PC - I FORM (Revised 2005)

PRODUCTION SECTORS
(Agriculture Production)

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT
(PIPIP)

(WORLD BANK ASSISTED)

Project Cost: **Rs. 36,000.705 Million**

(2011-12 to 2016-17)

DIRECTORATE GENERAL AGRICULTURE (WATER MANAGEMENT) PUNJAB, LAHORE

October 2011

1. NAME OF THE PROJECT

Punjab Irrigated-Agriculture Productivity Improvement Project

2. LOCATION

The proposed project will be implemented in entire Punjab (**Annexure-A**)

3. AUTHORITIES RESPONSIBLE FOR

a) Sponsoring

Agriculture Department through the World Bank

b) Execution

i) Punjab Agriculture Department through Directorate General Agriculture (Water Management), Lahore

ii) District Governments through District Officers (OFWM)

iii) Supply & Service Companies (SSCs)/Supplier Firms

iv) Project Implementation and Supervision Consultants (PISCs)

v) Participating Farmers/Water Users Associations (WUAs)

c) Monitoring

i) Directorate General Agriculture (Water Management) Punjab

ii) Program Management Unit (PMU)

iii) Monitoring and Evaluation (M&E) Consultants

d) Operation and Maintenance

Participating Farmers/ Water Users Associations (WUAs)

e) Concerned Federal Ministry

Not Applicable

4. PLAN PROVISION

a) If the project is included in the current Five-Year Plan, specify actual allocation

Government of Pakistan has indicated agriculture growth, uplift of agro-economy, and pro-poor interventions as its priority areas under its nine point development agenda. It has been planned to provide maximum financial resources for water resources management, being critical input to agriculture in arid and semi arid climate zones despite economic and financial difficulties faced by Pakistan's economy. The focus of investments in water sector has been envisaged on following areas.

a. Water resources augmentation
b. Water conservation
c. Infrastructure protection

Moreover, it has been emphasized in the current five year plan to focus development of farmers' institutions, institutional re-organizations, and staff training for improvement, rehabilitation, effective management, efficient utilization, and sustainable development of water management facilities. These measures are needed to be taken at much faster pace considering Pakistan's rapidly increasing population. In this context, the challenge will be the formulation and effective implementation of a comprehensive set of measures for efficient management of water resources at the farm level.

b) If not included in the current plan, how is it now proposed to be accommodated (Inter/Intra-Sectoral adjustment in allocation of or other resources may be indicated)

Not applicable.

c) If the project is proposed to be financed out of block provision for a program or PSDP/ADP, indicate in Pak-Rupees?

Not applicable.

d) If the project is not in the plan, what warrants its inclusion in the plan?

Population of Pakistan has increased at rapid pace during last four decades and it is anticipated to be doubled by the year 2025. In contrast, a little expansion in agricultural land took place in the country during this period but total area under agriculture remained almost the same because of urbanization and land degradation due to salinity. Although water resources have been expanded due to construction of dams during last forty years and irrigated area also increased but development in the water resources did not commensurate with population growth and accordingly sustainability of irrigated agriculture is at threat. The crop productivity is very low as majority of the farmers are still practicing traditional farming techniques. The existing conservative production technologies do not offer effective and efficient utilization of agricultural resources, particularly water. Extremely low efficiency of input use has led to wastage and depletion of natural resources besides environmental degradation. Resultantly, the country is facing serious threats to food security for its next generations.

Inadequate water availability is a major constraint in further expansion of the irrigated agriculture to enhance agricultural productivity of the country for meeting growing food and fiber demands. Horizontal as well as vertical expansion of agriculture is, therefore, urgently needed for the purpose. It is particularly important to consider possible strategies for increasing

water productivity through efficient management of the scarce water resources. A comprehensive approach may be followed in this regard by providing a complete package of OFWM interventions to minimize water losses at various levels and improve water productivity through ensuring its adequacy, equity, and reliability at the farm level.

The proposed project has been designed to maximize productivity of available water through developing tertiary conveyance system, promotion of high efficiency water conserving technologies like sprinkler/drip irrigation systems, LASER land leveling, capacity building of all stakeholders, and undertaking action research for acquisition, indigenization, and pilot testing of improved water management interventions to suit the local conditions. The combined effect of these advancements would lead to enhanced output of available land and water resources.

5. PROJECT OBJECTIVES AND ITS RELATIONSHIP WITH SECTOR OBJECTIVES

a) Project Objectives

The overall project development objective (PDO) is to improve water productivity i.e. producing more crop per drop. It will be achieved through increasing delivery efficiency, adopting improved irrigation practices, promoting crop diversification, and effective application of non-water inputs. The PDO would contribute to increased agricultural production, more employment opportunities in rural areas, higher incomes from the farming, better living standards of the farmers, and improved environment.

The proposed project will have following key objectives.

I. Improving productivity of irrigation water by efficient conveyance and its effective farm level use by adopting conservation agricultural practices.
II. Production of more profitable crops through high efficiency irrigation systems (HEISs) for meeting increasing domestic demand and enhancing exports.
III. Strengthening the private sector service delivery capacity and sustainability for supporting irrigated agriculture.
IV. Capacity building of stakeholders in better managing irrigation water for attaining higher crop yields with less production costs.

b) Sectoral Relationship

The proposed project would become part of the on-going on farm water management (OFWM) program for development and rehabilitation of conveyance system at the farm level, LASER land levelling for improving application efficiency, promotion of high efficiency irrigation systems for enhancing water use efficiency, and capacity building of the stakeholders in the province.

Implementation of the envisaged activities would result in enhancing water productivity and improving the quality of agricultural commodities to become competitive in the international market. The interventions proposed under the project are environment friendly as these allow efficient utilization of costly agricultural inputs like fertilizers, as well as help to minimize herbicide / pesticide's use. The underlying objectives of the envisaged initiative are consistent with those of the agriculture sector as a whole that aim at increasing water productivity at the farm, ensuring food security, economic uplift of small farmers, and improving economy of the country as a whole.

6. DESCRIPTION OF THE PROJECT

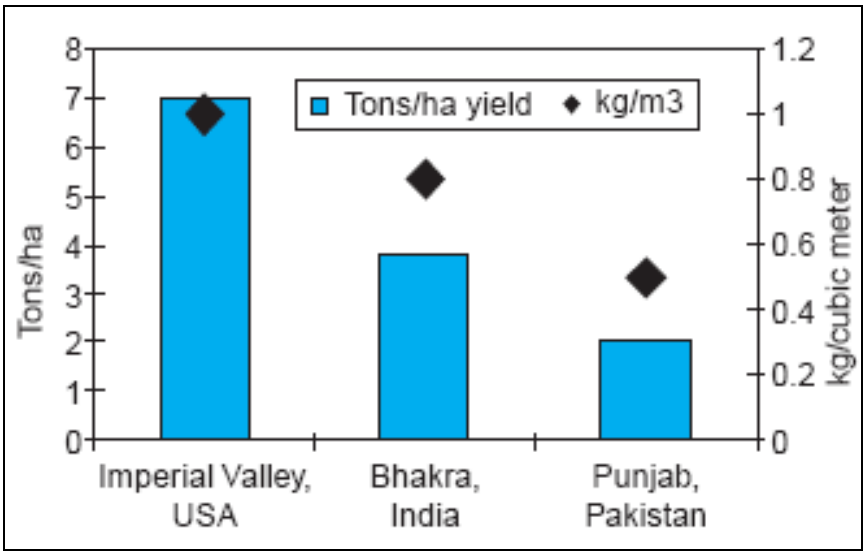
I) BACKGROUND/JUSTIFICATION

Water is the most critical and precious input for crop production in arid and semiarid areas. Growing physical scarcity of freshwater resources, snowballing uncertainties associated with ongoing climate changes in economically accessible water, growing population, and increasing competition for water amongst various sectors has threatened sustainability of agriculture in many developing countries including Pakistan. The situation has further aggravated due to low crop water productivity causing persistent food insecurity besides environmental degradation.

Irrigated agriculture is the lifeline of Pakistan's economy contributing 90 percent of the total agriculture share (over 21 percent) in Gross Domestic Product (GDP) and employs approximately 48 percent of total labour force. The sector is so intimately interwoven with almost all other major sectors that it acts as engine of growth for rest of the economy. However, the performance of agriculture sector in terms of water use and capacity as well as quality has remained very low for the last few decades. More importantly, the crop water productivity has been lowest than its potential because of ineffective and inefficient utilization of agricultural

resources, particularly water. Water is the determining factor for agricultural development, which, however, has to be managed sustainably. On the other hand, Pakistan's population has increased at a rapid rate and crossed 170 million posing a challenge to food security. It has been indicated that Pakistan is entering in the band of water scarce countries of the world where per capita water availability equals 1,000 m^3.

A comparison of wheat yields in Pakistan' Punjab, California (USA), and Indian Punjab show productivity ratios of about 3:6:10 per unit of land, and about 5:8:10 per unit of water (**Figure-1**).



Source: Pakistan Water Economy: Running Dry by John Briscoe & Usman Qamar (2006)

Figure-1: Wheat Yields per Unit of Land and Water

a) Water Resources Status

Pakistan has the largest single contiguous gravity flow irrigation system in the world. The Indus Basin Water System (IBWS) comprises three major reservoirs, 16 barrages, two headworks, two syphons across major rivers, 12 inter river link canals, 44 canal commands, and more than 140,000 watercourses. One of the main problems with the irrigation distribution network is that its design capacity cannot meet the crop water demands. The canal systems in Pakistan were designed for low water allowances targeting around 75 percent cropping intensity with the objective to thinly spread limited supplies over a large area. The growth in agriculture sector and its increasing commercial orientation resulted increase in the cropping intensity, crop diversification, and shift to high yielding hybrid varieties that consume more water.

The main source of irrigation in Pakistan is from vast canal systems but available surface supplies are inadequate to meet crop water requirements. This deficiency is met with groundwater abstraction mainly in the areas underlain with usable aquifers. Shallow subsurface water of good quality is, however, found merely along canals or in narrow belts of five to ten miles in flood plains of the rivers. In areas away from rivers or canals or in deserts, the underground water is highly mineralized but the farmers are pumping it desperately to make up shortage of the surface supplies. This is evident from the fact that the number of tubewells in the Punjab has increased from less than 10,000 in 1960 to about 1,000,000 in 2011, which are causing depletion of groundwater at alarming rates. Decline of watertable in freshwater areas is resulting in intrusion of saline water in these areas from adjoining brackish aquifers. The continuous use of deteriorated quality water leads to soil degradation that affects the crop yields and creates serious problem of salinization of productive lands. Over-exploitation of subsurface water is a serious threat for sustainability of irrigated agriculture in the province.

The surface water supplies to the Indus Basin Water System (IBWS) had been expanded from 67 million acres feet (MAF) to 85 MAF in 1976, prior to commissioning of Tarbela Dam with storage at Mangla and connecting water surplus western rivers (Indus, Jhelum and Chenab) to the water short rivers in the east (actually transferred to India after the Indus Waters Treaty of 1960). The post Tarbela annual canal diversion reached up to 105 MAF. Since then, the annual canal water withdrawals (1976-2010) are continuously decreasing in Rabi while almost constant for Kharif. The total annual canal diversion has significantly declined to about 94 MAF in the last decade against post Tarbela of 105 MAF (**Figure-2**).

Furthermore, construction of new dams has social, environmental as well as financial constraints and there is a little additional water that can be mobilized that is likely to materialize in near future. Even if these are built, their storage will hardly make-up the capacity of existing reservoirs lost due to sedimentation and aging. Another peculiar risk for Pakistan's agriculture is its reliance on a single river system. India has complete rights on the waters of three eastern rivers (the Ravi, the Satluj & the Bias) under Indus Water Treaty besides some share in flows of the western rivers. Resultantly, Pakistan has to rely on the western rivers for meeting its irrigation requirements. There is, therefore, a dire need to use this precious resource wisely and efficiently to conserve it for future generations.

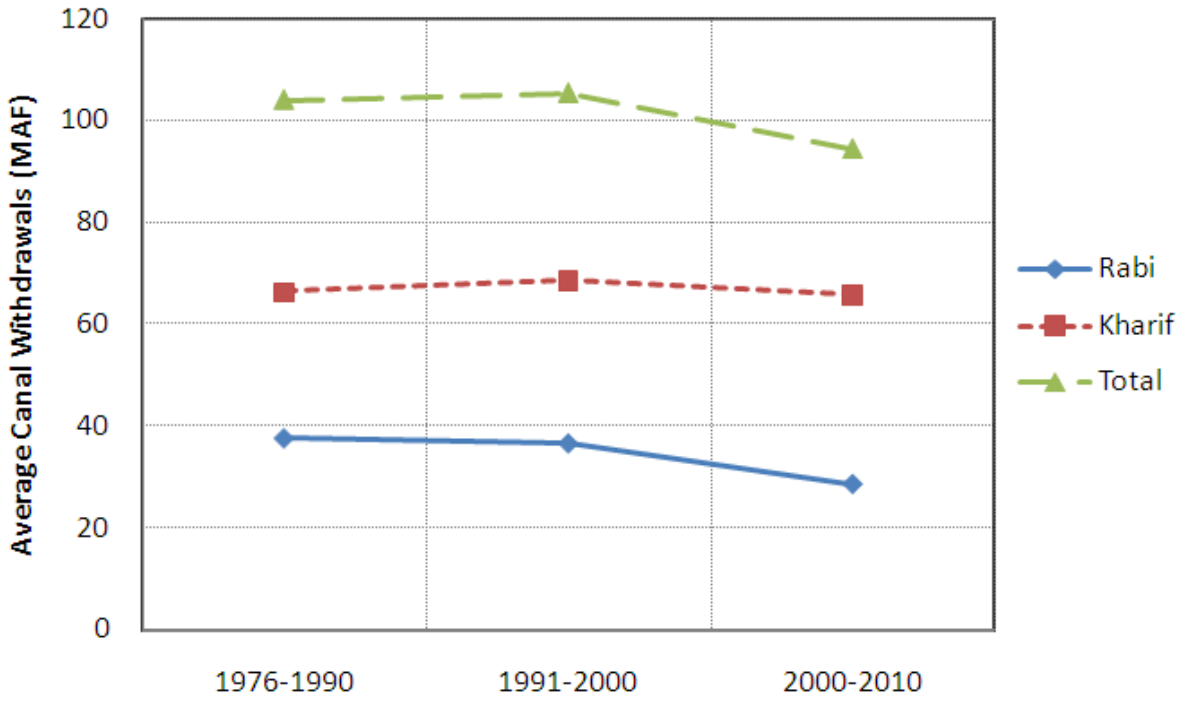


Figure-2: Average Canal Diversions (1976 to 2010)

b) Irrigation Efficiencies

Flooding is the most common irrigation method practiced by the farmers and its efficiency is not more than 50 percent. Such low irrigation efficiencies at farm level are major constraint in attaining potential production from otherwise highly productive agricultural lands. In addition, more than 40 percent of canal water is lost between mogha outlet and farmers' fields due to poor condition of tertiary conveyance system (watercourses). The crop water requirements are not met timely because of supply based irrigation water delivery, which negatively affects the overall agricultural production. A significant (20 to 25%) amount of irrigation water is lost during its application due to uneven fields and poor farm designing. This leads to excessive application to low-lying areas and under-irrigation of higher spots. Over-irrigation leaches soluble nutrients from the crop root zone, makes the soil less productive, and degrades groundwater quality on one hand whereas under-irrigation of elevated parts of the fields results in accumulation of salts in such patches besides causing water stress and injurious effects of applied fertilizer on the other.

The total surface water allocation for the Punjab as per Water Accord 1991 is 41.82 million hectare meters (55.54 MAF). There are, however, huge water losses in the distribution network comprising of main/branch canals, distributries, minors, and tertiary conveyance systems

comprising of about 58,000 watercourses. In addition, there are also substantial water losses (25%) at the farm level. The surface water available at the farm gate is only 16-19 million hectare meters (22-25 MAF) that is highly insufficient for sustainable irrigated agriculture. The groundwater abstraction is about 22-26 million hectare meters (30-35 MAF) to makeup shortage of the surface supplies. The water budget of the Punjab irrigation system is given in **Figure-3.** The situation further aggravates in the Rabi season when there are very low river flows and agriculture mainly depends upon groundwater. It is, therefore, imperative to devise holistic on farm water management (OFWM) approach for utilizing the scarcely available water more effectively and efficiently at the farm level.

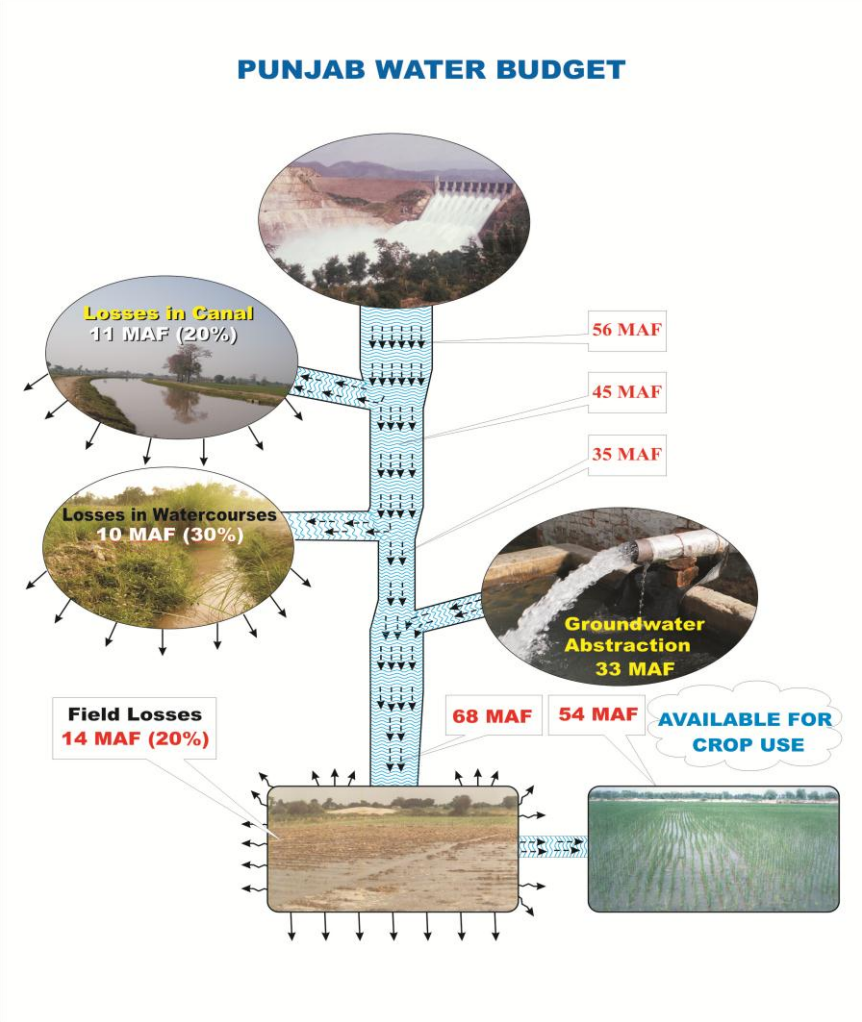


Figure-3: Punjab Water Budget

c) Punjab Context

The Punjab is the largest province of the country with respect to population. Its total geographical area is 20.63 million hectares or 50.98 million acres, out of which 0.50 million hectares or 1.24 million acres (2.42 %) are under forests, 2.98 million hectares or 7.36 million acres (14.5%) are uncultivable, 1.63 million hectares or 4.03 million acres (7.90%) are culturable waste, and 12.57 million hectares or 30.06 million acres (60.93%) are cultivated. More than 70 percent cropped area of the Indus food machine is situated in the Punjab. Its share in total agricultural production of the country is more than 80 percent in case of cotton, almost 70 percent for wheat, nearly 60 percent for sugarcane, and 50 percent in rice. Major crops are wheat (38%), cotton (15%), rice (10%), sugarcane (4%), and orchard (about 2%) as shown below (**Figure-4**).

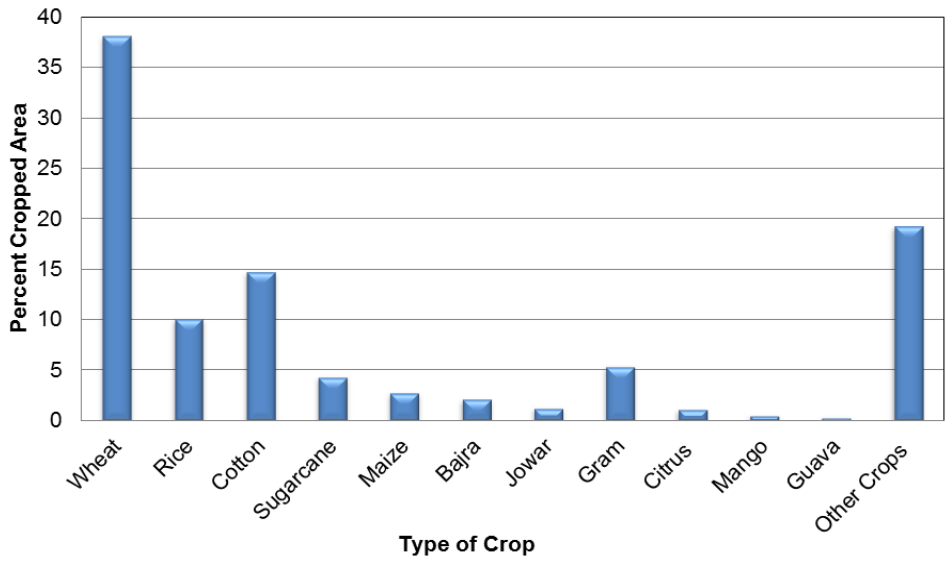


Figure-4: Cropping Pattern in Punjab

The Punjab is Pakistan's agricultural and economic heartland contributing over 80 percent towards agricultural output and about 90 percent of it comes from irrigated areas. Despite its everlasting significance in this vital sector of country's economy, the province is facing acute water shortages creating threats for food security of its people. Furthermore, the dismally low irrigation efficiencies at the farm level are major constraint in attaining potential production from otherwise highly productive agricultural lands. The water shortages registered during the last few years were as high as 40-50 percent. Although water resources have been considerably expanded

due to construction of dams, canals etc. during last four decades but these developments are not consistent with population growth.

On the basis of current water shortages and rapidly competing future demands, the foreseen situation would simply be unsustainable for agriculture on which national economy is based. Improving water productivity through capitalizing modern water resource conservation technologies and practices is the most viable option for maintaining the long term integrity of agriculture recourses; particular water. In fact, raising crop water productivity is the cornerstone of any demand management strategy to sustain crop production under escalating water shortages.

An integrated development approach based on promoting as well as adopting the most efficient modern technology-aided resource conservation technologies aiming at improving crop water productivity as well as research backup support is direly needed for sustainability of irrigated agriculture in Punjab.

d) Need for On Farm Water Management (OFWM)

It has been observed that the canal and subsurface water availability has almost become stagnant over last decade in the Punjab but there has been about 27 percent increase in crop production during 1999-00 to 2008-09 (**Figure-5**). This growth can be attributed to many factors e.g. improved irrigation management, use of better seeds, increased fertilizer application, effective insect/ pest control etc. The efficacy of all of these measures, however, largely depends upon improved water availability. There has been no incremental water resources development taken place during this period in the country as well as in the province. The only source of increased water availability at the farm level has been through adoption of conservation measures e.g. canal rehabilitation and lining, improvement of watercourses, LASER land leveling, bed and furrow irrigation etc. Mega initiatives implemented during this period for the purpose include National Program for Improvement of Watercourses in Pakistan (NPIW) wherein, improvement of 18,662 canal commanded watercourses and development/ rehabilitation of 3,734 irrigation schemes outside the canal commands have been completed with an investment of Rs. 15.742 billion. It has been quantified in its impact assessment study carried out by independent consultants that these improvements have increased farm level water availability to the tune of 2.30 million acre feet (MAF) per annum. In addition, the Punjab government incentivized establishment of LASER land leveling services in the private sector by investing Rs. 400 million

and currently more than 4,000 LASER units (including 2,500 government subsidized) are operating all over the province, which are annually leveling about 1.2 million acres of land resulting in saving of approximately 2.18 MAF water besides other numerous benefits.

