13. Dieldrin
14. Disulfoton
15. Endrin
16. Ethylene dichloride + Carbontenachloride
17. Leptophos
18. Mercury Compound
19. Mevinphos
20. Toxaphene
21. Zineb
22. Heptachlor
23. Methyl Parathion

[7] Source: Sindh Agricultural Extension Department

Annex 4

PAKISTAN

SINDH AGRICULTURAL GROWTH PROJECT

PEST MANAGEMENT PLAN

Emerging Issues as Identified in the PMP of SOFWM Project

There are a number of issues that emerge from the background materials of the PMP of SOEWM Project. An effort has been made to address a number of them, as relevant to Sindh province, in the Plan that has been laid out in para 6 of this document. The issues are:

(i). **Review of Plant Protection and IPM Policies**. There is a need to discuss pesticide related issues at the provincial level and enunciate a provincial policy which is non-existent;

(ii). **Review of Registration Procedures**. Provincial government is concerned with the registration of only distributing companies. Rules, in this regard, need to be reviewed and made more stringent so that malpractices of adulteration etc are minimized;

(iii). **Amendment of Existing Legislation to Strengthen Enforcement**. From the provincial point of view, legislation needs to be reviewed for framing amendments that would lead to better enforcement of the pesticide law;

(iv). **Enhancement of the Awareness of Stakeholders**. This is the most pertinent and important issue that would be addressed by the Plan;

(v). **External Costs of Pesticides**. There is very little awareness of the externalities associated with the pesticide use. Decision makers, therefore, need to be particularly sensitized about it.

(vi). **Introduction of IPM Philosophy in Educational Institutions**. This is part of the awareness raising program that would need to be launched;

(vii). **Training of Farmers**. The main stakeholder is the farmer. He needs to be trained to identify, understand, and resolve pesticide related problems;

(viii). **Training of Women**. Pesticides in Pakistan are mainly targeted at cotton and okra crops. The cotton and okra pickers are mainly women who are exposed to the hazards of pesticide use and, therefore, need to be trained;

(ix). **Enhancement of Coordination among Donors/Decision Makers**. The main actors in the field of IPM are government, donors, and international organizations. Their efforts need to be coordinated;

(x). **Stronger Partnership among Research, Extension and Farmers**. This partnership would need to be forged on stronger footings;

(xi). **Disposal of Obsolete Pesticides**. Large stocks of outdated and obsolete pesticides have been stored at various places. Their inventory needs to be updated and safe disposal arranged; and

(xii). **WTO Implications**. The developed countries, USA and EU included, have framed regulations disallowing import of agricultural products with pesticide residues above a certain

limit. More emphasis, therefore, would have to be laid in the future on the need for producing pesticide free agricultural commodities for export.