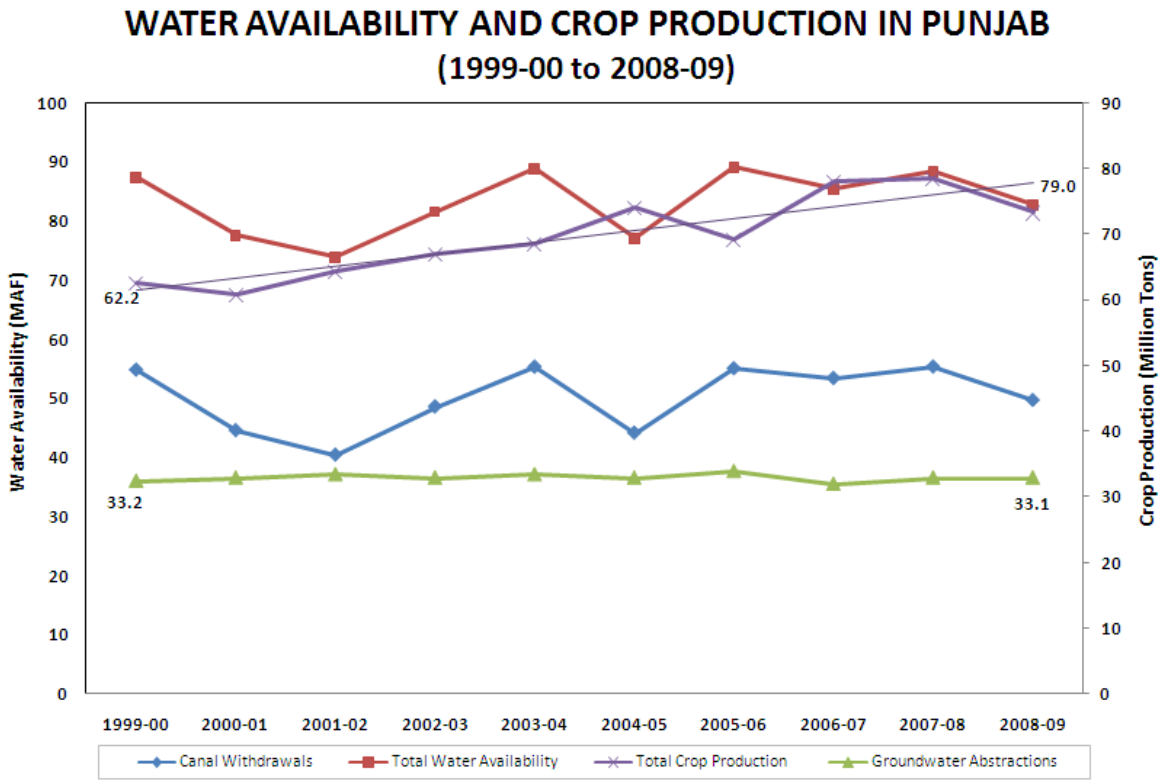


Figure-5: Water Availability and Crop Production

The Punjab on farm water management (OFWM) program is already promoting most of the above indicated interventions like improvement of un-improved watercourses for minimizing conveyance loss and to improve water availability at the farm level and provision of LASER land levelling services to reduce water application inefficiencies. Likewise, drip and sprinkler systems are being promoted to accelerate the efforts for conservation and efficient use of irrigation water at farmer's field. One of such programs is promotion of cotton cultivation with drip irrigation in Thal region for effective utilization of scarce irrigation water under desert environment. Furthermore, applied research has been started to resolve issues in adoption of new water management interventions as well as to provide backup support for their adoption by the farming community.

All above initiatives are being successfully implemented as standalone projects and improvements are contributing significantly towards enhancing water productivity at the farm level but a holistic approach has proved more successful all over the world. The proposed project envisages an integrated/comprehensive development package of on farm water management techniques and technologies as well as research backup support for maximizing productivity of irrigation water.

f) OFWM Technology Promotion Model

The canal network is being operated by the government while the watercourses are managed by the community. Accordingly, the input of an external catalyst is always required to carry out any community work. As such, the government has to continue its role for watercourse improvement by providing requisite technical and financial assistance for the purpose. The government may be gradually transferred to farming community when the management of feeding network will be shifted to farmers organizations.

The technology transfer plays a vibrant role for sustainable economic growth. Proposed project envisages technology transfer on the models successfully adopted in the province. For example, irrigation tubewells were initially installed by medium to large farmers as the government provided subsidy for installation of irrigation tubewells in addition to provision of drilling/boring services. The demonstration effects of the same created huge market that developed economy of scale for local fabrication of low cost tubewell machinery. The services related to tubewell machinery and drilling are now available in every nook and corner of the country. Resultantly, over 800,000 tubewells are in operation without any government support in the province and overwhelmly owned by small farmers.

Likewise, LASER land leveling was initially introduced on medium to large farms in 1985 when cost of LASER unit was Rs. 700,000 (US$ 53,000 @ 1US$ = Rs.13). It is pointed out that only one mega initiative by the government to subsidize 2,500 LASER levelers has resulted in about 80 percent local manufacturing of LASER equipment and development of repair facilities for LASER units at nearest places. Moreover, backup support is now available at local level. Consequently, the cost of LASER unit has come down to Rs. 500,000 or US$ 6,000 (1US$=Rs.85). The proposed project may, probably, be the last public sector intervention in

promotion of LASER land leveling technology as private sector will supplant the government role fully.

The similar strategy would be adopted for promotion of drip & sprinkler irrigation. As over 50 service providers are already involved in related services, the requisite capacity will be developed in private sector through project interventions. Although, on and off modes of PSDP funded HEIS project has discouraged the private sector to fully grow and come forward in a big way. Strenuous efforts will be made to encourage private sector for involvement in provision of various services related to high efficiency irrigation. The prime objective of proposed project would be as follows in this regard:

- Built confidence of service providers for assured sizeable market/clientage.
- Create enabling environment for existing pipe and plastic industry to start local manufacturing of drip/sprinkler components for technology indigenization.
- Encourage the firms for establishment of service provision network / backup support centers at regional/district level.

There is clear exit strategy from very beginning to gradually reduce government role by requisite creating capacity in the private sector.

e) Sustainability

The envisaged activities are designed to enhance the sustainability of the system. The project works will help to reduce the gap between demand and supply of water resources, thus enhancing the availability of water under escalating water shortages. It will also improve the application of chemicals and improve uptake by crops, which reduces waterlogging, salinity, mining of the groundwater aquifer as well as land and water degradation. The operation and maintenance of the works carried out under the project would be reduced and thus improving the sustainability of the works and this would ultimately help in enhancing sustainability of irrigation system overall. The project would provide necessary impetuous for private sector and farmers to undertake the installation of HEISs and Laser leveling as the works are being carried out through service providers that would develop their capability to carry out such works in the private sector. The project would have transformational effect in improving the sustainability of irrigated agriculture in Pakistan and improving its enduring productivity in Punjab.

d) Previous World Bank Assistance

The World Bank has a long history of partnership and collaboration with the Punjab government in water sector. It has provided support for several On Farm Water Management projects and has helped to introduce many irrigation innovations e.g. LASER land leveling, rainwater harvesting, high efficiency irrigation systems etc. The World Bank has provided assistance for three (3) standalone projects (OFWM-I, II & III) and OFWM components of seven (7) multisector projects under OFWM program, Punjab since 1981. Improvement of 14,252 watercourses; precision land leveling of 209,336 acres of land; establishment of 11,054 demonstration centers, installation of 2,643 community tubewells, and construction of 75 storage tanks were carried out besides imparting training to 45,937 personnel under these projects. Fourth OFWM project proposed for World Bank assistance could, however, not be finalized. The Agriculture Department recognizes the Bank's continuous support in bringing water management improvements and sees a vital role of the Bank in future also. The Punjab government may, therefore, seek further collaboration with the World Bank for finance, knowledge, expertise, and experience in this vital sector of the province.

The World Bank has also carried out two assessment studies including "Sustainability of FOs and Institutional Reforms of Irrigation System in Pakistan" and "Water Use Efficiency Improvement Study for Pakistan". The later focuses on assessment of farm level water saving technologies being implemented in Pakistan and identification of major constraints / issues impeding their development, adoption, and up-scaling.

II) PROJECT COMPONENTS

The major activities to be carried out under the proposed project would include, interalia, the followings.

A. Improving Water Productivity

- A-1 Installation of High Efficiency Irrigation Systems (HEISs)
- A-2 Strengthening of Precision Land Leveling Services in Private Sector

B. Upgrading Farm Level Irrigation Conveyance System

- B-1 Improvement of Unimproved Canal Irrigated Watercourses
- B-2 Completion of Partially Improved Watercourses

B-3 Rehabilitation of Irrigation Conveyance Systems in Non-Canal Commanded Areas

C. Adoption and Promotion of Modern Irrigation Technologies & Practices and Monitoring & Evaluation

C-1 Adoption and Promotion of Modern Irrigation Technologies and Practices

C-2 Monitoring and Evaluation of Project Impacts

D. Project Management, Supervision, Technical Assistance, Training and Strategic Studies

D-1 Project Implementation and Management Support

D-2 Implementation Supervision and Third Party Validation Consultancies

D-3 Strategic Studies, Technical Assistance, Training etc.

The description of envisaged activities under each component is given below. The conceptual framework of PIPIP is displayed in **Figure-6.**

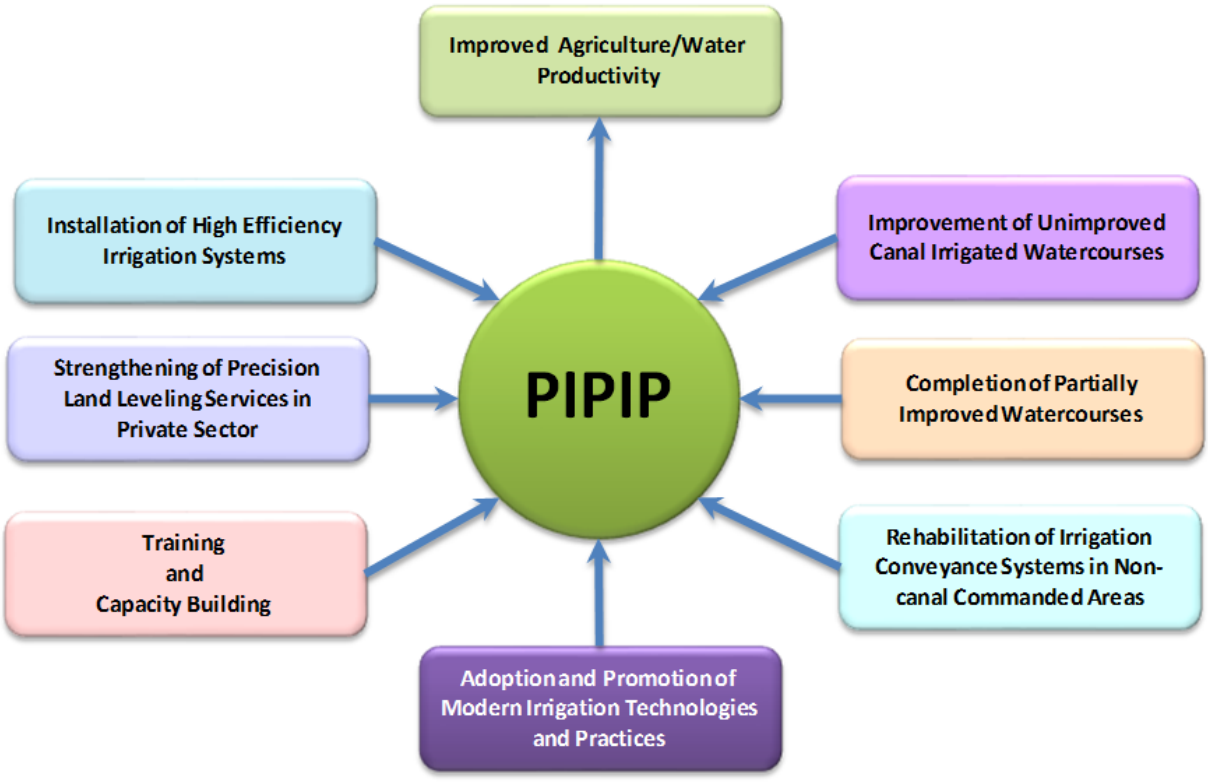


Figure-6: PIPIP Conceptual Framework

A. Improving Water Productivity

The component will support installation of high efficiency irrigation systems (HEISs) on **120,000** acres at farmers' fields. It will also include strengthening of precision land levelling services in the private sector through provision of **3,000** LASER units to the farmers/service providers in irrigated areas of the province.

A-1 Installation of High Efficiency Irrigation Systems (HEISs)

It is well established fact that irrigation water is the most critical factor in crop production and its efficient use enhances productivity of other non-water inputs as well. The Punjab is facing severe shortage of irrigation water for last many years on one hand and there is inefficient use of available resources on the other. The same is resulting in much lower agricultural productivity from highly productive resource base of the province. High efficiency irrigation systems have been found water and nutrient efficient and most appropriate option to address various crop production issues.

A-1.1 High Efficiency Irrigation Systems

Drip, bubbler, conventional sprinkler, rain-gun, center pivot etc. are together referred to as high efficiency irrigation systems (HEISs) which use pipes for conveyance of water from the source to points of use. In drip or trickle irrigation, water is provided to individual plants by means of small emitters in the form of droplets. Bubbler irrigation is very similar to trickle irrigation except that the water is delivered to the plants through micro sprinklers mounted on small spikes. In rain-gun irrigation systems, water is pumped at high pressure through a piped system and sprayed over the field.

i) Drip Irrigation System

Drip irrigation also called as trickle/micro irrigation is the most efficient technology that makes highly effective use of water, fertilizers, and nutrients. Its main principle is to apply water and other inputs slowly, regularly, and frequently as close to the plant roots as possible through emitters installed on plastic pipes laid out in the field. Regular and timely availability of nutrients throughout the plant growth period as per exact requirements and maintenance of favorable soil moisture conditions facilitate to maximize crop productivity. Drip irrigation technology is best suited for orchards and high value row crops such as cotton, maize, sugarcane, vegetables etc. It

has become the most valued innovation, which optimizes use of water and fertilizers by enhancing the irrigation efficiency as much as 95 percent.

A typical drip system includes a pumping unit, fertilizer tank, connecting/jointing fittings, filters, underground main pipeline with field hydrants, header pipes, laterals, emitters etc. The schematic layout of typical drip irrigation is presented in **Figure-7.**

ii) Sprinkler Irrigation System

The sprinkler system is the overhead irrigation whereby water is sprayed on the soil/crop somewhat like rain. A typical sprinkling unit comprises of an electric or diesel pumping unit, a portable or buried main pipeline with hydrants at predetermined intervals, and one or more sprinklers units attached to hydrants or hose. The schematic layout of typical sprinkler irrigation is presented in **Figure-8.** The parts of sprinkler head are shown in **Figure-9.**

Sprinkler systems are classified into various types on the basis of their spray pattern and mobility/portability.

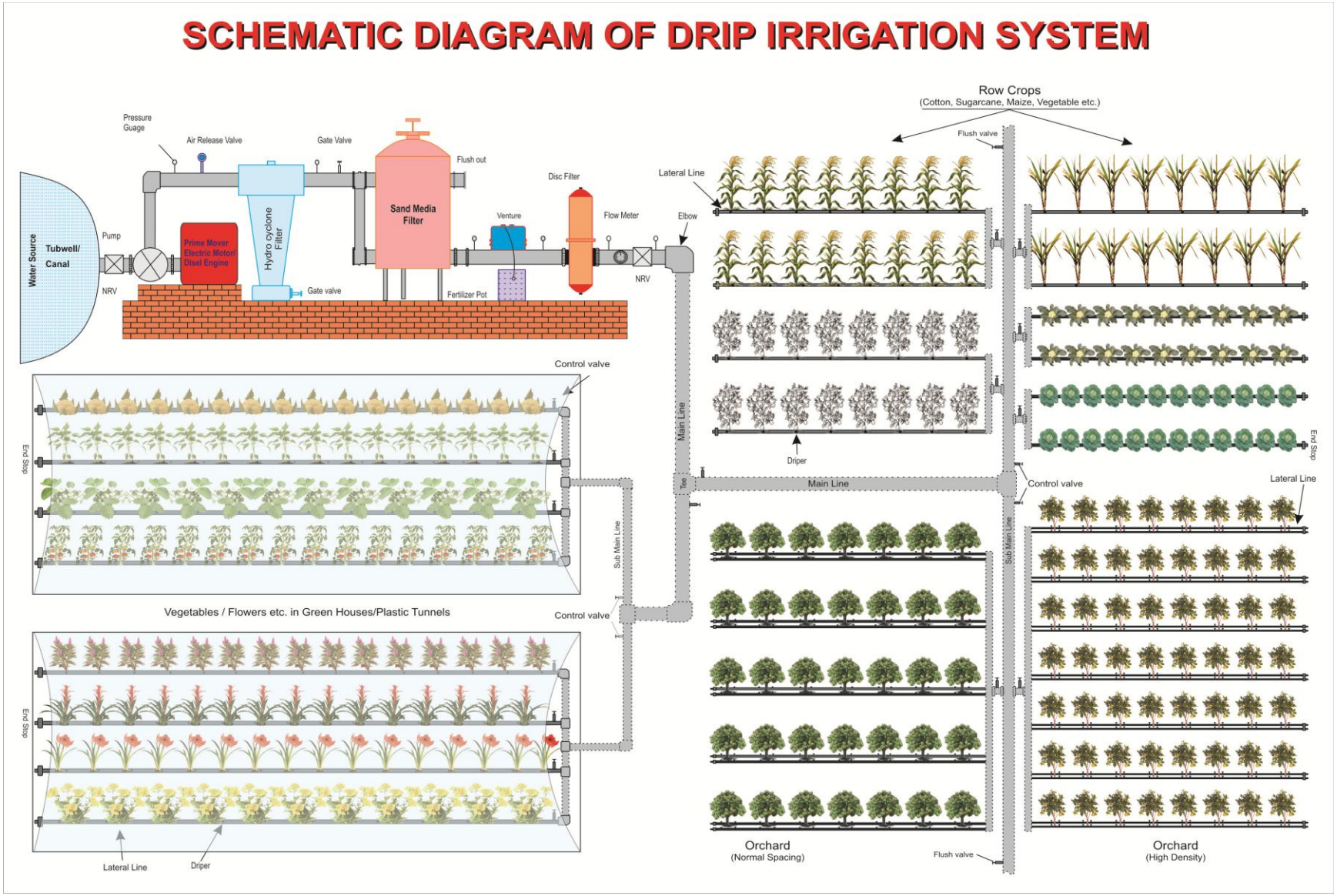


Figure-7: Schematic of Drip Irrigation System

Figure-8: View of Installed Drip Irrigation Systems

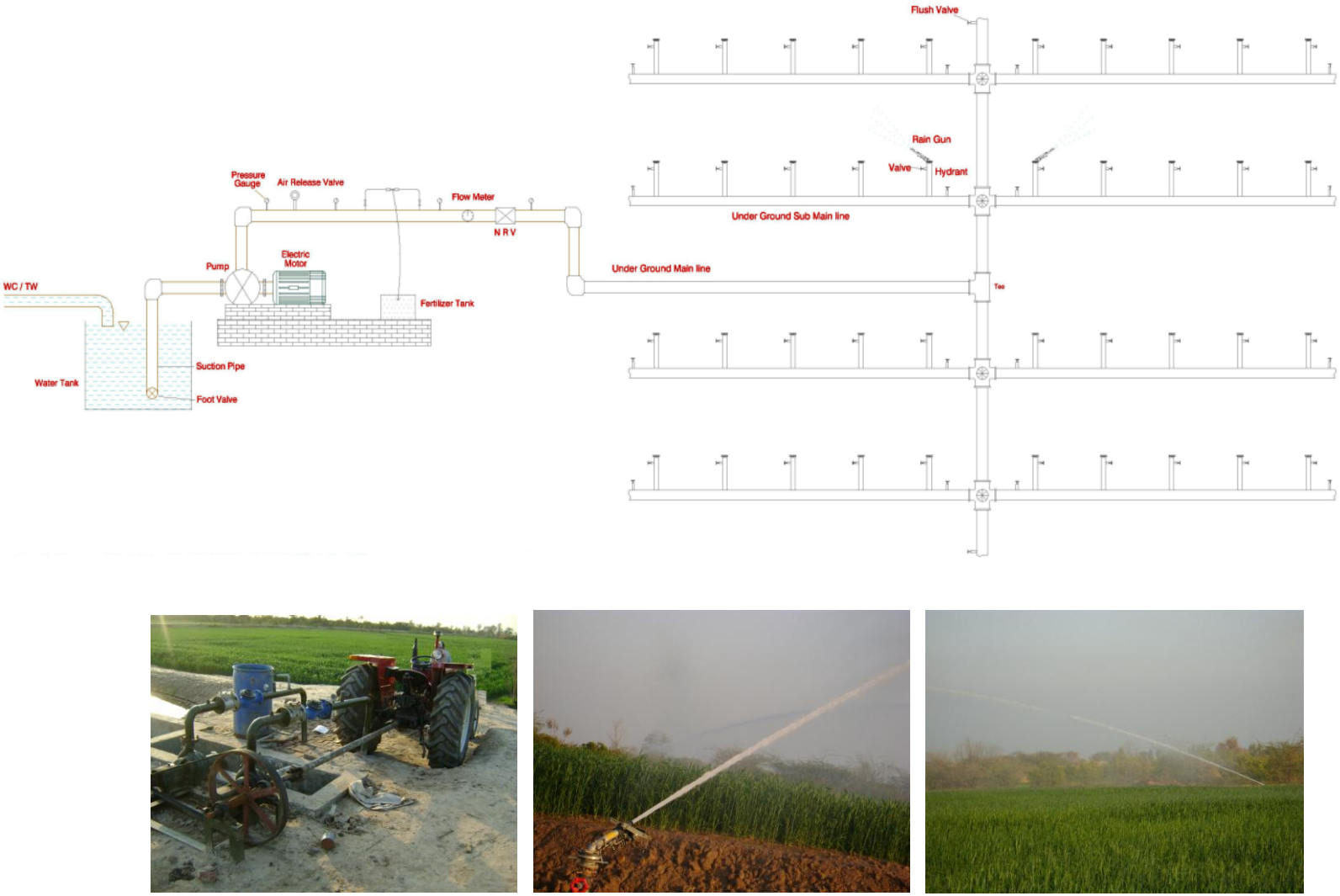


Figure-9: Sprinkler Irrigation System

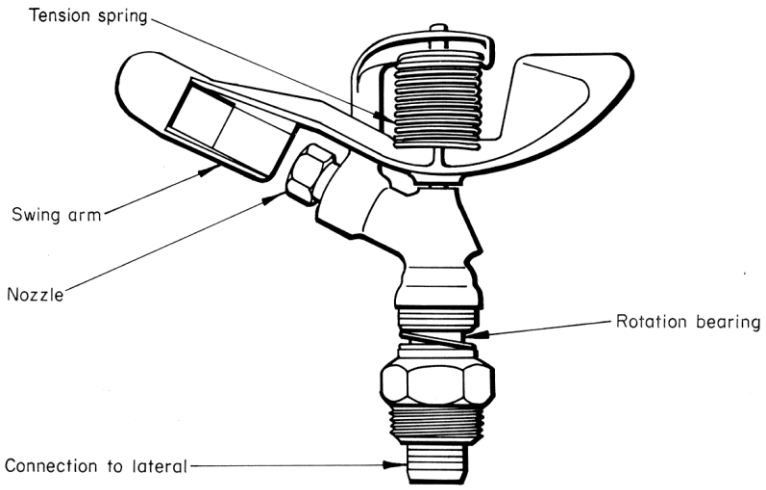


Figure-10: Sprinkler Head

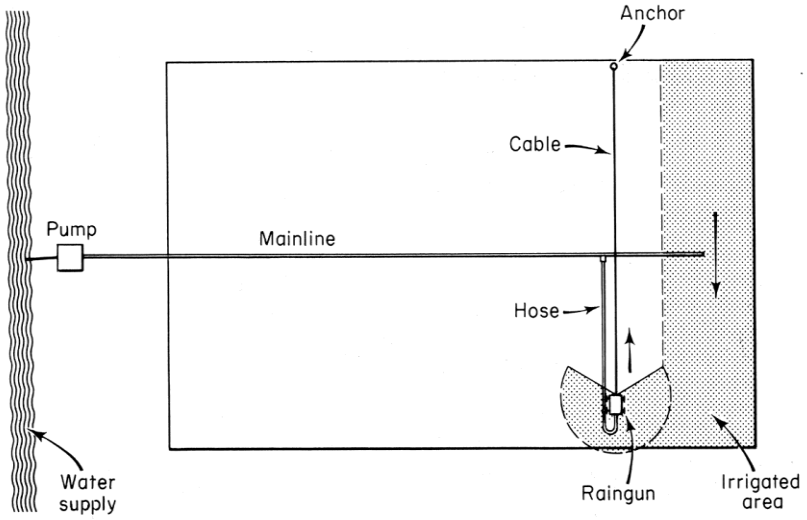


Figure-11: Layout of Hose Pull Reel Carriage System

a) Raingun

Raingun systems use large volume sprinklers operating at relatively high pressures (3-6 bars), mounted on a riser stand or towed through the field. In permanent system of installation, raingun riser stands are permanently fitted to solid pipeline network. The off-take points are either below the ground or elevated about the ground level fixed in masonry/concrete. In semi permanent

system, pipeline network is usually permanent and rain gun riser stand or only raingun is shifted from one location to the other.

b) Reel System

The reel sprinkler system uses a flexible hose for supply of water to the gun. A winch cable anchored at the end of the field pulls the cart through the field. These systems have their own power unit and cable winch mounted directly on the machine. The power unit may be an internal combustion engine or a water drive. This system requires more labor and higher operating pressures than center pivots and linear moves.

c) Center Pivot System

Central pivot sprinkler is a form of overhead irrigation consisting of self-propelled sprinklers rotating continuously around the pivot (center) point mounted on a trussed beam. It is a continuous move system comprising of a single lateral with a set of sprinklers mounted on a drive unit and suspended by trusses. The water is supplied from the source (a pump, a reservoir or a ditch) to the lateral through the pivot. The water application rate is controlled by the speed of rotation. The schematic of center pivot system is shown in **Figure-12**.

Center pivots are electric or engine drive systems, which can operate on soils with upto 15 percent slope. These systems are generally not recommended for heavy soils with low infiltration rates. Electricity driven pivots are the most popular devises due to flexibility of their operation. Computerized control panels allow speed changes at any place in the field, reverse the pivot, turn on auxiliary pumps at a specified time and use many other features. Center pivots are usually less than 500 meter in length (circle radius). The system is designed to provide a variable emitter flow rate across the radius for achieving uniform irrigation application.

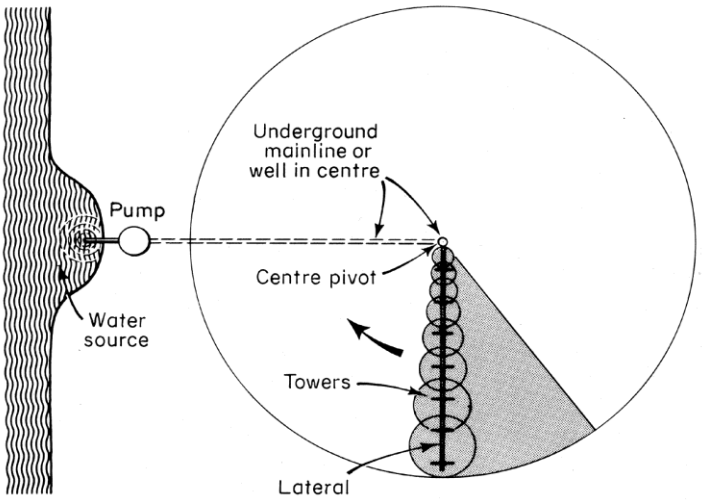


Figure-12: Layout of Center Pivot System

Figure-13: Center Pivot System

d) Linear Move System

The linear move sprinkler system is an adaptation of the center pivot. It moves in a straight line through the field at right angles to the row direction instead of moving in a circle. The hardware is very similar to the center pivot, there is a "boss" tower that moves with the remainder of the machine. Linear move machines use spray nozzles or low pressure impact sprinklers.

The system is designed for rectangular fields where travel distance is 2-3 times higher than the length of the machine. Since these sprinklers use low to medium pressure, they are best suited to fields with minimal elevation differences.

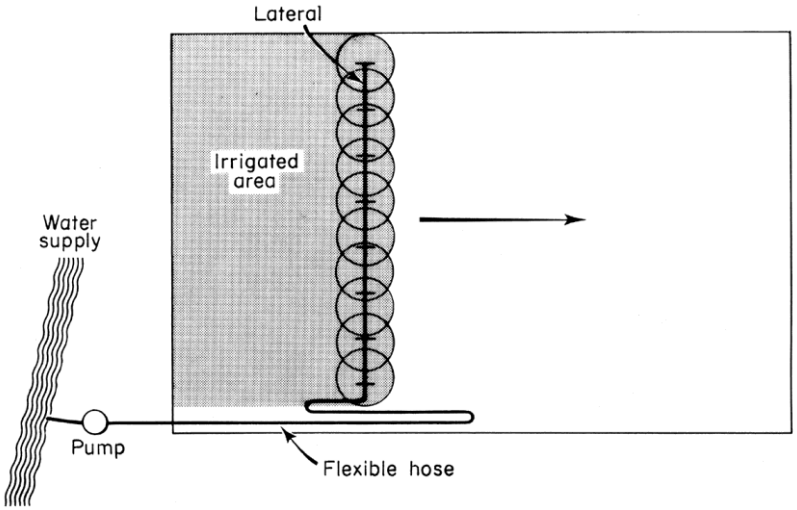


Figure-14: Layout of Linear Move System

Figure-15: Linear Move System

iii) Impacts of High Efficiency Irrigation Systems

Flood irrigation is the traditional irrigation practice at the farm level adopted by majority of the farmers in Pakistan. The efficiency of traditional irrigation methods ranges from 40-70 percent, while the drip and sprinkler irrigation systems are the most efficient having efficiency upto 95 percent as illustrated in **Figure-16.**

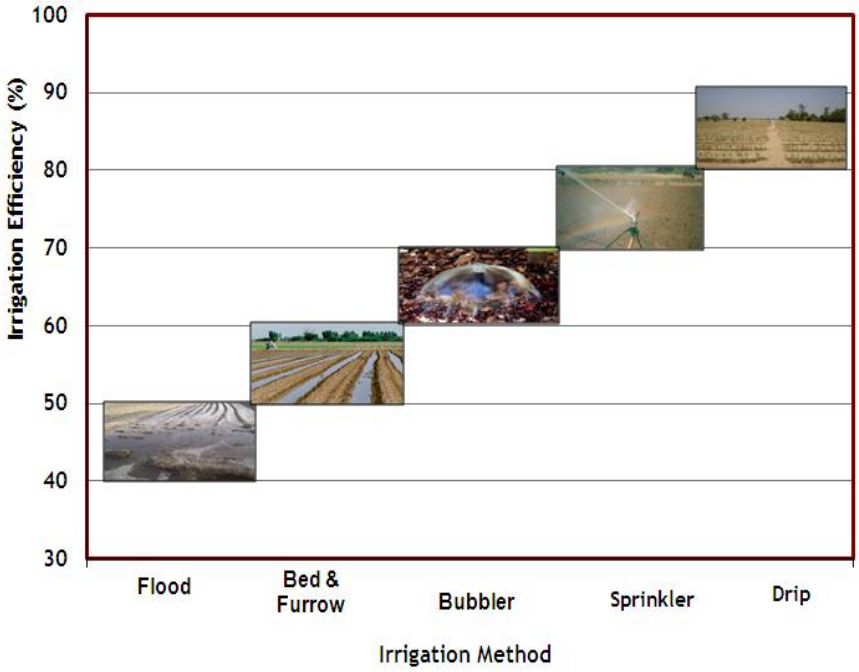


Figure-16: Efficiency of Irrigation Methods

The high efficiency irrigation systems (HEISs) have been developed and successfully adopted in various countries of the world including USA, Australia, China, India etc. Major constraint in adoption of these technologies is their high installation and operational costs. The issue has, however, been resolved through research on development, particularly in China where cost effective systems have been developed for orchards and all field crops including vegetables. The experience of other countries and studies conducted in the recent past recommend that introduction of high efficiency irrigation systems is highly effective in conserving water resources.

The impact assessment studies for performance evaluation of drip/sprinkler irrigation on sugarcane, citrus, potato, wheat, and gram have been undertaken by technical committees headed by Director (Research) of particular crops, with representatives from Punjab Economic Research Institute (PERI), Crop Reporting System (CRS), and Planning and Evaluation (P&E) Cell of Agriculture Department. These technologies have exhibited following impacts against conventional irrigation methods.

Sugarcane

- Increase in yield 39%
- Additional land brought under sugarcane 72%
- Water saving 57%
- Saving in irrigation cost Rs. 8,500 per acre
- Reduction in labour for irrigation management 60%
- Saving of Nitrogen and Phosphorous 53% and 28%
- Sugar recovery against conventional flooding 11.2% against 9.18%
- Easy, precise, efficient and uniform fertilizer application

Citrus

- Additional plants planted per acre 47 Nos.
- Reduction in mortality rate 100%
- Saving in irrigation cost 72%
- Increase in yield 105%
- Enhancement in sale price 76%
- Juicy contents 30% more
- Bigger fruit size 67 mm against 45 mm
- Uniform size & shape and better color fruit
- Adoption of high density orchard plantation for higher yields

Potato

- Increase in yield 34%
- Water saving 50%
- Savings in fertilizer used 30-40%
- Tuber cleanliness
- Better weed control
- Higher ratio of larger tubers

Wheat

- Increase in yield 230%
- Water saving 50%
- Enhancement in cropping intensity 100%
- Efficient nutrient uptake
- Uniform and better seed germination

Gram

- Water saving 50%
- Increase in cropping intensity 100%
- Better utilization of inputs
- Positive impact on socioeconomic status of farmer

In addition, Nuclear Institute for Agriculture and Biology (NIAB) Faisalabad has evaluated drip irrigation for cotton and flaunted the following impacts.

- Water saving 49%
- Increase in yield 52%
- Input productivity improvement
  - Fertilizer 69%
  - Water 67%

It is proposed to promote high efficiency irrigation systems (HEISs) on **120,000** acres for increasing water use efficiency and productivity of more remunerative crops including fruits and vegetables to bring their production to a level where not only domestic needs are fulfilled rather exportable surplus is also generated for foreign exchange earnings. Promotion of following water saving technologies would result in cultivating more area with same quantity of irrigation water as well as improving quality of the produce to become competitive in the international market.

iv) Eligibility Criteria

The farmers will be invited to apply for grant of financial assistance for installation of drip/sprinkler irrigation system. The transparent eligibility criteria followed under PIPIP (Pilot Phase) project will be adopted for selection of farmers under the proposed project after getting approval from the project steering committee (PSC).

v) Supply and Service Companies

The Agriculture Department is pre-qualifying the supply and service companies (SSCs) under PIPIP (Pilot Phase). It is planned to engage the pre-qualified SSCs for installation of HEISs under the proposed project after getting approval from the project steering committee (PSC). The SSCs would be responsible for installation of drip and sprinkler irrigation systems on turn-key basis and provision of post installation engineering and agronomic backup support services for at least two years. Their working would be regulated as per already approved procedures. The high efficiency irrigation system would be designed in accordance with accepted standards by keeping the costs down but ensuring trouble free operation.

A-2 Strengthening of Precision Land Leveling Services in Private Sector

Increasing water shortages have compelled the all concerned for developing strategies for efficient utilization of available water resources. Enhancement of water productivity at farm

level is the most appropriate solution to redress water scarcity. LASER land leveling is the best option for improving water productivity through minimizing water application losses. It is, accordingly, planned to accelerate the adoption of this technology through strengthening LASER land leveling services in the private sector.

A-2.1 LASER Land Leveling Technology

Precision land leveling (PLL) is a mechanical process of grading and smoothing the land to a precise and uniform plane surface at grade or no grade (zero slope) with variation of less than ±20 mm (2cm). Generally, traditional method is used for PLL that involves earth movement with bucket type soil scrapers and tractor mounted rear blades but it is very laborious and too expensive to finish the land surface to exact grade.

The LASER technology has proved to be a highly efficient tool for achieving a high degree of precision for carrying out PLL operations in much lesser time. The LASER controlled land leveling system consists of a LASER transmitter, a signal receiver, an electrical control panel, and a solenoid hydraulic control valve. The LASER transmitter transmits a LASER beam, which is intercepted by the signal receiver mounted on a leveling blade attached to the tractor. The control panel mounted on the tractor interprets the signal from the receiver and opens or closes the hydraulic control valve, that raises or lowers the leveling blade. Some LASER transmitters have the ability to level the field on single or dual graded slopes ranging from 0.01 to 15 percent.

Use of LASER technology in the precision land leveling was introduced in the Punjab during 1985 through on farm water management (OFWM) program. The same has been proved to be highly beneficial because it minimizes the cost of operation, ensures better degree of accuracy in much lesser time, saves irrigation water, ascertains uniform seed germination, increases fertilizer use efficiency, and resultantly enhances crop yields. An impact assessment study was carried out by Planning and Evaluation Cell of Agriculture Department during 2008 for its evaluation, which reveals following impacts at the farm level.

- Saving in irrigation time from 25.1 to 32.1 percent
- Increase in irrigated area by 34.5 to 42.0 percent
- Improvement in crop yields from 10.7 to 12.9 percent
- Reduction in farm cultureable waste land by 2.10 percent

Figure-17: LASER Land Leveling

A-2.2 Strengthening of LASER Land Leveling Services

There are about 210 LASER units with the District Governments including those transferred by the provincial government under Devolution Plan 2001 and added by them in the fleet from their own resources. A large number of these units have, however, became non-working due to lack of operational funds to be provided by the districts. The provincial government provided Rs. 8.00 million during 2008-09 to various District governments to make them operative to continue service delivery in the public sector. Moreover, the Punjab government has provided 2,500 LASER units to the farmers/service providers during three years (2005-06 to 2007-08) under "Strengthening of LASER Land Leveling Services in the Punjab" project, which has substantially improved the rental service of LASER land leveling for the farmers. Furthermore, about 1,425 units have been procured by the farmers/ service providers from their own resources in the province. It is indicated that one LASER unit can LASER level only 300 acres annually due to short window of time available for land leveling between Rabi and Kharif crops. Accordingly, precision leveling of about 1.2 million acres of land is carried out annually in the Punjab with nearly 4,000 LASER levelers available in private and public sector.

The total irrigated area of the Punjab is 34.38 million acres out of which about two million acres have been leveled once so far. Accordingly, precision leveling of remaining area in five years will require more than 22,000 LASER units. It is pointed out that LASER land leveling operation is required to be repeated after 3-5 years to get continued benefits of the technology.

It is, therefore, considered to add at least **3,000** more units to bring significant improvement in provision of LASER land leveling services. The innovative approach introduced under recently completed scheme will be replicated under proposed project for further strengthening of LASER land leveling services. This involves provision of one-time financial assistance to farmers/service providers for procurement of equipment and their capacity building to carryout the envisaged task that proved to be quite successful.

It has been observed that the demand for provision of LASER units is not uniform in all districts of the province. Actually, there is more requirement of LASER leveling in some areas growing cash crops like cotton, maize, potato, vegetables etc. It is, accordingly, planned that the distribution of LASER units among the districts would be based on the demand to be received in response to invitation of expression of interest by the farmers / service providers. The districts, where more applications will be received, will get proportionately more quota in the allocation of LASER units.

It is planned to provide **3,000** LASER units to the farmers/service providers for promoting LASER land leveling rental services in the province. The recipient will have the option of purchasing the equipment of his/her own choice from pre-qualified firms.

A-2.3 Prequalification of Supplier Firms

Locally manufactured LASER land leveling units as well as imported systems are readily available in Pakistan. The farmers/service providers will, therefore, have the option to purchase the LASER equipment of their own choice. The suppliers/manufactures will, however, be short-listed alongwith their units in order to safeguard quality of the equipment to be procured under the project. Each short-listed firm would be required to submit one complete set of its approved equipment, which will be used as reference for monitoring the quality of units subsequently provided to the farmers / service providers. The same will be returned to the concerned firm after completion of the project on provision of a certificate from all districts where the firm would have delivered LASER units that there remains no complaint/ shortfall to be addressed.

It is planned to engage already pre-qualified supplier firms under PIPIP (Pilot Phase) for provision of LASER land leveling units to the farmers after attaining approval for the same from the project steering committee (PSC).

A-2.4 Selection of Service Providers/Farmers

An applicant will be eligible for the grant of financial assistance provided that the person

i) possesses a tractor capable of operating LASER unit;
ii) is owner/tenant/lease and self cultivator of land not more than 12.5 acres and is preferably agricultural machinery service provider or an agricultural graduate possessing requisite land ownership;
iii) will agree to rent out the equipment for LASER land leveling in the area;
iv) undertakes to carry out/provide rental services for LASER land leveling of 300 acres per unit annually during project period; and
v) will be liable to pay full amount of financial assistance received for the purpose as arrears of land revenue in case of violation of any of the conditions of the scheme.

The project steering committee (PSC) would be authorized to amend/modify the above said criteria for selection of farmers/service providers. It is indicated that various makes and models of LASER equipment are available in the market, which are operable with different horsepower (HP) tractors e.g. 45-55 HP and more than 55 HP. Accordingly, the farmers would have the option of choose the equipment according to tractor they would be owning.

B. Upgrading Farm Level Irrigation Conveyance System

The proposed project will support upgradation of tertiary level irrigation system to enhance water conveyance efficiency. The activity will include improvement of canal irrigated watercourses, completion of partially improved watercourses, and rehabilitation of irrigation conveyance system in non-canal commanded areas. The watercourse command is a complex miniature irrigation system where water is distributed to the field by a weekly time rotation (warabandi) based on the size of the land holding as shown in **Figure-18**.

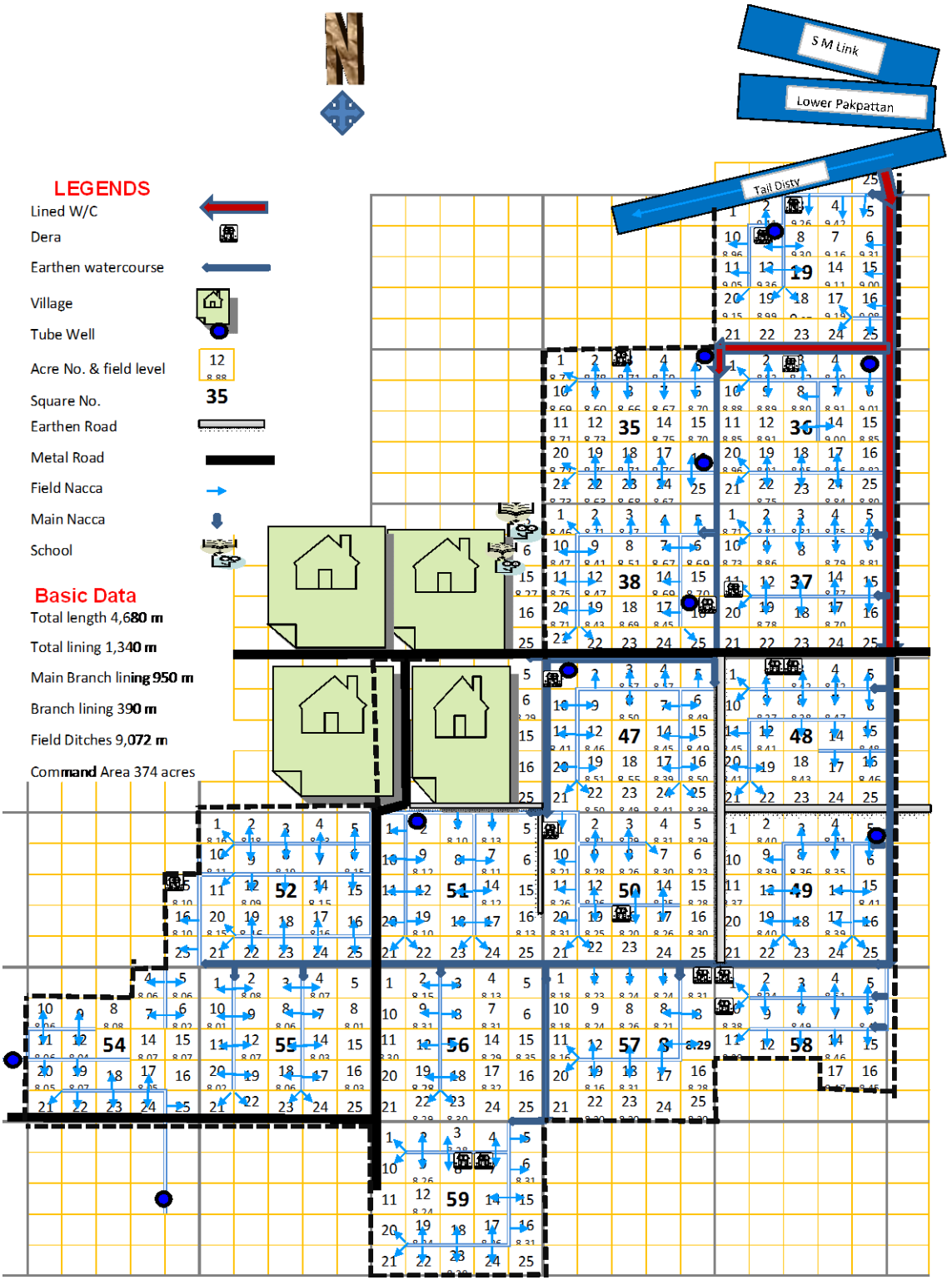


Figure-18: Typical Canal Area Watercourse Command

B-1 Improvement of Unimproved Canal Irrigated Watercourse

Tertiary level irrigation system in the Punjab comprises of about 58,000 watercourses. It has been established that a significant portion of irrigation water (about 40%) is lost in these century old community watercourses because of their poor maintenance and aging. The main sources of these losses are seepage, spillage, and side leakage from the watercourses, resulting from following factors.

- Irregular profile and zigzag alignment of banks, with many points of weakness
- Variable cross section of water channels
- Silt deposition, causing restrictions in flows, and overtopping
- Trees, shrubs, and vegetation growing in watercourses
- Damage caused by rodents and farm animals
- Frequent bank cutting and plugging for water abstraction

The potential for increasing water availability at farm gate by reducing this colossal wastage is, therefore, quite enormous. Accordingly, watercourse improvement offers a great opportunity for improving farm level water availability. The watercourse improvement / renovation consists of complete demolishing of community channel and its rebuilding/re-aligning according to the engineering design to increase conveyance efficiency by reducing seepage, evaporation, and operational losses.

B-1.1 Watercourse Improvement Status

Improvement of about 23,000 canal watercourses had been completed in the Punjab before launching of National Program for Improvement of Watercourses in Pakistan (NPIW) during 2003-04. Its Punjab component has an outlay of Rs. 28,223.50 million for improvement of 28,000 watercourses in canal irrigated areas and development/improvement of 2,000 irrigation schemes in barani tracts of the province. So far, 16,210 canal commanded watercourses have improved and 3,734 irrigation schemes have been developed in barani tract under NPIW. In total, about 39,210 canal area watercourses have been improved and it is planned to improve about 2,000 canal watercourses during current year (2010-11). As such, there will be still about 17,000 unimproved watercourses in the Punjab.

B-1.2 Impact of Watercourse Improvement

Different impacts evaluation studies have been carried out by various agencies under previous OFWM projects. The findings of these assessments have indicated significant benefits accruing from watercourse improvement including average reduction of about 33 percent in water conveyance losses, improvement in delivery efficiency to the tune of 38.5 percent, increase in cropping intensity by nearly 20 percent and overall increase in crop yields by around 24 percent. In addition to water savings, a number of other significant benefits also accrue from watercourse improvements including, inter alia, the followings.

i) Reduction in time to fill reaches of a watercourse, leading to increased time for field application. This is often perceived as the greatest benefit by the farmers.
ii) Control of tampering with watercourse turn-outs (nuccas), particularly in lined sections.
iii) Saving in land taken for watercourse right of way due to narrower cross sections of improved/lined reaches.
iv) Decrease in waterlogging, particularly adjacent to watercourses.
v) Lessening the drudgery of irrigation operation to a great extent.

A recently completed "Project Impact Evaluation Study (PIES) for National Program for Improvement of Watercourses in Pakistan (NPIW)" by the Planning Commission of Pakistan reveals that the intervention is highly cost effective option for improving farm gate water availability. The salient impacts of watercourse improvement reported in the study are summarized hereunder.

- Annual saving of 123 acre feet (AF) of irrigation water per watercourse
- Increase of 21 percent in irrigated area
- Improvement of crop yields by 10.8 percent, 5.9 percent, 12.4 percent, and 15.4 percent for wheat, rice, cotton and maize respectively
- Enhancement of cropping intensity by 4.37 percent
- Reduction in soil salinity by about 87 percent
- Shift to high delta crops like vegetables

It is, accordingly, highly essential that improvement of remaining watercourses may be completed in the shortest timeframe to mitigate the farm gate water shortages.

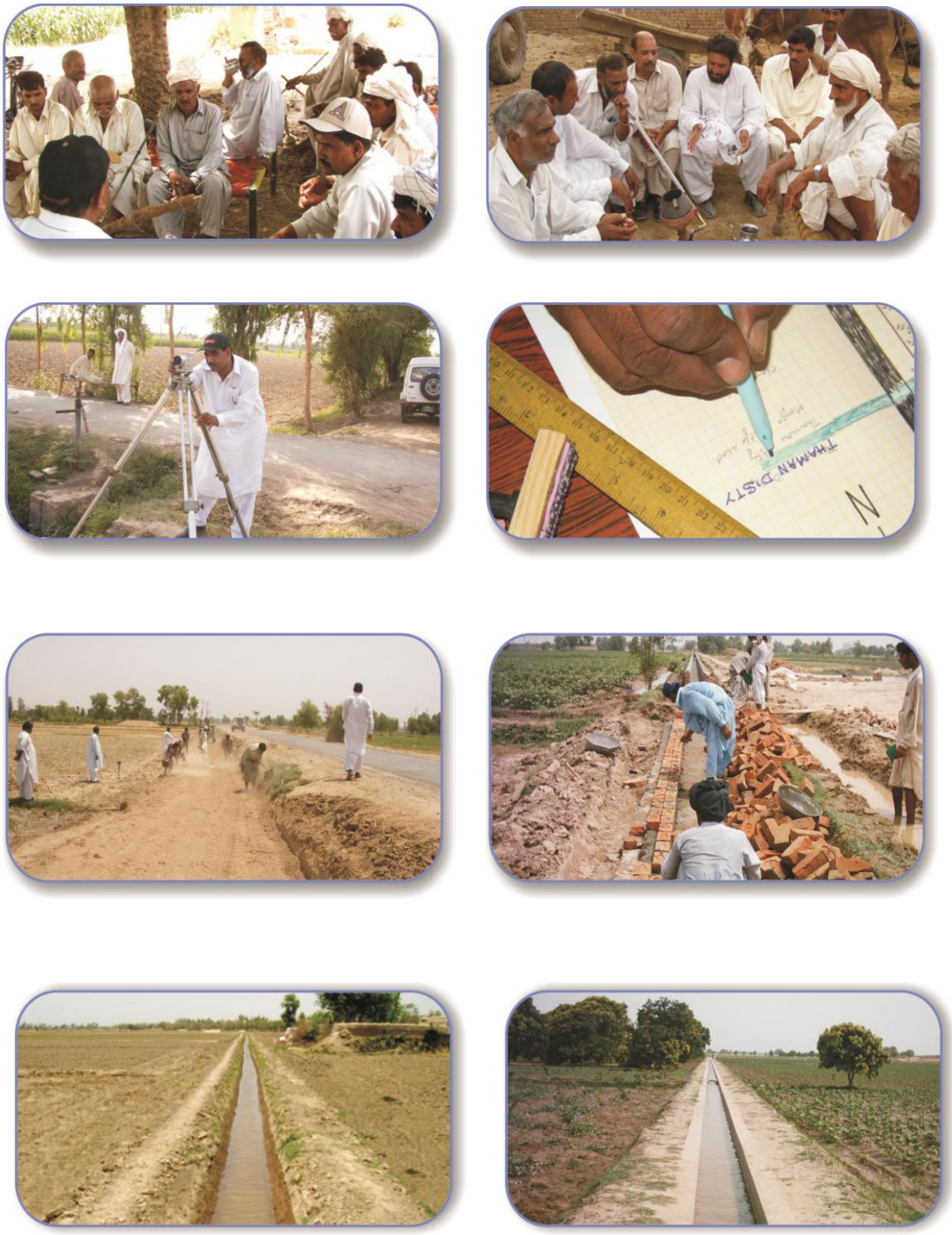


Figure-19: Watercourse Improvement Process

B-1.3 Organization of Water Users Associations (WUAs)

Effective involvement and participation of the shareholders acts as a catalyst for successful implementation of any development undertaking. The key of success of on farm water management (OFWM) program in Pakistan is farmers' participation in execution of envisaged interventions by following a community driven implementation approach. The OFWM staff has adequate capability and capacity to carry out requisite social mobilization by successfully undertaking this function for past 30 years. They have organized about 48,000 water users associations (WUAs) having membership of about 2,160,000 farm families in the province for improvement of watercourses. These WUAs have contributed in cash about Rs. 2.312 & Rs. 2.051 billion as skilled and unskilled labour for civil works respectively. Moreover, they have also contributed about Rs. 5.454 billion as unskilled labour for earthen improvements and Rs. 2.73 billion for material costs. It is indicated that watercourses feeding state lands/government farms cultivated by tenants/leasee may also be taken up under proposed project as per procedure.

There would be one WUA for each canal watercourse to be improved under the proposed project that will be registered under "On Farm Water Management & Water Users Association Ordinance [Act]-1981 (Amended 2001)". The WUA will be the key institution for implementation of watercourse development activities with following key responsibilities.

a) Provide right of way for constructing watercourse
b) Arrange skilled and unskilled labour required for reconstruction of earthen water channel, installation of structures and lining of critical reaches
c) Procure construction materials for carrying out civil works
d) Settle matters of disputes amongst the water users in respect of channel alignment, fixation of nuccas, distribution of work etc.
e) Make alternate arrangements for conveyance of water during execution of improvement works
f) Carry out civil works in accordance with standards and specifications under the supervision of OFWM field staff
g) Regularly undertake O&M of improved watercourses

In addition, WUAs would be encouraged to assume following functions.

a) Undertake construction / improvement of farmers' branches and field ditches
b) Participate in the process of water allocations and distribution (warabandi) within the watercourse command
c) Install and carry out O&M of community tubewells

d) Develop surface/sub-surface on farm drainage facilities
e) Facilitate distribution of non-water inputs
f) Access funding from various government and non-government organizations to carry out development works in agriculture sector

B-1.4 Watercourse Improvement

The watercourse improvement / renovation consists of complete demolishing of community channel and its rebuilding/re-aligning according to the engineering design with clean compacted soil. Parts of reconstructed channel are lined and necessary water control structures are installed to improve conveyance of the canal and tubewell water. The standard "Pucca" lining carried out under previous and ongoing OFWM programs is a rectangular shaped channel using double-brick masonry walls (23 cm) and a brick masonry bed (7 cm) plastered inside and on top of the walls. This design has proved to be durable and easy to install. The same will, therefore, be continued under the proposed project. Other types of lining e.g. pre-fabricated concrete (pre-cast parabolic lining), pipe, plastic etc. will also be followed considering farmers' choice, field conditions, and cost effectiveness.

Precast "nakkas" would be installed at all authorized places to reduce channel deterioration, seepage loss, to improve water control, and considerably reduce drudgery in irrigation operation. Under normal conditions, where the land is fairly leveled and belongs to one or two farmers only, the standard practice of providing one nakka (turnout and check) for every 25 acres is quite satisfactory. Extra provision of nakkas would, however, be made where the land has been subjected to fragmentation because of uneven topography repeated division of ownership, social problems etc. Moreover, culverts would be constructed at major crossings as well as a limited number of checks/drop structures, animal wallows/buffalo baths, and laundry sites would be provided as required. The construction of washing places and lining of reaches through villages give additional public health benefits. It is planned that execution of field activities will be carried out by following procedures adopted under NPIW for the purpose.

B-1.4.1 Lining Percentage

The lining of watercourses would be carried out upto 30 percent of total length of community channels. It has, however, been experienced under previous projects that actual lining remained much lower than maximum ceiling, which seriously affects watercourse improvement impacts. It is, therefore, proposed to fix lower limit of 20 percent in this regard.

B-1.4.2 Selection Criteria

The following criteria as followed under NPIW and PIPIP (Pilot Phase) will be adopted to take up watercourses for improvement under proposed project after its approval by the project steering committee (PSC) for the purpose.

a) Watercourse has not been previously improved.
b) The farmers are willing to form a water users association (WUA) and agree with the cost sharing arrangements to be followed under the proposed program.
c) The shareholders agree to re-construct katcha portion of the watercourse prior to commencement of lining work.
d) Sections of watercourse to be lined will be selected as per following criteria.
    i) Head reaches having maximum usage and flows.
    ii) Elevated sections susceptible to leakage, over topping, and spillage.
    iii) Portion of watercourse crossing / passing through / along villages/roads.
    iv) Sections having sandy/porous soils.

B-2 Completion of Partially Improved Watercourses

Lining of watercourses upto 50 percent length was found technically and economically feasible way back in 1980's. It was, however, limited upto 30 percent due to financial constraints to provide wider coverage of program with limited available financial resources. A large number of watercourses improved during last 35 years have been lined much lower than the permissible limits, or only nakkas have been installed, owing to funding constraints, farmers' financial capacity, lack of awareness etc. Although, it is needed to undertake watercourse lining upto 50 percent of entire watercourse length keeping in view the demand of the farmers, technical feasibility, cost effectiveness and current water economics, the financial constraints still do not permit it yet. It is, accordingly, proposed to complete lining upto existing permissible limits on **1,500** already improved watercourses under the proposed project.

In order to ensure execution of additional works on the already improved watercourses in a transparent manner, it is proposed to adopt uniform & transparent selection criteria and effective external monitoring mechanism as given below.

a) The entire cost recovery pertaining to previous improvements, pending if any, is deposited by the farmers into proper head of government account.

b) The watercourse is improved prior to NPIW would only be eligible for undertaking additional works under the scheme.

c) The procedure for undertaking additional works on the already improved watercourses will be as follows.

   i) A complete case accompanied with inventory of previously executed works and those planned to be covered under the proposed project, duly marked on the topo map, will be submitted to the PIS consultants for its scrutiny, checking and approval.

   ii) The PIS consultants will check and approve the designs and cost estimates, hold spot checking during execution of the scheme, and finally certify the completed works.

   iii) The PIS consultants will review the design and performance of existing lined section of the watercourses to recommend modification in design and upgradation of the section for improving its efficiency.

   iv) Nakkas, culverts and other structures will be installed on only sanctioned / approved points.

The above said criteria will be reviewed and modified by the project steering committee (PSC) on periodical basis to ensure smooth implementation of the project.

B-3 Rehabilitation of Irrigation Conveyance Systems in Non-Canal Commanded Areas

The farmers in non canal commanded areas mainly depend upon very scarce irrigation water available through precipitation and in certain areas from natural nallahs, small and mini dams, and limited pockets of groundwater. Accordingly, it is needed to rehabilitate/improve water conveyance systems of such sources to promote irrigated agriculture and enhance water productivity for long term sustenance of social and economic developments in these areas. It is planned to rehabilitate **2,000** irrigation schemes in non-canal commanded areas under the proposed project.

B-3.1 Conveyance Network of Non-canal Water Sources

The conveyance network of almost all non-canal water sources comprises of earthen channels. Its delivery efficiency is very low, which is major constraint in attaining potential production

from otherwise highly productive agricultural lands. There is, therefore, a great opportunity for saving loss of precious irrigation water and resultantly increase crop yields by reducing deficit irrigation as well as enhance cropping intensity.

B-3.2 Water Sources in Non-Canal Commanded Areas

Major sources of water in non-canal commanded areas of the Punjab are precipitation, small dams, mini dams, perennial nallahs, ponds, dugwells, tubewells etc. Brief description of the same is given below.

i) Small Dams

Small dams have been built mostly on state lands in Potowar area. There are 48 such dams already constructed but these are quite insufficient to collect the available rainwater runoff. The same have been built to bring more areas under irrigation by developing community irrigation schemes. The stored water in small dams could, however, not be fully utilized due to inadequate development of their command areas. There is, therefore, a vast potential to introduce irrigated agriculture in their commands with the available storage capacity of these dams by improving on-farm infrastructure facilities.

ii) Mini Dams

Mini dams have been constructed on either perennial nallas or runoff water from catchment areas at suitable sites. Mostly these are used for fish farming but some of the water is also used to irrigate the agricultural lands. About 600 mini dams have been constructed in Potowar area by individual or group of farmers.

iii) Water Storage Ponds

The water storage ponds have been built in low depressions to collect rainwater that is mainly used for bathing and drinking by animals. These ponds are, however, partially utilized for supplemental irrigation of adjoining lands.

iv) Hand Dugwells

A large number of hand dugwells have been built in Potowar area by the government organizations as well as by farmers themselves. Out of total over 4,300 dugwells, about 2,200 dugwells have been developed under OFWM component of Barani Village Development Project

(BVDP). A dugwell normally serves an area of about five acres and there is a lot of potential for rehabilitation of small irrigation schemes on these dugwells.

v) Perennial Nallas

There are a number of perennial nallas/natural streams passing through barani areas. Generally, the water from these streams is lifted for irrigation of adjoining cultivable lands.

vi) Tubewells

There are about 125,000 tubewells installed in non-canal commanded areas of the province for irrigation, owned individually or by a group of farmers. The water so pumped is highly expansive due to increasing energy costs. Improvement of their water conveyance system is, therefore, highly beneficial to minimize conveyance losses and to bring more area under irrigation.

B-3.3 Organization of Water Users Associations

The development/improvement of irrigation schemes involves social mobilization of the water users for their active participation in field activities, organization / registration of shareholders into water users associations to create a legal entity for acting as an interface with all stakeholders, and carry out development activities.

There would be one water users association (WUA) for each irrigation scheme or tubewell watercourse to be taken up for improvement under the proposed project. The WUA will be registered under "On Farm Water Management & Water Users Association Ordinance [Act]-1981 (Amended 2001)", which will be the key institution for implementation of project activities to develop/improve irrigation conveyance system.

B-3.4 Water Conveyance System Improvement Activities

The rehabilitation works on irrigation schemes in non-canal commanded area would be some what different than the conventional improvement of canal commanded watercourses. Mostly piped water distribution network will replace existing earthen channels. In case, the cultivatable area is at higher elevation than the water source, irrigation of fields is carried out by lifting the water. Such irrigation scheme generally includes, interalia, following components.

- Lifting of the irrigation water from the natural nallahs and low-lying water ponds through pumping devices.

- Conveying the water to the fields situated at higher elevations through GI and PVC pipes.
- Supplying water to the fields of lower or equal elevation through open channels.
- Connecting different fields having depressions in between through RCC or PVC pipes.
- Providing nakkas and turnouts at water distribution points.

It is planned to rehabilitate water conveyance network of existing lift irrigation schemes as well as develop such new schemes at suitable sites on the basis of demand and feasibility for promoting irrigated agriculture in non-canal commanded areas.

Similarly, there are a large number of tubewells installed in non-canal commanded areas for pumping irrigation water. Their watercourses pass through uneven topography or loose soil and a lot of water is wasted during its transit. The combined effects of leakage, wastage, and seepage result in heavy losses of water. The opportunity for increasing agricultural production by reducing this colossal wastage is, therefore, quite enormous. The watercourse renovation would consist of complete demolishing of watercourse and its rebuilding/re-aligning would be carried out according to engineering design. Parts of reconstructed watercourses will be lined and necessary water control structures will be installed to improve conveyance of irrigation water. Selection of watercourse will be based on uniform and transparent criteria approved by the project steering committee (PSC) for the purpose.

B-3.6 Conveyance Systems Renovation Procedure

The procedure for rehabilitation/development of irrigation schemes and tubewell watercourses will be same as adopted for these activities under PIPIP (Pilot Phase) after getting approval from the project steering committee (PSC). Details are given below.

a) The OFWM staff will mobilize shareholders of each irrigation scheme/watercourse to organize water users associations (WUA). The same will be registered under OFWM and W.U.As Ordinance [Act] 1981 (Amended 2001).

b) The WUA will execute an output-based agreement with DO (OFWM) wherein, roles and obligations of both the parties will be defined.

c) An account will be opened in a Commercial Bank to be operated jointly by its Chairman and Treasurer.

d) The OFWM field staff will conduct engineering surveys of the command area and prepare design and cost estimates in consultation with WUAs that will be checked / verified by PISCs. The competent authority will accord the Technical Sanction.

e) The WUA will execute, facilitate, monitor and supervise the works for their quality as well as responsible for dispute resolution, provision of land for irrigation scheme/watercourse right of way, and labour cost for installation of water control structures, lining etc. as well as material cost over and above the project assistance.

f) After completion of earthen watercourse construction, nakkas will be installed and culverts will be constructed.

g) The lining of critical reaches of watercourse will be provided subsequently.

h) The OFWM staff will provide technical assistance to WUA for watercourse development activities. DDO (OFWM) will make frequent visits at sites to ensure that field staff is regular in supervising the works and prescribed standards / specifications are being followed as well as offer the completion report to the PISCs for final verification.

C. Adoption and Promotion of Modern Irrigation Technologies & Practices and Monitoring & Evaluation

The need for judicious and economical use of scarce water resource for sustainable agriculture is becoming increasingly important day by day due to constantly escalating water shortages. Water Management wing is promoting various water management technologies and techniques for improving water productivity at farm level. Watercourse improvement contributes to improve water availability at farm gate through enhancing conveyance efficiency of tertiary water channels. Similarly, LASER land levelling of fields helps to improve water application efficiency through reducing application losses. Likewise, adoption of high efficiency irrigation systems adds to increase water use efficiency. There is, however, a huge gap in amount of water being applied and actual irrigation requirements that is required to be curtailed by modernizing application methods and scheduling the irrigation on scientific basis. Likewise, orthodox guess work of plant and soil feel/appearance for irrigation is needed to be replaced with scientific measurement and monitoring of soil moisture for accurate determination of "*WHEN and HOW MUCH water to apply to a field*". Measurement and monitoring of soil moisture and its use in decision making for irrigation would lead to shift from in-exact to exact or conventional to precise irrigation.

C-1 Adoption and Promotion of Modern Irrigation Technologies and Practices

This component will support identification, evaluation, indigenization, and adoption of modern irrigation technologies at farmers' field through creation of awareness among farming community, demonstration of envisaged improved water management interventions, applied research, and capacity building of stakeholders.

C-1.1 Awareness Campaign

The well informed and knowledgeable farmers contribute significantly in enhancing productivity of all factors of production i.e. water, nutrients, energy, labor, capital etc. It is, accordingly, planned to create awareness and motivate farming community to actively participate in project activities for improving water as well as crop productivity. The farmers will be made aware of efficient irrigation methods, farm layout planning and improvement, water saving agronomic practices, soil moisture measuring/monitoring tools and techniques, cultivation of high value crops under drip and sprinkler irrigation etc.

Technical information will be provided to the farmers for enhancing conveyance, application, and water use efficiencies at the farm level for improving crop as well as water productivity. A comprehensive mass awareness campaign would be launched in print and electronic media about project activities, services/facilities available to the farmers under the proposed scheme, and impacts/benefits of improved water management interventions. Publicity material about new irrigation technologies and project activities would be prepared and distributed among farmers. It is also planned to create awareness in this regard through workshops, field days, radio programs, media clips, cable operators etc. The field events would be organized at farmers' doorstep to ensure their maximum participation.

C-1.2 Establishment of Irrigation Demonstration Sites (IDSs)

It is envisaged to demonstrate various improved water management techniques and technologies to the farmers to make efficient use of available water at the farm gate as well as to translate water savings accrued from improvement in on farm irrigation delivery and application efficiencies into increased agricultural production. These water management technologies will be showcased at various irrigation demonstration sites (IDS) throughout the province. A compact block of agricultural land (about 25 acres) owned by the farmers will be selected at each site for

the purpose. These farms will be located at easily accessible locations and will be operated throughout the project gestation period. The selection of IDSs will be carried out in accordance with the transparent criteria approved by the project steering committee (PSC) for the purpose.

The project will provide technical and financial assistance for demonstrating envisaged water management technologies at selected sites. A detailed survey of the selected site/ farm would be conducted for collecting necessary data for layout designing. Proper farm layout and irrigation system design would be prepared for IDSs considering various factors e.g. topography, soil types, available irrigation supplies, cropping patterns to be followed, field sizes, farm channels, location of turnouts, pathways, on farm water storage etc. The technologies to be demonstrated will include improved irrigation methods (furrow, bed & furrow, basins, gated pipes, siphon tubes), water storage tanks, high efficiency irrigation (drip/ sprinkler) systems, irrigation scheduling, moisture measuring/monitoring, water saving agronomic practices (water saving crops and cropping patterns), high density orchard cultivation, crop diversification (high value cropping) etc.

Field days will be held at the IDSs in an organized manner during each crop season wherein, water users will be educated on different improved water management technologies. A water management information kiosk (WMIK) for keeping pamphlets, literature etc. will also be maintained at the IDSs for dissemination of information about showcased techniques among other farmers. The success of IDSs will be judged from their impact in terms of water savings, enhancement in crop production, and adoption of demonstrated interventions by the farmers of the adjoining area.

C-1.3 Development of Infrastructure for Water Management Services Provision

The growing demand for installing high efficiency irrigation systems has exposed many weaknesses in the private sector regarding provision of post installation backup support related to water management, particularly service delivery for sustainable operation of the systems and crop production under high efficiency irrigation. It is, accordingly, planned to support/encourage the registered supply & service companies for establishment of their service provision network/service centers at regional/district level.

All technical information about water management techniques in the form of brochures, pamphlets, booklets, monthly periodicals, guides in local language etc. will also be available at

service centers for availability to the farmers. The proposed kiosks will offer advisory services to the farmers and will support their efforts for efficient water management and crop diversification to grow high value crops.

The integrated technical assistance and water management advisory services through the service centers will eventually enhance crop productivity. It is anticipated that a viable homegrown services and support infrastructure would have been developed in the rural areas by project completion to support all water management related needs of the farmers.

C-1.4 Research and Development Activities

Research in water management technologies was an integral component of on farm water management (OFWM) program at its onset in 1977. These efforts led to the standardization of various lining alternatives, pre-cast panel nakkas, and various other structures. The research component was, however, discontinued during 1980s, when the focus was diverted to upscale the OFWM physical activities. Resultantly, there has been a little development/improvement in indigenization of the latest water management developments made in the World. Taking cognizant of this need, the Punjab government has already revived OFWM applied and adaptive research. The proposed project will support the research and development program for developing viable parameters of new water management interventions to suit local conditions for providing flexibility, accuracy, and simplicity. The same would facilitate successful adoption of modern water management technologies and practices.

Soil moisture is a critical and highly variable component of root zone environment. Plant growth and crop yield largely depend on timely application of water in required quantity. Its less as well as excess provision affects the growth and development of plant directly and, consequently, its yield and produce quality. Accordingly, irrigation scheduling (exact water application) becomes increasingly important, particularly for high value crops. It is planned to evaluate soil and plant moisture monitoring devices for their effectiveness including time domain reflectometer (TDR) soil moisture meters, moisture probes and sensors, “FullStop” (wetting front detector), evapotranspiration gauges etc. to develop precise irrigation practices. It is envisaged to evaluate and indigenize these tools and techniques in estimating crop water requirements of major crops and developing correlations with water availability for better planning about what to grow and how.

The farm area (about 75 acres or 30 ha) available at the Water Management Research Farm (WMRF) will be used to evaluate, indigenize, and demonstrate improved water management technologies and techniques. The same will help in obtaining the accurate information on their impacts and economic returns per unit volume of water i.e. water productivity. It is planned to demonstrate and indigenize/standardize irrigation methods including drip/sprinkler irrigation system, hydroflumes (gated pipe and syphon tube), furrow irrigation, bed & furrow irrigation etc. Other research activities to be carried out at the WMRF will include farm layout planning/improvement, farm irrigation & drainage systems, irrigation scheduling/moisture monitoring, crop production monitoring through RS and GIS techniques, residual moisture management etc. The ultimate goal of the research and development activities will be to design sustainable on-farm irrigation water management packages for different areas to enhance crop and water productivity. The moisture measuring tools and gadgets tested and evaluated at WMRF will be recommended for provision to the farmers for demonstration under the proposed project. It is planned that needing facilities will be created at WMTI and WMRF to carry out proposed activities.

The on farm water management research activities to be carried out by the Water Management Training & Research Institute at WMRF will be executed in collaboration with the scientists from eminent sister research centers, universities, institutions etc. The specific topics and areas of research will be determined by inviting proposals from researchers, which will be scrutinized and awarded by a committee constituted for the purpose. Apart from the applied research and pilot testing, it is also proposed to sponsor reviews and strategic studies on various water management issues of the country.

C-1.5 Development and Updation of OFWM Database

Global positioning system (GPS) has revolutionized the concept of spatial database management, although it started primarily as a navigation system. The GPS has now become an important planning and monitoring tool worldwide. Agriculture Department, in collaboration with SUPARCO, has developed geographic information system (GIS) software and established GIS laboratory for spatial database management of wide range of information regarding water management activities. The GIS lab presently has computer network and server having high speed broadband internet facility, and related customized software. Digitization of watercourse

command area maps and database development for 27 districts has been completed and incorporated in the database while work on seven districts is underway. There is, however, no provision for continued updation and upgradation of database as well as software itself. It is planned to update and upgrade this useful facility for effective planning and monitoring of OFWM performance under the proposed project.

Use of remote sensing (RS) technology for monitoring and planning purposes is gaining popularity in the field of water management all over the world. It is, therefore, planned to develop RS techniques for strengthening existing database for improved and effective monitoring of envisaged program activities as well as planning for future OFWM projects. The consultants would assist the Directorate General Agriculture (Water Management) in establishing a spatial GIS database (with geo-referencing) and procure the required satellite imagery to analyze project impacts as well as capacity building of OFWM personnels.

It is planned that existing human resource and facilities would be utilized while incremental resources will be provided for the proposed project to carry out intended activities. It is indicated that a block allocation of financial resources will be provided in the PC-I and the same will be provided to executing agencies for various activities under different sub-component on the approval of project steering committee (PSC).

Figure-20: Hydoflumes

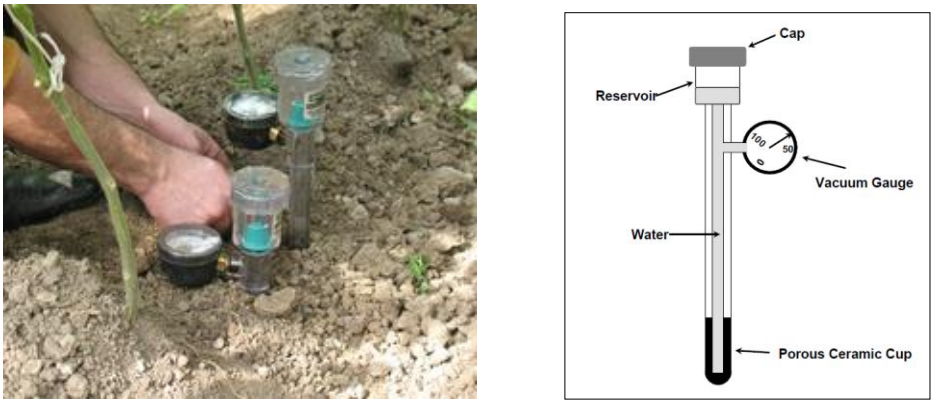


Figure-21: Tensiometer

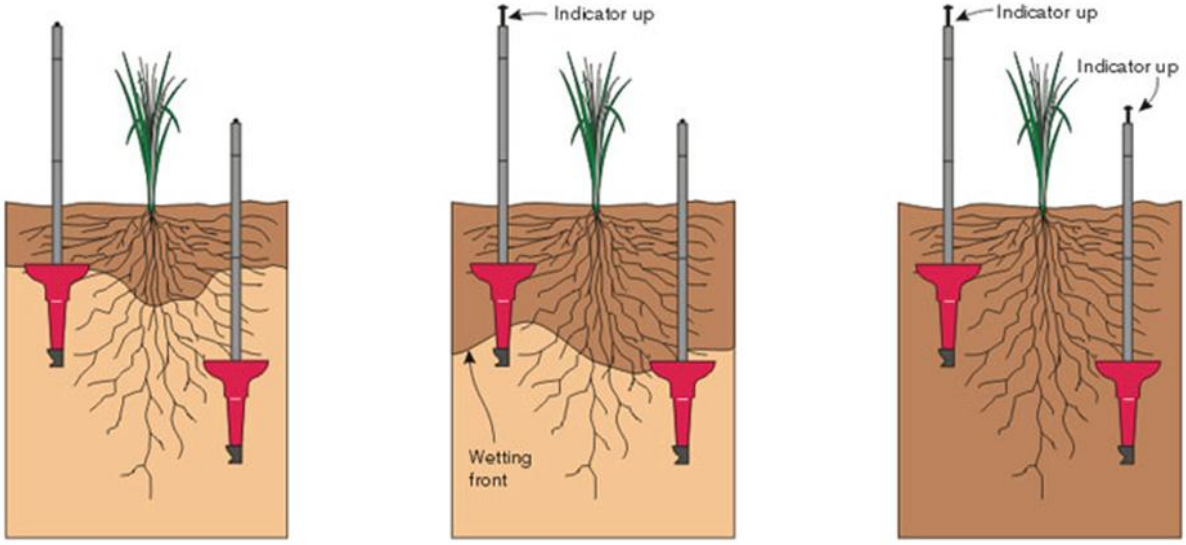


Figure-22: FullStop (Wetting Front Detector)

D. Project Management, Supervision, Technical Assistance, Training and Strategic Studies

Directorate General Agriculture (Water Management), Punjab would be responsible to supervise, manage, and monitor the proposed project from provincial headquarters mainly through existing establishment. Some incremental staff will, however, be provided to strengthen its capacity for effectively carrying out the functions specific to this mega initiative. The project will provide/support requisite resources at provincial, regional, district, and tehsil levels for the purpose.

It is planned to engage a team of expatriate consultants to provide technical assistance to executing agencies for successful adoption and promotion of new water management interventions. The consultant's team will analyse the existing capacity of stakeholders to assess the need for training and technical inputs so as to prepare plan for providing requisite assistance. Likewise, strategic studies will be planned to assess the impacts of various modern water management interventions as well as factors constraining promotion of such activities among end users.

The overarching goal in professional development and capacity building of end users is efficient and sustainable irrigation water management. The Water Management Training Institute (WMTI), Lahore established right at onset of OFWM program in the Punjab during 1976-77, is the only institution with inherent capacity to meet the training requirements of various projects. The trainings for staff involved in execution of different initiatives are highly specialized in nature involving a mix of different disciplines such as engineering, agriculture, soil science, agronomy, sociology etc. as well as a dynamic understanding of field conditions. The WMTI's capacity has, however, considerably deteriorated in terms of infrastructural facilities as well as manpower/staffing. Nevertheless, it is the only institution in the Punjab to exclusively meet the training requirements in the field of on-farm water management. In order to meet capacity building needs of various stakeholders, it is imperative to build up WMTI potential to provide effective demand driven trainings to project staff as well as other public and private sector entities to tackle water scarcity challenges.

It is planned to establish two Water Management Training Centers (WMTCs), one each at Rawalpindi and Multan, as satellite institutions of WMTI, Lahore. These WMTCs will be established in existing OFWM buildings previously used as farmers training centers (FTCs) and will cater training needs of water users/farmers in specific water management interventions for the area. Some minor repairs of buildings will be carried out to establish proposed centers. The up-gradation works at the WMTCs require replacement of unserviceable fixtures (doors, windows), repair of lecture halls, offices, garages, bathrooms etc. A brief description of training and capacity building plan for various stakeholders is given below.

i) Training of Staff

The capacity building of OFWM staff is imperative for creating a cadre of trained professionals as well as imparting awareness about the latest water management technologies and techniques for their successful adoption. It is, accordingly, planned to formulate a comprehensive need based training program for OFWM staff through a strategic action plan, which significantly increases trained human resource and knowledge base for promoting modern water management interventions to improve water productivity.

It is planned that in-service trainings will be imparted to OFWM staff at Water Management Training Institute (WMTI), Lahore with technical assistance of project consultants. The same will comprise of four different types of trainings including basic, refresher, technical, and professional/specialized modules. The basic training would be mandatory for all new interents in the water management wing while the other trainings would focus on existing staff. A number of short refresher courses will be designed and conducted to update the OFWM field staff on the latest water management technologies and developments. Apart from the mandatory and short trainings imparted under the professional courses, different optional/supporting technical training courses will also be conducted. These will constitute subjects that will enhance the capacity of trainees to perform their duties efficiently. The trainings will also be available for private sector for improvement of professional skills. The technical trainings covering drip/sprinkler design, farm planning and design, soil moisture measuring/monitoring, irrigation scheduling, advance computer use for water management, use of geographic information system (GIS) in water management, social mobilization and community development etc. will be mandatory for OFWM staff engaged in project implementation. This will lead to create more efficient human resource for successful implementation of envisaged activities.

ii) Capacity Building of Farmers

The farmers in the Punjab normally practice traditional agriculture due to lack of knowledge about more profitable modern agricultural techniques and technologies. The crop production under high efficiency irrigation requires fundamental change in the irrigated agriculture. Accordingly, good working knowledge of the operators is required in operation, maintenance, trouble shooting, and crop production strategies with drip and sprinkler irrigation for sustainability of these emerging technologies. An extensive as well as intensive training program would be needed to train farmers about requirements and techniques of modern irrigated

agriculture so as to efficiently utilize the scarcely available water that will boost agricultural production, improve profitability of farming, and ultimately increase farmers' income.

A number of training courses will, therefore, be designed for the farmer operations including LASER operation, LASER equipment maintenance, HEIS operation, maintenance, crop cultivation with drip/ sprinkler irrigation, efficient irrigation methods, soil moisture measuring/monitoring, gender participation in irrigation water management, etc. for improvement in irrigation efficiency and water productivity.

III) COST SHARING ARRANGEMENTS

The paying capacity of the farming community has been eroded due to persistent water shortages and increase in prices of essential inputs required for crop production. They are finding it difficult to mobilize matching resources for on farm infrastructure devlopmenets. A farmer-friendly cost sharing mechanism has, therefore, been proposed for envisaged project interventions as given below.

a) High Efficiency Irrigation Systems

The government assistance under the proposed project will be limited to 60 percent of total system cost for installation of high efficiency irrigation on upto 15 acres while the remaining expenditure will be contributed by the beneficiary farmers. The farmers especially having small holdings, may also join through a contract agreement to share the water source/storage pond and head unit to economize the system costs. Under such arrangements, the joining farmers will be eligible for financial assistance upto upper ceiling of acreage in each case. In addition, government will provide Rs. 10,000 per acre for construction of water storage pond, if needed. The level of financial assistance will, however, be revised according to changes in this regard made under any subsequent similar scheme approved in the province to maintain uniformity. Furthermore, the acreage distribution for installation of sprinkler and drip irrigation systems would be inter-adjustable according to farmers' demand. In order to cover the variability due to specific conditions of the areas, type of drip and sprinkler irrigation system, and other inflation factors, the PSC may review the prescribed ceilings of system costs to facilitate smooth implementation of the project activities.

b) LASER Land Leveling

It is planned to provide one time financial assistance of Rs. 225,000 per unit to the farmers/service providers. It is pointed out that eligible beneficiary is required to own a tractor capable of operating LASER unit and submit valid document/proof for the purpose. The current price of such a tractor is over Rs. 1,000,000. Moreover, the market price of LASER unit ranges from Rs. 550,000 to 600,000 without General Sales Tax (GST), which has been imposed recently on LASER equipment resulting in further enhancement of the price by about 17 percent making it over Rs. 600,000. Thus, the total contribution of the farmer comes to be about Rs. 1,350,000 which is about 85 percent of total investment and the government is in fact providing only 15 percent. The participating service provider would, however, be required to procure equipment from one of the LASER equipment suppliers pre-qualified under the PIPIP (Pilot Phase) that would meet bare minimum specifications notified by the Agriculture Department after approval of the departmental standardization committee (DSC).

c) Watercourse Improvement

The government is providing entire cost of construction materials while the farmers are required to contribute entire labour costs for improvement of the watercourses under on-going OFWM program. These arrangements are well understood and adopted by the farming community of the province. It is, therefore, planned that the same cost sharing mechanism would be allowed to continue under proposed project as per following provisions.

A. Farmers will contribute entire labour costs for

i. Demolishing and reconstruction of katcha watercourse
ii. Excavation for the portion to be lined
iii. Back earth filling of structures and lined section
iv. Masons and unskilled labour of all civil works

B. Government will bear the entire material costs for lining and structures.

As such, the farmers will contribute in cash and kind. The cash contribution requirement would be for the payments to be made by the WUA to the masons and labour for lining and installation of structures, while all remaining share may be contributed in kind as labour. In case of irrigation schemes in non-canal commanded areas, a maximum ceiling of materials cost to be subsidized from the government will be Rs. 250,000 for each scheme, while the remaining cost of materials also, if more, will be borne by the beneficiary farmers.

IV) IMPLEMENTATION ARRANGEMENTS

A) Existing Facilities

On Farm Water Management program in the Punjab is part of the Provincial Agriculture Department headed by Secretary Agriculture, Government of the Punjab. The program is planned, coordinated, supervised, and operated by Director General Agriculture (Water Management) at provincial level who is assisted by the Director (Headquarters) and Director (Training). On Farm Water Management functions have been devolved to District Governments on promulgation of Devolution Plan 2001. Under this set-up, offices of District Officers (OFWM) have been established in all 36 districts of the province to supervise OFWM activities. Tehsil is the lowest tier of OFWM administrative system where office of Deputy District (OFWM) has been created for physical execution of works through field staff comprising of one Deputy District Officer (OFWM), one Water Management Officer, two Water Management Supervisors, and other support staff. Out of 133 tehsils of the province, offices of Deputy District Officers (OFWM) have been established at 101 tehsil headquarters so far, out of which 83 are located in irrigated areas and 18 are in barani tract. This basic tier in at least 25 tehsils is being created under proposed project.

The Water Management Training Institute (WMTI), Lahore has been established under Directorate General Agriculture (Water Management) Punjab to provide training support to various stakeholders of water management in the province. The training facilities at WMTI are being upgraded under "Upgradation of Water Management Training Institute" to cope with future training and research requirements. A Water Management Research Farm is being developed on 30 hectares (75 acres) land for evaluation, indigenization, and standardization of new water management interventions. The facility will also provide research support to stakeholders for adoption of advanced water management as well as water conservation techniques and technologies. The institute will, accordingly, be renamed as Water Management Training and Research (WMT&R) Institute. The upgradation project is being funded from the provincial Annual Development Program (ADP).

B) Project Implementation and Coordination Arrangements

The proposed project will be primarily implemented with existing infrastructure and human resource base of Agriculture Department. The governments' over all policy of devolution of

power would be adopted and District Governments will be executing the envisaged interventions. The major project activities will be implemented through well established and time tested farmers' institution of water users association (WUA).

i) Project Implementation

Planning and Development Department (P&DD) is the apex organization at provincial level responsible for preparing overall development framework, coordination & monitoring of development programs, and provision of assistance to various departments for planning & executing development activities. The Agriculture Department, Punjab is responsible for agricultural development in the province through introduction of new technologies and provision of support services to the farmers for better crop production. The Punjab Irrigated-Agriculture Productivity Improvement Project (PIPIP) will be over seen and monitored by P&DD, Punjab. It will be coordinated, and managed by the Agriculture Department, Punjab through its Water Management wing. The program will be supervised, coordinated, and operated by Directorate General Agriculture (Water Management) Punjab. The District Governments and water users association (WUA) as well as private sector service providers and services & supply companies (SSCs) will be the executing agencies with technical assistance and support of OFWM staff, and project consultants. The administrative and institutional structure is attached (**Annexure-B**).

a) Provincial Supervision, Management, and Monitoring

Director General Agriculture (Water Management), Punjab would act as Project Director who will be responsible to supervise, manage and monitor the proposed project from provincial headquarters mainly through existing establishment. Some incremental staff will, however, be required to strength the capacity for effectively carrying out the functions specific to this mega initiative. These would include two Deputy Project Directors (Headquarters) (BS-19), one for HEIS & LASER and the other for Watercourse Improvement activities as well as one Deputy Director (Accounts) (BS-18). Each Deputy Project Director (Headquarters) will be assisted by two Assistant Directors (Technical) (BS-18) and some support personnel. It is also planned to deploy one Deputy Director (Farms) (BS-18+SP) for Water Management Research Farm, Renala Khurd to carry out and monitor the envisaged research activities. The DPDs, DD (Farms), DD (Accounts) and other staff will be deployed by transfer from existing regular OFWM staff on

seniority cum fitness basis, whereas the remaining staffing requirements of the proposed project will be met from personnel available under completed/on-going projects through their re-appointments on various posts. The Project Coordination & Implementation Unit (PCIU), High Efficiency Irrigation Systems (HEIS), and Technology Promotion Unit (TPU) established in Directorate General Agriculture (Water Management) Lahore under "Water Conservation and Productivity Enhancement through High Efficiency (Pressurised) Irrigation Systems (the Punjab Component)" and "National Project to Stimulate the Adoption of Permanent Raised Bed in Maize-Wheat and Cotton-Wheat Farming System in Pakistan (the Punjab Component)" projects will be re-organized and merged into the proposed project.

b) Regional Project Coordination Support

It is planned to establish three Regional Project Coordination Units (RPCUs), one each at Lahore, Multan and Rawalpindi, to provide necessary technical support to the District Governments as well as coordinate activities between provincial headquarters and field formations. The regional level PCUs would be headed by a Regional Project Director (RPD) in BS-19 who will be supported by one Deputy Director (Technical) in BS-18+SP and one Assistant Director (Technical) in BS-18 with some support staff. The existing three offices of RDPDs, established at Rawalpindi, Lahore, and Multan under PSDP funded HEIS project as well as exiting field offices of PRB project at Multan and Sahiwal will be reorganized and merged into the proposed project.

c) District and Tehsil Offices

District Office (OFWM) would be responsible for supervision, coordination and internal monitoring at district level. It is planned to strengthen the capacity of this office for implementation of HEIS and LASER land leveling activities by providing incremental staff for establishing HEIS Field Teams comprising of two Water Management Officers (WMOs), one Computer Operator, one Vehicle Driver, two Rodmen and one Naib Qasid.

One of the HEIS Field Team WMO will have degree in Agricultural Engineering and shall look after the technical aspects of the HEIS installed in the area and LASER land leveling units. The second WMO of the team will be a graduate in Agriculture with Agronomy / Soil Science / Horticulture as major subject and will provide complete agronomic back-up support to

successfully grown crops under high efficiency irrigation environment e.g. planting, fertigation, weed & pest management, harvesting, marketing etc. to the farmers. The Assistant Agricultural Engineer (AAE) of the DO (OFWM) office will be re-designated as Assistant Director (Technical) who will provide support to DO (OFWM) for supervising and monitoring the project activities in the district.

The field activities under proposed project will be executed by the Deputy District Officers (OFWM) for which targets will be assigned to each tehsil. It has, accordingly, been proposed to establish offices of Deputy District Officers (OFWM) in 25 uncovered tehsils under the proposed project which will operate with the development funds during its gestation period. Existing OFWM regular staff will be posted on these vacancies on seniority basis while contractual staff working under various abandoned/completed projects will be adjusted on so vacated posts. On termination of the project, the setup of newly established DDO (OFWM) offices will be evaluated for their continuity under recurrent budget.

In addition, the incremental staff comprising of Water Management Supervisors and Rodmen will be provided in the offices of DDOs (OFWM) as per work load/targets in various tehsils. There will, however, be many tehsils where such ministerial staff will not be needed and project works will be carried out with existing OFWM personnel. For example, the tehsils where about 90 percent of the watercourses have already been improved, incremental staff will not be required and project works will be undertaken with the available staff. Likewise, barani area DDOs (OFWM) will not need any additional project support in terms of human resources. NPIW experienced staff available in various districts will be reappointed/re-adjusted in different tehsils according to the workload. The policy/guidelines for adjustment of staff will be got approved from the project steering committee (PSC).

d) Deployment Plan

There are about 2,141 contractual staff from BS-1 to BS-17 working in various development projects who will be adjusted/ posted in the proposed project with due approval from the competent authority. The list of staff categories to be deployed in PIPIP is given (**Annexure-C**) and there would be no additional staff to be recruited afresh under the project. The requirement of staff will be met by making adjustments of available personnel amongst various existing categories. For example, Water Management Officers will be recruited from amongst available

Assistant Agricultural Engineers and Water Management Officers. Likewise, Vehicle Drivers (BS-04) will be appointed from amongst available Rodmen and Naib Qasids having requisite driving license. It is further indicated that posts becoming vacant by the leaving /resigning of staff will not be refilled during currency of the project except their bare minimum assessed levels required for smooth execution of project activities. The above said staff will be will be offered fresh posting/appointment orders against available vacancies under proposed project or against regular posts anywhere in the Punjab.

Table-1: Summary of staff to be adjusted under proposed project

Sr. #	Name of post	Name of the project						Total
		NPIW	HEIS	PRB	CCTDI	WMTI	Solar	
1.	Water Management Officer (BS-17)	159	1	1	-	1	1	163
2.	Accountant (BS-14)	-	2	-	-	-	-	2
3.	Assistant (BS-14)	-	4	-	-	-	-	4
4.	W. M. Supervisor (BS-11)	569	-	-	-	-	-	569
5.	Computer Operator (BS-11)	100	3	-	2	-	-	105
6.	Vehicle Driver (BS-04)	-	12	2	-	-	-	14
7.	Rodmen (BS-01)	1,076	-	-	-	-	-	1,076
8.	Naib Qasid (BS-01)	183	10	2	-	-	-	195
9.	Chowkidar (BS-01)	-	8	-	-	-	-	8
10.	Sweeper (BS-01)	-	5	-	-	-	-	5
	Total:-	**2,087**	**45**	**5**	**2**	**1**	**1**	**2,141**

ii) Project Management

The coordination, administration, and monitoring for successful execution of envisaged activities under the proposed project will be achieved through establishment of following committees.

a) Project Policy Committee (PPC)
b) Project Steering Committee (PSC)
c) Project Implementation Committee (PIC)
d) District Implementation Committee (DIC)
e) District Rate Committee (DRC)

a) Project Policy Committee

The project policy committee (PPC) would provide planning and strategic guidance for project implementation as well as facilitate inter-agency coordination at the highest level. The PPC would be chaired by the Chairman, Planning and Development Board, Punjab with Secretaries of Agriculture, Irrigation, Local Government and Finance departments as its members. Director General Agriculture (Water Management) will be the member/secretary of the PPC. The PPC would initially meet quarterly but once the project would have set its pace, it may hold its meetings twice a year or when needed. The major functions to be performed by the PPC would be, interalia, as follows.

i. Make policy decisions for smooth project execution
ii. Ensure coordination among all stakeholders
iii. Arrange bridge financing for local resources during any financial constraint from donors
iv. Constitute committee/s for resolving any policy related issue
v. Modify implementation mechanism for project interventions, if needed
vi. Approve criterion and mechanism for reappointment of NPIW contractual staff under the proposed project
vii. Resolve issues constraining smooth implementation of envisaged activities

b) Project Steering Committee

The project steering committee (PSC) would be chaired by Secretary Agriculture, Government of the Punjab with Director General Agriculture (Water Management), Punjab; Chief (Agriculture) Pⅅ Additional Secretary (Expenditure), Finance Department; and Additional Secretary (Tech.), Irrigation Department as its members. Director General Agriculture (Water Management) would act as Secretary of the PSC. The PSC would meet quarterly to review the physical and financial progress as well as to suggest means to overcome the constraints/bottlenecks faced in the field for execution of project activities. The major functions of PSC would be as follows.

i. Approve annual work plan and streamline flow of funds
ii. Monitor physical and financial progress
iii. Approve the criteria's for selection of beneficiaries under various project components

iv. Identify the constraints in achieving targets and devise strategies for their redressal
v. Review provincial/district monitoring reports and take appropriate actions
vi. Constitute committee/s for approval of equipment specifications/standards, prequalification of supply & services companies for LASER land leveling units, HEISs etc., preparation of technical proforma etc.
vii. Formulate committee/s to resolve specific issues relating to civil works, unspent funds, rates of construction materials, and make recommendations for decision by the PPC
viii. Approve work plan (targets, financial requirements etc.) for awareness, irrigation demonstration sites, pilot testing, research activities, trainings etc. on annual basis or as required for smooth execution of envisaged activities
ix. Ensure implementation of decisions of Project Policy Committee
x. Devise mechanism for transparent monitoring of project activities
xi. Review subsidy slabs/financial assistance level and modify for smooth implementation of project activities

c) Project Implementation Committee

The project implementation committee (PIC) would be chaired by Director General Agriculture (Water Management) with Director (Headquarters), Director (Training), Deputy Project Directors (Hqs.), Regional Project Directors, Deputy Directors (Hqs.), District Officers (OFWM), and Team Leaders of Project Implementation Supervision Consultants (PISCs), Monitoring & Evaluation (M&E) Consultants and Technical Assistance & Training (TAT) Consultants as its members. Director (Headquarters) would act as Secretary of the committee. The PIC would meet every month to review the physical and financial progress as well as to suggest means to overcome the constraints faced in execution of project activities. The major functions of PIC would, interalia, be as follows.

i. Prepare annual work plan
ii. Review physical and financial progress
iii. Coordinate and supervise the project activities
iv. Ensure implementation of decisions of Project Steering Committee
v. Formulate mechanism for transparent external monitoring of project activities
vi. Review the monitoring reports and rectification of the shortfalls

d) District Implementation Committee

The district implementation committee (DIC) comprising of the following officers would be constituted in each district to implement the project at district level.

a)	District Coordination Officer	Chairman
b)	Executive District Officer (Finance & Planning)	Member
c)	Executive District Officer (Agriculture)	Member
d)	Regional Project Director concerned	Member
e)	Representative of Revenue Department	Member
f)	District Officer (OFWM)	Member/Secretary

The DIC is proposed to meet on monthly basis and its major functions would be as follows.

i. Review physical and financial progress
ii. Ensure effective project implementation
iii. Oversee proper flow of funds to WUAs
iv. Arrange transparent internal monitoring of project activities
v. Make recommendations to PIC for improving pace of implementation

e) District Rate Committee

The district rate committee (DRC) comprising the following officers will be constituted under DIC to decide the rates of construction materials for improvement of watercourses.

a)	Executive District Officer (EDO) Agriculture	Chairman
b)	District Officer (OFWM) concerned	Member/Secretary
c)	District Officer (Building)	Member
d)	Field Engineer (Consultant)	Member

The DRC will have the following mandate.

i. Periodically review rates of various construction materials
ii. Fix price band for different materials for clusters on geographical basis

iv) Project Monitoring

Internal monitoring of project activities at provincial level would be carried out by the Director General Agriculture (Water Management) Punjab, through regional Project Directors while internal monitoring at district level would be responsibility of DO (OFWM). The external monitoring & evaluation of project activities would be undertaken by project consultants.

The Program Monitoring Unit (PMU) with its existing setup i.e. provincial headquarter and regional offices will continue to monitor all the activities to be carried out for proposed project under the administrative control of the Secretary Agriculture. The funding for the same will be provided by the Punjab government through non-development budget (Grant No. 18) in accordance with existing arrangements.

v) EXECUTION OF FIELD ACTIVITIES

Directorate General Agriculture (Water Management) will be responsible to supervise, operate, and monitor the proposed project mainly through existing infrastructure. All activities envisaged under the proposed project will be implemented by the District Governments with active participation of the farming communities. Memorandum of Understanding (MOU) will be signed between Government of the Punjab, Agriculture Department and District Governments for the purpose. A comparison of implementation modalities between completed/on-going and proposed PIPIP is enclosed (**Annexure-D**). Implementation modalities for each of the envisaged activity are described below.

A) High Efficiency Irrigation Systems (HEISs)

A committee constituted by the project steering committee (PSC) will pre-qualify the prospective supply and service companies (SSCs), which will be registered by the Agriculture Department for installation of high efficiency irrigation systems (HEISs) on turnkey basis. The SSCs will also be responsible to provide post installation technical support to the farmers for operation and maintenance of systems as well as crop production technology for two years warranty period. The PIS consultants will provide technical input during prequalification process to select capable SSCs and standard equipment at proper prices. Agriculture Department will advertise for invitation of applications from the farmers for installation of HEISs. The HEIS Field Team will mobilize the farmers for adoption of HEISs and selection of suitable system for the farm. The applications will be scrutinized viz-a-viz approved criteria and eligible applicants will be advised to approach the pre-qualified SSC of their own choice for survey, design, and cost estimation of the selected system. The HEIS Field Team will coordinate with SSC to expedite the preparation of design/BOQs. The SSC will submit the same to the PISCs for review and approval. After approval of design and cost estimates, the farmer will be advised by District Officer (OFWM) to deposit his/her entire share in the form of pay order/bank draft drawn in favour of selected SSC,

which will be transmitted to Director General Agriculture (Water Management) for issuance of work order.

On receipt of farmer contribution, the concerned SSC will be issued work order by the DGA (WM)/PD to supply the equipment at site, which will be verified by the PIS consultants in terms of quality and quantity viz-a-viz approved standards/specifications. On receipt of satisfactory report from the PIS consultants, DGA (WM) will make 50 percent payment of total cost or farmer's share, whichever is higher, to SSC by releasing farmers' demand draft and remaining from project funds, if farmer share is less than 50 percent of total cost, alongwith advice to install the system. The spot checking will be carried out by RPD, HEIS Field Team, and PIS consultants to ensure installation as per approved design parameters. The installation completion will be reported by the SSC to the concerned DO (OFWM) who will request PIS consultants for verification of installed system. On completion of installation and making the system functional, consultants will verify the final completion as per design, satisfaction certificate of farmer, irrigation & fertigation schedules, log book, certificate that farmer has been trained about system operation & maintenance and O&M manual has been provided to the farmer. After certification/verification by PIS consultants, DGA (WM) will pay remaining cost after retaining 10 percent of total system cost, which will be released after two years or presentation of bank guarantee of an equal amount to ensure free service during two years warranty period. The HEIS team in the district will provide technical support to the farmers for the operation, maintenance, and troubleshooting of installed system as well as provide agronomic support regarding cropping geometry, fertigation, weed management, disease/pest control etc. under high efficiency irrigation environment. The flow chart of envisaged activities is given in **Figure-23.**

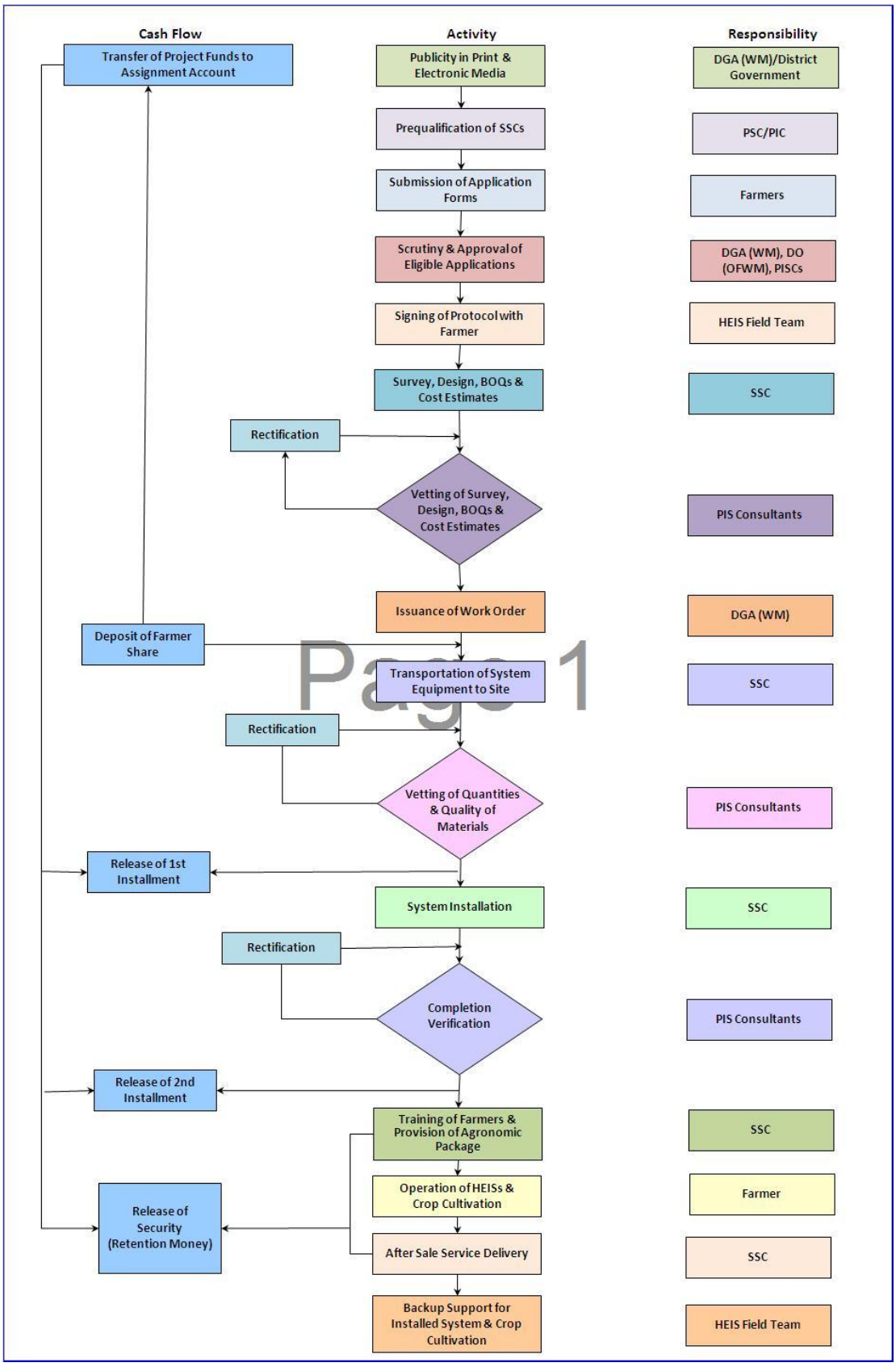


Figure-23: Schematic Process for Installation of HEISs

B) LASER Land Leveling

The departmental technical and pre-qualification committee will be notified by Project Steering Committee to develop standards & specification of equipment, short listing/prequalification of the firms, approval of equipment, criteria for selection of farmers/service providers, finalize application & inspection reporting formats etc. Short listing of LASER land leveling equipment supply firms will also be completed by said committee. The PISCs will provide technical support during prequalification process to ensure selection of capable firms and quality equipment for supply under the project. Each short-listed firm would be required to submit one complete set of its approved units to the DGA (WM), which will be used as reference for monitoring the quality of units being provided to the farmers / service providers. The same will be returned to the concerned firm after completion of the project on provision of a certificate from all districts where the firm has delivered LASER units that there remains no complaint/ shortfall to be addressed.

Agriculture Department will advertise for invitation of applications from the farmers interested to work as service providers for LASER land leveling rental services for which targets would be assigned to various districts. The applications will be received / collected in the office of District Officer (OFWM) that will be scrutinized viz-a-viz approved criteria by the designated committee. The PISC will assist the committee to carry out scrutiny for short listing of applications. DO (OFWM) will convey the complete list of eligible applicants to the DGA (WM) for confirmation of quota as the activity will be demand driven. DGA (WM) will confirm the quota of each district if the number of eligible applicants are more than allocated quota.

All districts will be informed about the same to proceed further for allotment of LASER units to eligible applicants by following District Allotment Committee (DAC).

a)	District Coordination Officer	Chairman
b)	Executive District Officer (F&P)	Member
c)	Executive District Officer (Agriculture)	Member
d)	Additional District Collector (Revenue)	Member
e)	Regional Project Director, RPCU	Member
f)	District Officer (OFWM)	Member/Secretary

In case of less number of eligible applicants than allocated quota, the extra LASER units will be allocated to other districts where demand is higher than the available quota for the district.

Workshops will be organized at district level wherein, the pre-qualified firms/SSCs will exhibit and demonstrate their equipment to facilitate allottees to select the firm/equipment of their choice. Each allottee will have to book LASER unit with pre-qualified firm within 30 days of allotment by submitting original draft of his/her entire/full share, drawn in favour of short-listed firm of his/her choice, to DGA (WM) through concerned DO (OFWM). Director General Agriculture (Water Management) will issue advice to the concerned firm for supply of booked LASER unit within 90 days of the issuance of this advice (or period specified in the supply order) under intimation to the concerned DO (OFWM).

The supplier firm will ensure delivery of booked unit within stipulated period and defaulting firms will be dealt as per government Rules. In case of failure of a firm to deliver the unit within specified time, the farmer will have the choice to book the LASER unit with one of the other pre-qualified supplier firms through concerned DO (OFWM) and DGA (WM).

A committee comprising of Assistant Director Technical (ADT) of concerned district & regional PCU, recipient farmer/service provider, and PISCs will inspect the equipment jointly under the supervision of DO (OFWM) and record the make, model, serial number and other features of all components of LASER unit. The technical inspection report, duly signed by the inspection team, will be sent by DO (OFWM) to DGA (WM) for releasing payment. DGA (WM) will hand over the original draft of concerned allotee's share to the firm alongwith project assistance. The schematic process for provision of LASER land leveling equipment is given in **Figure-24**.

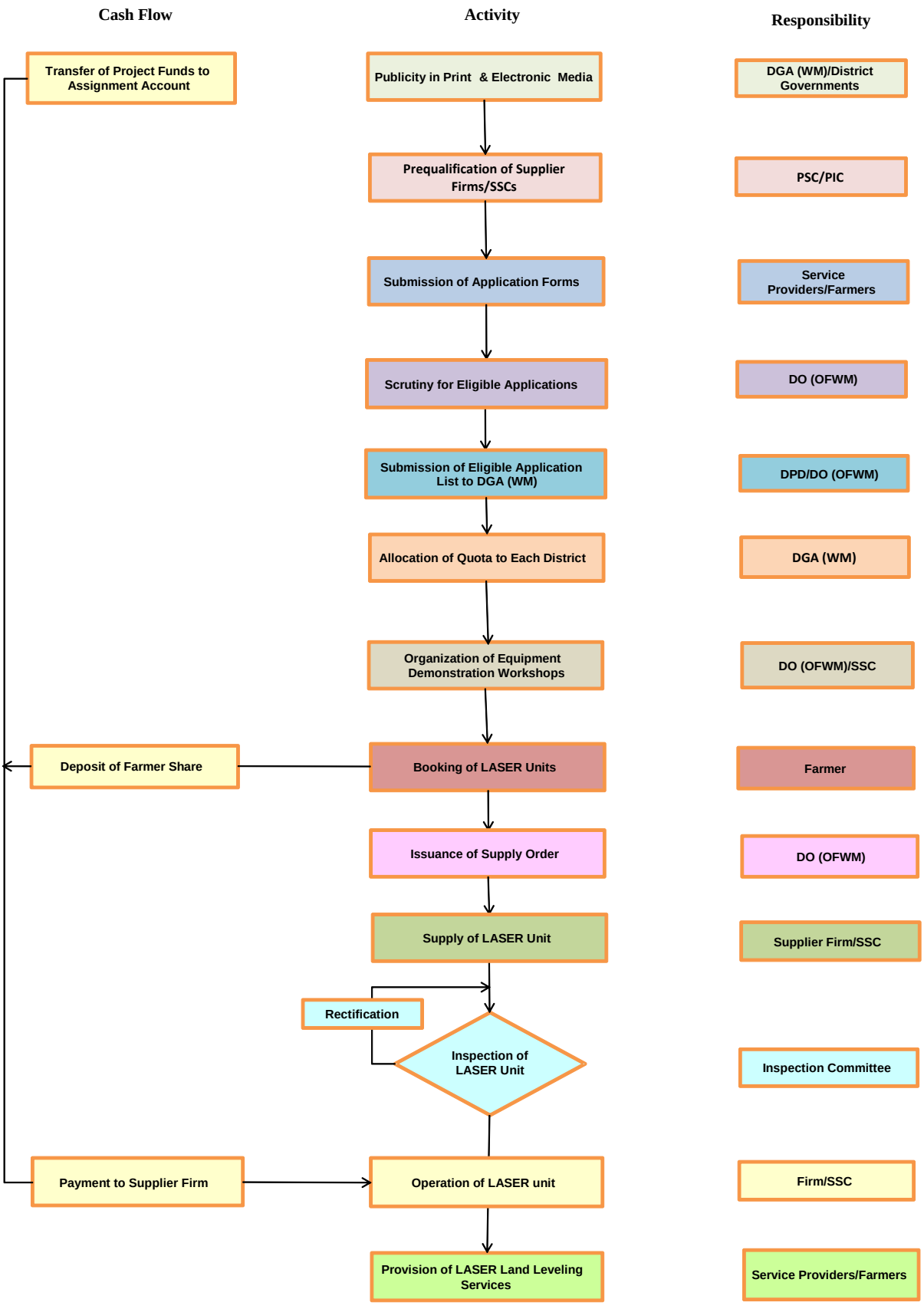


Figure-24: Schematic Process for Provision of LASER Land Leveling Equipment

C) Improvement of Unimproved Canal Irrigated Watercourses

Agriculture Department will launch awareness campaign through electronic and print media for watercourse improvement and its benefits. The tehsil level OFWM staff will mobilize shareholders of the watercourses to organize Water Users Associations (WUA). The same will be registered under OFWM and WUAs Ordinance [Act] 1981 (Amended 2001). The WUA will open a joint account to be operated by its Chairman and Treasurer in a Commercial Bank. The WUA will provide bank statement alongwith the specimen signatures of Chairman and Treasurer to DDO (OFWM) who will forward the same to DO (OFWM). The WUA will execute an output-based agreement with District Officer (OFWM) wherein, roles and obligations of both the parties will be defined. The agreement will be based on lump-sum contracts with payments linked with achievement of physical milestones as defined in agreement.

The OFWM staff in the respective tehsil will conduct engineering surveys of the watercourse command area and prepare design and cost estimates in consultation with WUA that will be checked/verified by PISCs. The competent authority will accord Technical Sanction. The WUA will carry out earthen improvement of 50 percent of proposed length under the supervision of OFWM field staff. This will involve removal of shrubs, bushes, and vegetation as well as other natural or man-made obstructions from the right of way. This will be followed by demolishing of existing channel, constructing a well compacted pad, and excavation of new channel as per design. The requisite funds from Account-IV will be released into joint account of the respective Water Users Association by District Officer (OFWM) in three installments on recommendations of the PISCs as per following criteria.

I) First Installment

Release of 40 percent of the estimated cost on receipt of First Intermediate Completion Report (ICR-I) from the consultants certifying following requirements.

i. Issuance of Technical Sanction by the competent authority.
ii. Deposit of 50 percent farmers' share on account of labour charges for lining and installation of water control structures.
iii. Renovation of at least 50 percent of designed earthen sections.

II) Second Installment

Release of 30 percent of the estimated cost on receipt of Second Intermediate Completion Report (ICR-II) from consultants verifying followings.

i. Deposit of remaining 50 percent labour charges of farmers' share on account of lining/installation of water control structures etc.
ii. Renovation of entire designed earthen sections.
iii. Completion of at least 30 percent planned lining and other works (volumetric basis).

III) Third Installment

Release of remaining 30 percent of the estimated cost on receipt of Final Completion Report (FCR) from consultants certifying following factors.

i. Completion of all planned works.
ii. Rectification of any pending discrepancy.

The WUA will procure the construction materials on the rates fixed by the District Rate Committee for the tehsil/cluster and carry out civil works under technical supervision of OFWM field staff. DO (OFWM) will make internal monitoring of improvement works while Deputy Project Director will undertake external monitoring to ensure quality of works. The PISCs will carry out spot checking and third party validation/final verification of improvement works. The schematic process for improvement of watercourses is indicated in **Figure-25.**

D) Completion of Partially Improved Watercourses

The works for completion of partially improved watercourses will be taken up for additional lining where the entire cost recovery pertaining to previous improvements has already been cleared. A certificate in this regard will be submitted by the concerned DO (OFWM). Water Users Association (WUA) will be reorganized, re-activated, and registered (if needed) on each watercourse for undertaking further improvements. OFWM staff will prepare watercourse file containing complete inventory of previously executed works as well as design and cost estimates of that planned under the proposed scheme, which will be properly marked on the topo map. The DDO (OFWM) will submit the same to the PISCs for its scrutiny, ground trothing, and approval. After approval by PISCs, the procedure being adopted for watercourse improvements in canal commanded areas will be followed for completion of planned additional works on these watercourses.

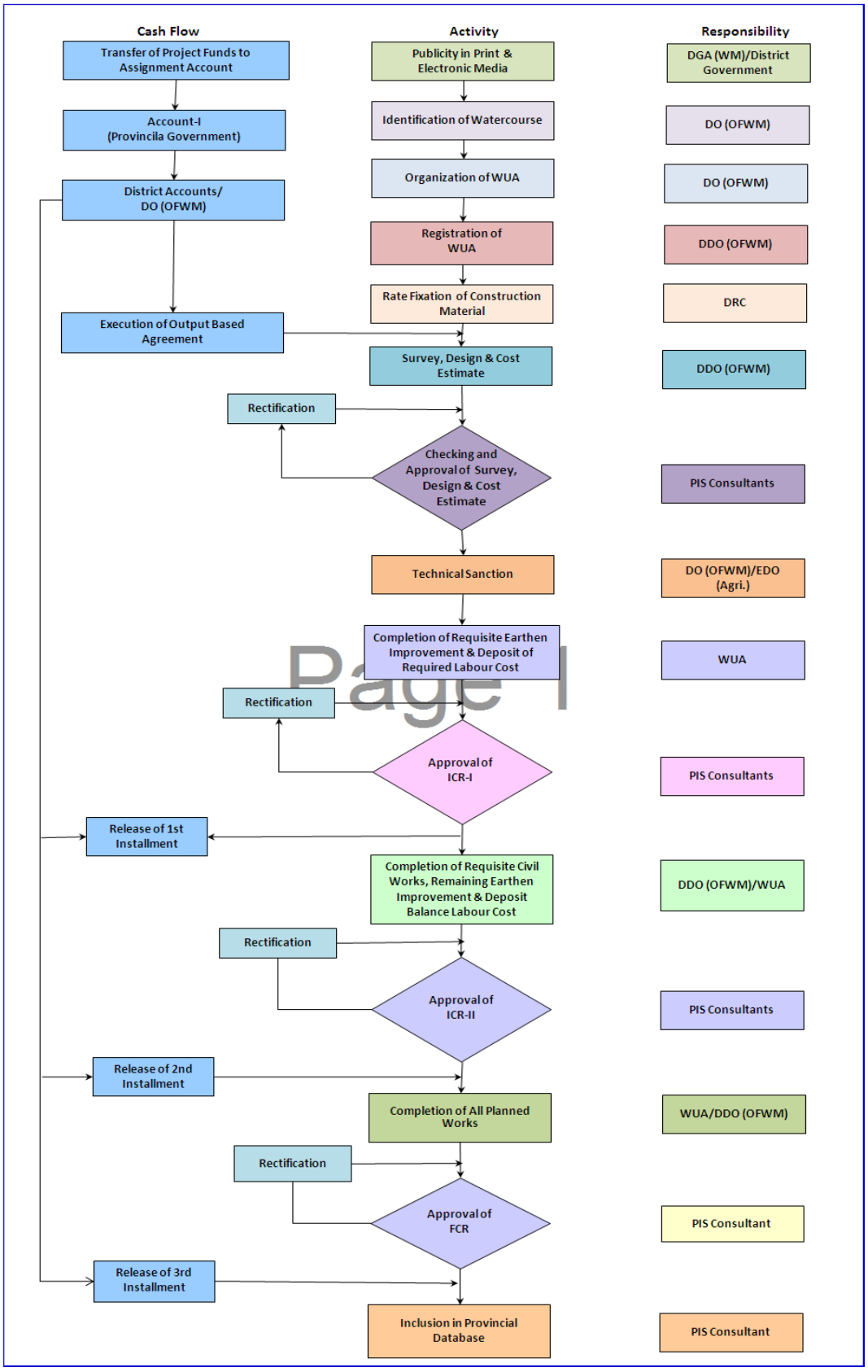


Figure-25: Schematic Process for Watercourse Improvement

E) Rehabilitation of Irrigation Conveyance Systems in Non-canal Commanded Areas

The procedure for mobilization of shareholders, organization and registration of Water Users Association (WUA) for rehabilitation of conveyance system in non canal commanded areas will be same as that for watercourse improvements in canal commands. OFWM staff in the respective tehsil will carry out engineering surveys of the irrigation scheme command area and prepare design and cost estimates in consultation with WUA. The same will be checked/verified by PISCs. The funds will be released from Account-IV by District Officer (OFWM) to joint account of the respective Water Users Association on recommendations of the PISCs in three installments as per following criteria.

I) First Installment

Release of 70 percent of the government share for improvement/development costs on receipt of First Intermediate Completion Report (ICR-I) from the consultants certifying following requirements.

i. Issuance of Technical Sanction by the competent authority.
ii. Excavation of at least 30 percent of designed sections.
iii. Deposit of 70 percent farmers' share for improvement/development of irrigation scheme.

II) Second Installment

Release of 20 percent of the remaining government share for improvement/development costs after verification of Second Intermediate Completion Report (ICR-II) verifying the followings.

i. Deposit of remaining 30 percent of farmers' share for improvement/development of irrigation scheme.
ii. Availability of entire construction materials/equipment at site.
iii. Excavation for entire planned length.
iv. Completion of at least 70 percent of planned works.

III) Third Installment

Release of remaining 10 percent of the cost for improvement works on receipt of Final Completion Report (FCR) from consultants certifying following factors.

i. Completion of all planned works.
ii. Rectification of any pending discrepancy.

The WUA will carry out envisaged activities under technical supervision of OFWM field staff. DDO (OFWM) will observe the approved standards/specifications and submit the completion report to PISCs for final verification. The PISCs will carry out spot checking and third party validation/final verification of improvement works.

F) Adoption and Promotion of Modern Irrigation Technologies

The improved water management techniques and technologies can contribute significantly in improving water productivity at the farm level. Particularly, high efficiency irrigation systems offer successful cultivation of more profit generating horticultural crops for export that are required to be introduced at wider scale. The same are, however, needed to be evaluated, indigenized, demonstrated, and made cost effective for successful adoption by the farmers. It is, therefore, planned to carry out following activities under the proposed project for the purpose.

i) Awareness Campaign

Awareness campaign about efficient water management, effective utilization of available water resources, and social mobilization of the farming communities will be launched through Water Management Training Institute (WMTI), Regional Project Directors, and DOs (OFWM). It is planned to educate farmers through training programs, workshops, field days, radio programs, media clips, cable operators etc. for dissemination of improved water management interventions. An awareness campaign committee comprising of the following will be constituted.

a) Director General Agriculture (Water Management), Punjab	Chairman
b) Director (Agriculture Information), Punjab	Member
c) Regional Project Director	Member
d) Director (Training), WMTI	Secretary/Member

The committee will perform following functions.

i. Formulate mass awareness campaign.
ii. Prepare professional publicity and advertising material in consultation with advertising/media companies.
iii. Vetting of all training materials including pamphlets/brochures/leaflets etc.
iv. Finalize irrigation demonstration sites to establish/showcase improved water management technologies.
v. Monitor the awareness campaign.

ii) Establishment of Irrigation Demonstration Sites (IDSs)

The Water Management Research Farm (WMRF), Renala Khurd will be focal point for demonstration and indigenization/standardization of water management interventions including designing for appropriate irrigation methods, installation of high efficiency irrigation systems (drip / sprinkler), flexible gated pipe (FGP) irrigation system, syphon tube irrigation, scheduling irrigation as per crop water requirement/available soil moisture (TDR, FullStop etc.) etc. It is also envisaged to showcase all water management technologies at about 100 irrigation demonstration sites (IDS) throughout the province. A compact agricultural block owned by the farmers (about 25 acres) will be selected at each IDS for the purpose. Field days will be organized at these sites, wherein water users will be educated on different improved water management techniques and technologies. The IDSs will be maintained by the water users association members, who will also maintain a water management information kiosk (WMIK) for dissemination of knowledge through pamphlets and literature.

iii) Establishment of Infrastructure for Water Management Service Provision

The project will provide support to the registered service provider companies for establishment of network of service and maintenance centers at district / regional level through public private partnership (PPP). The representative of the SSCs will work under supervision of Regional Project Director stationed at each region. The registered companies will be required to keep all necessary spares of HEISs and LASER land leveling equipment as well as essential service tools in these offices. Upon contact by the farmer, the representative of the company will immediately respond to the complaint. All information about water management including brochures, pamphlets, booklets, monthly periodicals, guides in local language etc. will be available for the farmers at these service centers. It is planned to establish about 36 service and maintenance centers in each district for the purpose.

iv) Research and Development Activities

Applied research and development (R&D) of new water management and conservation technologies will be part of the proposed project to develop effective and locally viable parameters for irrigation methods to further improve their efficiency. The project will also sponsor pilot testing and evaluation of improved irrigation methods e.g. syphon irrigation,

flexible gated pipes, soil moisture measurement, irrigation scheduling etc. The research activities will be carried out by inviting proposals from researchers, which will be scrutinized and awarded by the following Water Management Research Committee.

a)	Director General Agriculture (Water Management) Punjab	Chairman
b)	Representative of Punjab Agricultural Research Board	Member
c)	Representative of University of Agriculture, Faisalabad	Member
d)	Deputy Director (Farms), WMRF, Renala Khurd	Member
e)	Director (Training), WMTI, Punjab	Member/Secretary

One Deputy Director (Farms) alongwith supporting personnel will be engaged as incremental staff at the Water Management Research Farm for research activities.

v) Development and Updation of Database

The Agriculture Department in collaboration with SUPARCO has developed Geographic Information System (GIS) software and GIS laboratory for spatial database management of all information regarding water management activities. It is planned to support the activities to update and upgrade this database. The project will also assist in development of remote sensing techniques in conjunction with the existing database for improved and effective monitoring and planning of various OFWM projects. The project consultants will develop GIS and RS techniques for solidification of existing database for effective monitoring as well as planning for future OFWM projects.

G) Training and Capacity Building

The training and capacity building of various stakeholders in latest water management technologies is imperative for successful implementation of project interventions. Water Management Training Institute (WMTI) is the only institution with inherent capacity to meet the training requirements for execution of the various schemes, being implemented in the Punjab. The project will also support establishment of two Water Management Training Centers (WMTCs), one each at Rawalpindi and Multan. These WMTCs will be established in existing OFWM buildings previously used as farmers training centers (FTCs) and will cater training needs of farmers in specific water management interventions for the area.

On the job and follow up training is essential for continuing professional development of project staff/end users. In-service trainings will be imparted to OFWM staff at WMTI with the technical assistance of expatriate experts and Project Implementation and Supervision Consultants (PISCs). The same will comprise of four different types of trainings including basic, refresher, technical, and professional training courses. The basic training would be mandatory for all new entrants of the water management wing while the other trainings would focus on existing staff. It is also planned to design training courses for the farmers including LASER tractor operation, LASER equipment maintenance, HEIS operation & maintenance, efficient irrigation methods, soil moisture measuring/monitoring, gender issues and role in water management etc. for improvement in irrigation efficiency and water productivity.

It is not possible to provide precise work plan (targets, financial requirements etc.) for adoption and promotion of modern irrigation technologies including awareness campaign, establishment of irrigation demonstration sites, research and development activities, establishment of infrastructure for water management service provision, and development and updation of OFWM database as well as for training and capacity building program at this stage. The same will be got approved by the project steering committee (PSC) annually or as required for smooth implementation of envisaged activities.

F) Project Consultants

It is indicated that Project Implementation Supervision Consultants (PISCs) would be recruited for provision of technical support to OFWM staff at provincial, regional, district, and field level in implementation of the proposed project interventions including design review/approval, construction supervision, quality assurance, technical assistance, and overall coordination of project execution. Similarly, Monitoring & Evaluation (M&E) Consultants would be engaged for monitoring of project impacts and Technical Assistance and Training (TAT) Consultants would be recruited for providing technical assistance, training, database management, strategic studies and similar other assignments.

i) Project Implementation Supervision Consultants (PISCs)

Project Implementation Supervision Consultants (PISCs) would provide implementation assistance and supervision in implementation of the proposed project interventions. Their main responsibilities will, interalia, include design review/approval, construction supervision, quality

assurance, technical assistance, and overall coordination of project execution. The consultants' team shall primarily report to the Director General Agriculture (Water Management) but its major responsibilities would be in the districts. All records and sites shall be open and available to the consultants to enable them to perform their functions. The selection of PISCs will largely depend on their technical expertise and experience in providing consultancy services under similar projects. The Consultant Selection Committee (CSC) would recruit the consultants in accordance with World Bank's procedures and guidelines approved for the purpose. The PISCs scope of work would include but not limited to the followings tasks.

i. Prepare standards and specifications for civil works, HEIS equipment, LASER land leveling units etc.
ii. Draft technical documents/agreements/formats for SSCs including contract conditions, specifications for design, materials and installation of equipment, itemized list of typical items etc.
iii. Provide project management support services to DGA (WM).
iv. Help in evaluation of the technical and financial proposals of SSCs.
v. Assist in mobilization and screening of farmers for HEIS/LASER land levelling/watercourses as per criteria.
vi. Facilitate in finalization of rates for various items and services.
vii. Inspect and advise on standards, specifications, and criteria for the construction materials/equipment.
viii. Check surveys carried out by the OFWM staff.
ix. Review and approve plans, designs, cost estimates for watercourses, HEISs etc.
x. Facilitate timely completion of works and recommend onsite design modifications.
xi. Spot check for quality of works during construction of a minimum of one third by their number.
xii. Certify quantities and quality of completed works and delivered equipment for watercourse improvement, HEISs and LASER land leveling units.
xiii. Verify financial resource transfer applications.
xiv. Notify the Director General Agriculture (Water Management) of compliance / non-compliance of works with agreed criteria and standards.
xv. Submit monthly, quarterly, and annual reports for proposed project activities besides other periodic reports as per requirements of project management.

xvi. Provide technical support for training of OFWM staff in all project interventions, particularly relating to high efficiency irrigation systems as well as new water management techniques and technologies.

xvii. Deliver technical assistance for updation/upgradation of Water Management GIS database, development of RS technologies, and its management.

xviii. Liaise with provincial, regional, and district project management for smooth execution of field activities.

xix. Extend technical support to maintain a website containing information on facilities and services, applications, procedures, watercourses database etc.

a) Key Staffing Requirements

The experts required for the supervisory consultancy alongwith their estimated inputs, are given below.

Sr. #	Category	Number	Man Months
1.	Team Leader	1	60
2.	Senior Irrigation Engineer/Deputy Team Leader	2	120
3.	Field Engineer	50	3,000
4.	Design Engineer	1	60
5.	Horticulturist	1	60
6.	Soil Scientist	1	60
7.	Irrigation Agronomist	2	120
8.	Financial Management Specialist	1	60
9.	GIS Specialist	1	60
10.	Unallocated	-	60
	Total	**60**	**3,660**

Indicative duties / job description of PISCs core team of experts required for PIPIP is appended (**Annexure-E-1**).

ii) Monitoring and Evaluation (M&E) Consultants

Monitoring and Evaluation (M&E) consultancy services would be required for monitoring and evaluation of project impacts to ensure achievement of Project Development Objective. The Consultants would develop a computer based state-of-the-art project monitoring and information system (PMIS) to monitor key performance indicators, produce useful reports, and track achievements according to plan. These indicators and reporting formats (including easy-to-read graphics) can be further expanded, refined, and organized (e.g. into input/process, output/outcome, or core/ancillary indicators) by the consultant as per requirement of Directorate

General Agriculture (Water Management). In connection with preparation of PMIS, the Consultant would develop an integrated, user-friendly web-based software to manage project activities in accordance with the modern concept of project management and track key project indicators, install this on a secure web-server as per Directorate General Agriculture (Water Management)'s specification. This may be linked with GIS and possibly with the Google Earth maps.

In addition to regular monitoring, impact assessment studies shall be undertaken to evaluate the project performance and progress towards achieving the set objectives providing recommendations to the Directorate General Agriculture (Water Management) for improvements. As part of project evaluation, the consultant shall undertake overall project evaluation (based on key output and outcome indicators) of the monitored information. Project performance will be evaluated on the basis of selected outputs and outcome indicators. The M&E studies will evaluate the success in project implementation in terms of meeting the project's objectives, and assess its physical, hydrological, environmental, social, and economic impacts. The consultants will provide continuous feedback of M&E activities to the PPC, PSC and the donor on projects performance. The M&E consultants scope of work would include but not limited to the followings tasks.

i. Provide technical assistance to Director General Agriculture (WM) Punjab for achievement of project development objective.
ii. Develop the overall framework of monitoring and evaluation plan including collecting, analyzing, and reporting project data for continual effective tracking of project development objectives.
iii. Formulate a set of key performance indicators and means of assessment against these indicators for project activities to be implemented.
iv. Monitor and evaluate the implementation of project activities and their impacts.
v. Propose recommendations about project modalities to ensure achievement of envisaged development objectives.
vi. Contribute in development of Annual Work Plan, ensuring alignment with project strategy, agreement on annual targets and inclusion of M&E activities in the work plan.
vii. Oversee and execute M&E activities of water management practices and techniques with particular focus on results and impacts as well as in lesson learning.
viii. Any other duty assigned by the project management.

It is proposed to acquire M&E of following expatriate experts for the purpose.

Sr. #	Category	Number	Man Months
1.	Water Management Specialist	1	60
2.	Irrigation Agronomist	1	60
3.	Soil Scientist	1	60
4.	Agricultural Economist	1	60
5.	Unallocated	-	60
	Total	**4**	**300**

The term of reference (TORs) of the Monitoring and Evaluation (M&E) consultants is attached (**Annexure-E-2**).

iii) Technical Assistance and Training (TAT) Consultants

The Agriculture Department, Punjab lacks adequate expertise in advanced water management and conservation technologies/techniques including, interalia, the followings.

i. Planning, designing, installation and operation & maintenance of high efficiency irrigation systems.
ii. Crop cultivation, irrigation agronomy, fertigation, and weed & pest management under high efficiency irrigation environment.
iii. Moisture measuring/monitoring tools/techniques.
iv. Precise irrigation as per crop water requirement.
v. Irrigation scheduling, use of GIS & RS for effective planning and monitoring.
vi. Water management for high density horticulture.
vii. Mechanization and automation of irrigation systems.

The Technical Assistance and Training (TAT) consultancy services would be required for training of OFWM staff in modern water management technologies & techniques, capacity building of farmers for adoption of improved water conservation practices, preparation of technical manuals and guidelines, use of geographic information system (GIS) and remote sensing (RS) techniques for database management, identification & recommendation of modern water management methods from all over the world best suited to the Punjab, strategic studies for accelerating adoption of improved irrigation etc. The same will facilitate to provide technical support to OFWM staff at provincial, regional, district, and field level for smooth implementation of the proposed project interventions. The TAT consultants scope of work would include but not limited to the followings tasks.

i. Evolve new/innovative approaches to planning and implementation issues addressing water scarcity and promoting sustainable on farm water management.

ii. Provide technical assistance in estimating crop water requirements of major crops and compare those with water availability for planning what to grow and how.

iii. Identify the most suitable new water management interventions from all over the world replicable in the Punjab.

iv. Assist in establishment of Irrigation Demonstration Sites (IDSs) for effectively showcasing improved water management and conservation techniques/technologies.

v. Design sustainable irrigation water management packages at the farm level and facilitate their demonstrations.

vi. Guide the OFWM staff in identification and selection of appropriate irrigation methods for various areas/regions.

vii. Prepare technical reports, guidelines and training manuals to disseminate the latest OFWM information among stakeholders for adoption/promotion of improved water management interventions.

viii. Provide technical assistance to field staff for extending back up support to farmers about new water management interventions.

ix. Address issues and suggest solution to the problems related to technical aspects of irrigation methods as confronted by the farmers.

x. Support in use of GIS and RS techniques for development, management, updation, upgradation and processing of water resources database for planning and monitoring purposes.

xi. Carry out strategic studies to reform OFWM model for accelerating/promoting new water management interventions in the Punjab.

xii. Supervise demonstration, evaluation and indigenization of improved water management techniques/technologies under local conditions for their adoption by the farmers.

xiii. Identify the most efficient and cost effective tools and techniques for planning irrigation scheduling at the farmers' field.

xiv. Determine the holistic and comprehensive training and capacity building strategy/program for stakeholders involved in implementation of OFWM interventions.

xv. Identify specific capacity building requirements and define the skills needed for the different participating stakeholders to pursue in the short and long term periods addressing capacity gaps.

xvi. Prepare a comprehensive training plan including processes, tools and analytical framework for capacity building of stakeholders in modern water management interventions.

xvii. Design a tracking system to monitor the training and capacity building for effective monitoring and implementation.

xviii. Support in training of technical staff and master trainers involved in promotion of water management technologies.

xix. Identify successful models of water management in developed countries and arrange technology transfer through foreign visits/trainings.

xx. Assist in developing training modules, manuals, flyers, calendar etc.

xxi. Assist in preparing, reviewing and evaluating the capacity building plans for farmers and recommendation for their improvements.

xxii. Any other duty assigned by the project management.

It is planned that the reputable local organizations having experience in irrigation/water management e.g. Water Management Training & Research Institute (WMTRI), International Water Management Institute (IWMI), Food & Agriculture Organization (FAO) etc. will be engaged to associate the World renowned universities and research organizations in these fields on a single source basis.

VI) MATERIALS, SUPPLIES AND EQUIPMENT REQUIREMENT

It is envisaged to procure vehicles and office equipment for provincial and regional PCU as well as districts for smooth implementation of the scheme (**Annexure-F**). The requirement for vehicles has been worked out after the adjustment/transfer of existing vehicles to on-going OFWM projects. The procurement will be made by Directorate General Agriculture (Water Management) or through Purchase Cell of Agriculture Department in accordance with World Bank's procedures and guidelines approved for the purpose.

7) CAPITAL COST ESTIMATES

a) Indicate date of estimation of project cost estimates

The cost estimates of the project have been prepared during July 2011.

b) Basis of determining the capital cost (market survey, schedule rates, estimation on the basis of previous work done etc.)

Capital cost of the project is based on the prevailing average market rates of various items available in the open market during July 2011 as well as costs of various high efficiency irrigation systems installed in the Punjab under "Water Conservation & Productivity Enhancement through High Efficiency (Pressurized) Irrigation Systems (Punjab Component)".

The unit costs analysis for HEISs, LASER land leveler, and watercourse improvement is attached (**Annexure-G, H & I**).

c) Year-wise/Component-wise Phasing of Physical Activities

The year-wise/component-wise phasing of physical targets/activities of the project is appended (**Annexure-J-1**).

d) Year-wise/Component-wise Financial Requirements

The year-wise/component-wise phasing of financial requirements of project activities is provided (**Annexure-J-2**). The financial and staffing requirements at provincial, regional, district, and tehsil level is also attached (**Annexure-K**). It is indicated that no physical/price contingencies have been provided in cost estimates of the project. It has been considered that the appreciation of Dollar-Rupee exchange rate during its implementation period would provide sufficient financial resources for these purposes. The cost estimation is based on currency exchange rate of 1 US$=Rs. 85 and later on allocations of various heads e.g. POL, repair, TA etc. will be adjusted with this rate to that prevalent exchange rate at start of financial year.

8) ANNUAL OPERATING AND MAINTENANCE COST AFTER COMPLETION OF PROJECT

It is envisaged that supply and services companies (SSCs) would assist the beneficiary farmers in operation and management of installed HEISs during warranty period and ensure provision of after sale service on charge afterwards. Likewise, the farmers/service providers would be responsible for the operation and maintenance of the LASER units provided under the project and LASER supply / manufacturing companies would provide after sale follow-up service after delivery of units. The service centers established at district / regional level under the project would provide/facilitate technical services and maintenance facilities to the farmers. The farmers/water users would be responsible for the operation and maintenance of improved watercourses. As such, there would be no recurring expenditure for activities carried out under the proposed project.

9) DEMAND AND SUPPLY ANALYSIS

The low irrigation efficiencies at the farm level are major constraint in attaining potential production from otherwise highly productive agricultural lands. As such, more than 40 percent of canal water is lost between mogha outlet and farmers' fields due to poor condition of tertiary conveyance system (watercourses). The crop water requirements are not met timely because of supply based irrigation water delivery, which negatively affects the overall agricultural production. A significant (20 to 25%) amount of irrigation water is lost during its application due to uneven fields and poor farm designing. This leads to excessive application to low-lying areas

and under-irrigation of higher spots. Over-irrigation leaches soluble nutrients from the crop root zone, makes the soil less productive, and degrades groundwater quality. On the other hand, under-irrigation of elevated parts of the fields results in accumulation of salts in such patches besides causing water stress and injurious effects of applied fertilizer.

The existing initiatives are being successfully implemented as standalone projects and improvements being made are contributing significantly towards enhancing water productivity at the farm level but a holistic approach would be more effective as is being followed all over the world. The proposed project envisages an integrated/comprehensive development package of on farm water management techniques and technologies as well as research backup support for maximizing productivity of irrigation water.

10) FINANCIAL PLAN (FINANCING SOURCES)

a) Equity

NA

b) Debt

NA

c) Grants alongwith Sources

(Rs. in million)

Sources	Amount for Capital Cost	Amount for Recurring Cost
(a) Foreign Assistance		
i- Loan	*21,249.997*	-
ii- Grant	-	-
iii- Technical Assistance	-	-
(b) Federal Government	-	-
i- Grant	-	-
ii- Loan	-	-
iii- Investment	-	-
iv- Direct Expenditure	-	-
(c) Provincial Government	-	-
i- Grant	-	-
ii- Loan	-	-
iii- Investment	-	-
iv- Direct Expenditure	-	-
(d) Sponsoring Agency's own fund	-	-
(e) Private Investment (SSCs)	-	-
(f) Local Body Resources, if any		
(g) Non-Government borrowing	-	-
(h) Beneficiaries Contribution	*14,750.709*	-
(i) Other sources (e.g. Recoveries)	-	-

d) Weighted Cost of Capital

NA

e) Flow of Funds

The DGA (WM) would be allowed to maintain and operate two separate Assignment Accounts for channeling the World Bank funds (foreign currency) and second for counterpart funding (local currency) from provincial government after fulfilling prescribed codal formalities. The funds from World Bank and provincial government will be transferred directly into these specified accounts. The allocations approved by project steering committee (PSC) for pay & allowances, operational expanses, and watercourse improvement activities would be transferred from Assignment Accounts on proportionate basis to Account No.1of provincial government for onward transfer to Account IV of district governments through Finance Department. The funds required for consultancy services and payments to supply and services companies on account of supply of LASER units, installation of HEIS, and training/demonstration activities etc. will be retained at provincial level for disbursement by DGA (WM). The PSC would be authorized to make necessary adjustments in financial and implementation modalities, if needed, while keeping the overall scope and cost of the project intact. In order to cover the variability due to specific conditions of the areas, type of the system/material and other inflation factors, the PSC may review the prescribed ceiling of system/material costs to facilitate smooth implementation of the project activities. The schematic diagram illustrating flow of funds is given in **Figure-26.**

The consultancy services of qualified Procurement Specialist and Financial Management Specialist may be hired on a short term and single source basis to provide technical assistance for fiduciary and procurement management as well as capacity building.

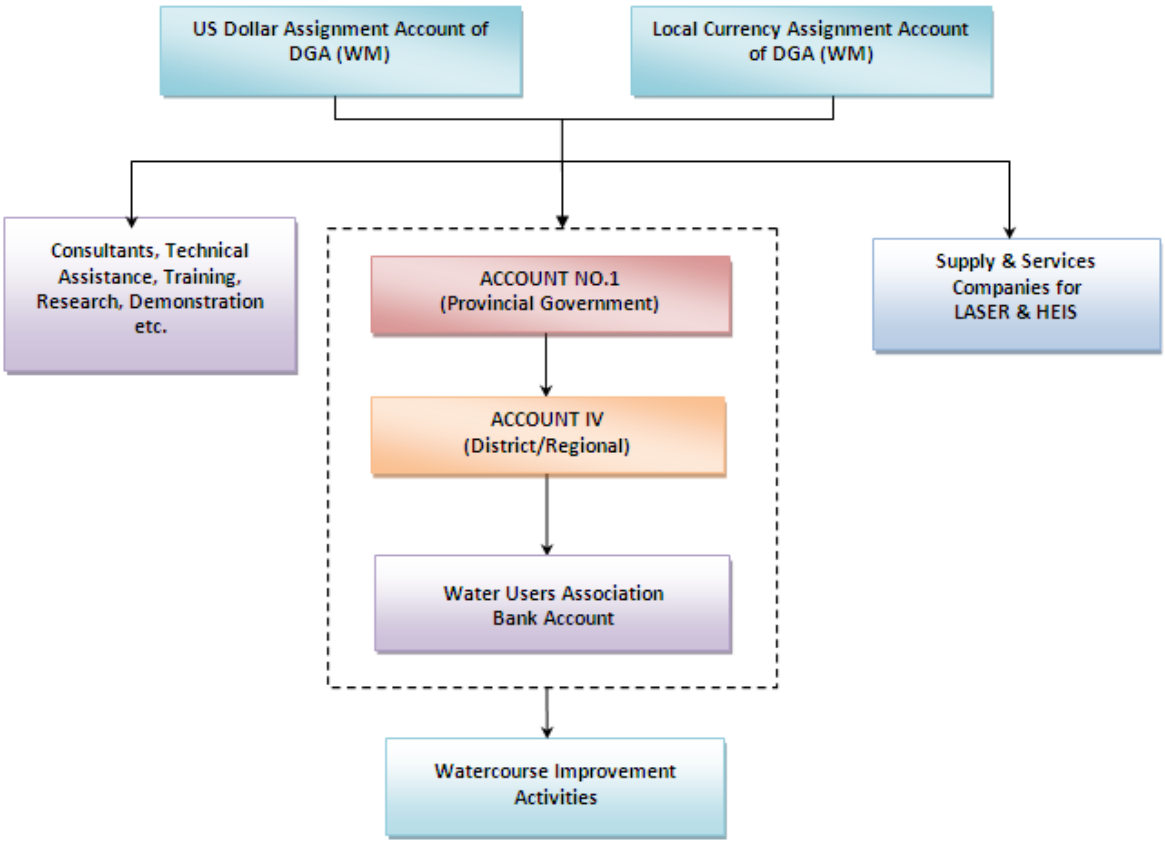


Figure-26: Schematic Process for Financial Arrangements

11) PROJECT BENEFIT AND ANALYSIS

a) Financial Benefits

The project will have both tangible and intangible benefits but there will be no direct income from the scheme to the government. Increase in crop yields, cropping intensity, cropped area, better change in cropping pattern, good quality produce etc. resulting from implementation of envisaged interventions will, however, have an indirect impact on its income side. The same would result in substantial increase in farm returns and provide enhanced employment opportunities to the rural population of project area.

b) Economic Benefits

A great degree of confidence in attaining envisaged project benefits is based on demonstrated effects of proposed intervention in various countries with similar agro-climatic conditions of Pakistan/Punjab. Following positive outcomes are expected from the scheme.

i) A more efficient, productive and sustainable water application system delivering greater development impact at lesser cost to the government budget as a result of community participation.

ii) Increased agricultural growth, poverty alleviation, and private sector development in rural areas where most of the absolute poor is inhibited.

iii) Substantial contribution in GDP due to higher agricultural output and greater rural employment.

The Project would have a transformational impact on Punjab's Water Sector, by cutting down the water losses and introducing technologies which help in water conservation and increased productivity of water. It is quiet challenging to fully capture and quantify the benefits of such intervention in sector like agriculture in which many factors are at play. Therefore, a simplified approach is used to estimate the incremental benefits of the project and cost benefit analysis is carried out by determining a discount rate which equalizes the costs and benefits i.e. the Economic Rate of Return (**Annexure-L**).

c) Social Benefits

Irrigation water saved through reduced conveyance losses in the improved/rehabilitated watercourses, coupled with improved irrigation application (drip/sprinkler, LASER land leveling, and adoption of modern water management practices at farm level) would increase the cropped area, crop yields, cropping intensity and farm incomes in the project area. Accordingly, increased income level of the farming community will improve livelihood in the rural areas.

d) Environmental Benefits/Impact Assessment

Various project impact evaluation studies were carried out to assess the effects of different OFWM interventions such as watercourse improvements, LASER land leveling, and drip irrigation system. These studies clearly indicate that the improvements in water conveyance and application have positive affects in controlling waterlogging and rising watertables, improving water management, reducing the drainable surplus, and reducing soil salinity risks.

The project builds on existing infrastructure and improves system operations. It would, thus, not experience adverse environmental affects normally associated with new developments, such as resettlement, depletion of land and water resources, and loss of wildlife habitat. In addition to reducing the problems of waterlogging and salinity, improved water management would reduce incidence of mosquito-borne diseases by reducing the habitat of mosquitoes with reduction in stagnant water leaking from deteriorated water channels. The project would support a program to monitor the impact of project interventions on water management and environment.

e) **Employment Generation**

Implementation of the project would provide enhanced employment opportunities, particularly to the rural population of project area. About **20,000** and **3,000** persons will be engaged as operators and helpers in operation of high efficiency irrigation systems and LASER units. Furthermore, marketing and repair facilities of these systems will be established in the private sector throughout the province that will open new avenues of employment for skilled workers. The installation of drip irrigation systems on **120,000** acres will create more jobs in the firms already functioning for the purpose. Moreover, employment opportunities will become available for skilled and unskilled labor during execution of project activities. Improvement in crop yields will also boost economic activity in rural areas of the province that will create further employment options. It is estimated that an amount of about **Rs. 14,750.709 million** would be contributed by farmers as cost sharing under the project. It is, therefore, concluded that project implementation will stimulate employment generation not only for skilled and unskilled labor in the villages but will help in opening of new earning opportunities in the rural sector.

f) Impact of Delays on Project Cost/Viability

The escalating surface water shortages, depleting groundwater aquifers, and mining of subsurface water resources due to over exploitation necessitate immediate adoption of water conservation technologies for efficient utilization of limited water resources. Any delay in implementation of proposed interventions may result in irreversible losses besides increased in project costs due to price escalation of equipment/materials.

12) IMPLEMENTATION SCHEDULE (INCLUDING STARTING AND COMPLETION DATES)

Indicate starting and completion date of the project:-

Starting Date	Completion Date
July 2012 or date of loan effectiveness, whichever is earlier	2017

The PC-I envisages project commencement from 01 July 2012. Its pilot phase has, however, started with ADP funds of Rs. 708.302 million to be retroactively reimbursed by the World Bank. The implementation of proposed project may be started during current financial year (2011-12), after loan effectiveness by the World Bank, to utilize the available capacity of human resource/other infrastructure for execution of envisaged activities.

13) CERTIFICATE

Certified that the project proposal has been prepared in the light of instructions provided by the Planning Commission for the preparation of PC-I for production sector projects.

Prepared by:

(Hafiz Qaisar Yasin)
Water Management Officer
Directorate General Agriculture
(Water Management), Lahore
Ph. # 042-9204897

(Dr. Maqsood Ahmed)
Provincial Project Director (PRB)
Directorate General Agriculture
(Water Management), Lahore
Ph. # 042-9204899

Checked by:

(Chaudhary Mohammad Ashraff)
Director General Agriculture
(Water Management), Punjab, Lahore
Ph. # 042-99200703

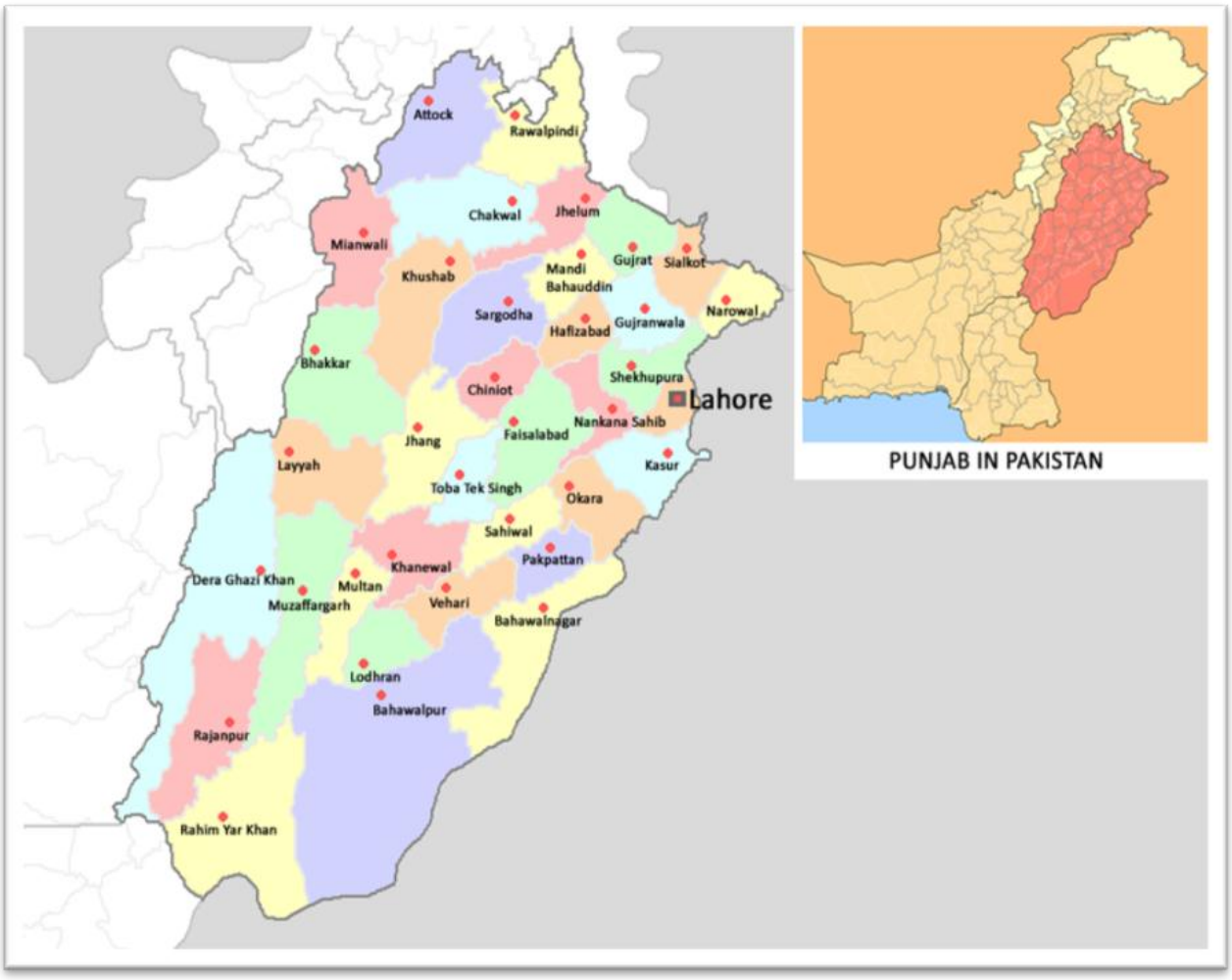
Approved by:

(Arif Nadeem)
Secretary
Government of the Punjab
Agriculture Department, Lahore
Ph. # 042-99210130

Annexure-A

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

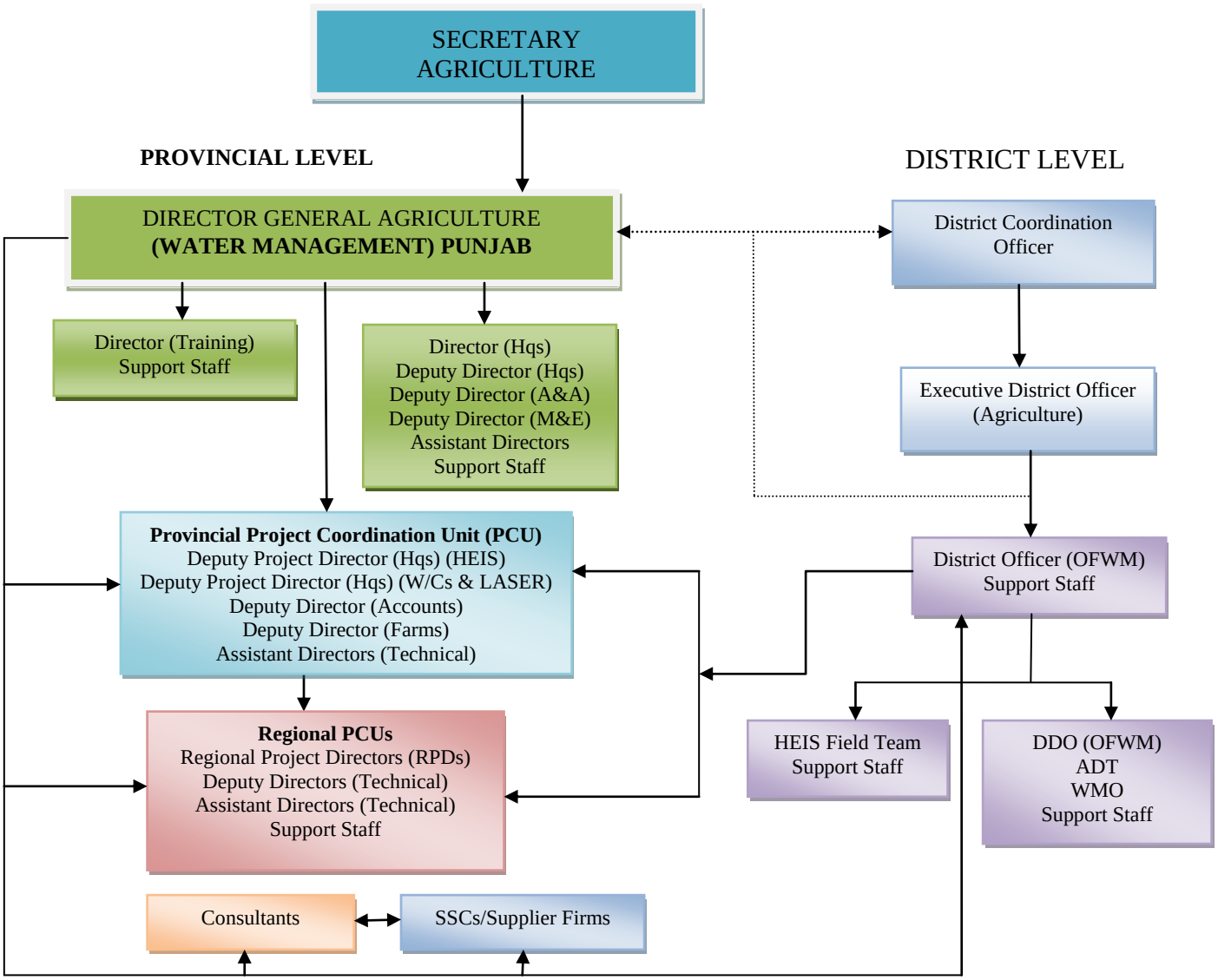
Project Area Map (Punjab Province)



Annexure-B

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Institutional Arrangements



Annexure-C

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Staff Deployment Plan

Sr. #	Name of Post	BS	Regular Staff	Staff Requirement for Implementation of Proposed Project								Total Staff	Staff Available from Completed Projects								Difference	Remarks	Minimum Optimal Staff Requirement (Over and Above Regular Posts)
				Provincial	Regional	District	Tehsil			Vacant Regular Posts	G.Total		NPIW	Other Projects						G.Total			
							Uncovered	Incremental staff	Total					HEIS	PRB	CCT	UpGrd. WMTI	Solar	Total				
1	Deputy Project Director (W/Cs & LASER)	19	-	1					-	-	**1**	1							-	**-**	1	By transfer among available staff	**1**
	Deputy Project Director (HEIS)	19		1					-	-	**1**	1							-	**-**	1		**1**
2	Regional Project Director (Lahore, Multan, Rawalpindi)	19	-		3				-	-	**3**	3							-	**-**	3		**3**
3	Deputy Director (Tech.)	18+SP	-		3				-	-	**3**	3							-	**-**	3		**3**
4	Deputy Director (Farms)	18+SP	-	1					-	-	**1**	1							-	**-**	1		**1**
5	District Officer (OFWM)	18+SP	36						-	-	**-**	36							-	**-**	-		**-**
6	Deputy Director (Accounts)	18	-	1					-	-	**1**	1							-	**-**	1		**1**
7	Assistant Director (Tech.)	18	19	4	3	7			-	10	**24**	43							-	**-**	24		**14**
8	Assistant Agronomist	18	15						-	-	**-**	15							-	**-**	-		**-**
9	Deputy District Officer (OFWM)	18	101				25		25	-	**25**	126							-	**-**	25		**25**
10	Water Management Officer	17	94			72	25		25	7	**104**	198	159	1	1		1	1	4	**163**	(59)	Adjusted against resultant vacant posts after filling of above posts	**97**
11	Accountant	16	-	2					-	-	**2**	2		2					2	**2**	-		**2**
12	Superintendent	16	-	2	3				-	-	**5**	5							-	**-**	5	To be filled by transfer among available staff	**5**
13	Assistant	14	-	4					-	-	**4**	4		4					4	**4**	-		**4**
14	Water Management Supervisor	11	208				50	523	573	(4)	**569**	777	569						-	**569**	-		**425**
15	Computer Operator	11	11	8	6	59	25		25	2	**100**	111	100	3		2			5	**105**	(5)	Adjusted against resultant vacant posts after filling of above posts	**98**
16	Vehicle Driver	4	141	11	9	36	25		25	29	**110**	251	-	12	2				14	**14**	96	To be filled in among Rodmen/Qasid qualified for the post of Drivers under the Rules	**81**
17	Rodman	1	268			72	50	953	1,003	(66)	**1,009**	1,277	1,076						-	**1,076**	(67)		**500**
18	Naib Qasid	1	152	10	9	36	25		25	25	**105**	257	183	10	2				12	**195**	(90)	To be adjusted against the posts of Chowkidars & Sweepers or against the post of Drivers, Chowkidars and Sweepers	**80**
19	Chowkidar	1	114	2	6		25		25	28	**61**	175	-	8					8	**8**	53	To be filled in among Naib Qasid/Rodmen	**33**
20	Sweeper	1	34	2	6				-	5	**13**	47		5					5	**5**	8	To be filled in among Naib Qasid/Rodmen	**8**
Total			**1,193**	**49**	**48**	**282**	**250**	**1,476**	**1,726**	**36**	**2,141**	**3,334**	**2,087**	**45**	**5**	**2**	**1**	**1**	**54**	**2,141**	-		**1,382**
Provincial Level Regular Staff		**1-20**	**159**	-	-	-	-	-	-	-	**-**	159	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**			
G. Total			**1,352**	**49**	**48**	**282**	**250**	**1,476**	**1,726**	**36**	**2,141**	**3,493**	**2,087**	**45**	**5**	**2**	**1**	**1**	**54**	**2,141**	**-**	**-**	**1,382**

Annexure-D

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Comparison of Implementation Modalities for Various OFWM Activities

Sr. #	Parameter	Completed Schemes	PIPIP (Pilot Phase)	Proposed PIPIP
1.	Execution of project activities	District governments	District governments	District governments
2.	WC earthen improvement	Entire earthen improvement by the farmers	Entire earthen improvement by the farmers	Entire earthen improvement by the farmers
3.	WC improvement cost sharing	Material costs by government and labour costs by WUAs	Material costs by government and labour costs by WUAs	Material costs by the project and labour costs by the farmers
4.	Transfer of funds to WUAs	District Officer (OFWM)	District Officer (OFWM)	District Officer (OFWM)
5.	Procurement of WC construction materials	Water users associations (WUAs)	Water users associations (WUAs)	WUAs
6.	Short-listing of SSCs for HEIS	Pre-qualification of SSCs by the federal/ provincial government	Implementation of activities through SSCs shortlisted by the federal/ provincial government	Pre-qualification of SSCs by the Punjab government
7.	HEIS and SSC selection	Selection of HEIS technology and SSC by the farmer of his own choice	Selection of HEIS technology and SSC by the farmer of his own choice	Selection of HEIS technology and SSC by the farmer of his own choice
8.	HEIS installation	Installation by SSCs on turnkey basis	Installation by SSCs on turnkey basis	Installation by SSCs on turnkey basis
9.	Maximum area for HEIS installation subsidy	50 acres	20 acres	15 acres
10.	HEIS cost sharing	i) Rs. 72,000 per acre by government and Rs. 8,000 per acre by the beneficiary **under Cotton-Thal project** ii) Rs. 36,000 per acre by government and remaining by the farmers **under PSDP funded HEIS Project**	Rs. 40,000, 50,000 and 60,000 per acre by the government for sprinklers, drip for orchards and drip for row crops, respectively as well as Rs. 10,000 per acre for water storage pond while all remaining costs would be borne by the farmer	60 percent of total cost by the government for HEIS installation as well as Rs. 10,000 per acre for water storage pond while all remaining costs would be borne by the farmer
11.	Mode of payment to HEIS SSCs	i) Payment of farmer share by the beneficiary to SSC on approval of design & cost estimates by the consultants ii) Payment of 20 percent of government share on confirmation of deposit of farmer share iii) Release of 40 percent of estimated cost on verification of equipment at site by consultants iv) Transfer of remaining cost to SSC on	i) Payment of farmer share paid by the beneficiary to SSC on verification of equipment at site by consultants ii) Transfer of government share to SSC on verification of final completion by consultants	i) Payment of 50 percent of total cost including farmer's share on certification of delivered equipment at site by the consultants ii) Release of 40 percent of total cost on commissioning of system as well as final certification by the consultants while remaining 10 percent will be retained as performance guarantee

		verification of final completion by consultants		
12.	Standardization of LASER equipment	Approval of specifications by DSC	Approval of specifications by DSC	Approval of specifications by DSC
13.	Maximum ceiling of land for eligibility of LASER subsidy	25 acres	12.5 acres	12.5 acres
14.	Short-listing of LASER equipment and supplier firms	Pre-qualification of SSCs by the Agriculture Department	Pre-qualification of SSCs by the Agriculture Department	Adoption of SSCs pre-qualified by the Agriculture Department under PIPIP (Pilot Phase)
15.	Mode of payment to LASER SSCs	i) Payment of 25 percent of farmer share on booking of equipment ii) Payment of remaining 75 percent of farmer share on delivery of equipment iii) Release of entire government share after certification by the concerned DO(OFWM)	Payment of entire farmer share as well as project assistance on certification of equipment by the designated committee	Payment of entire farmer share as well as project assistance on certification of equipment by the designated committee
16.	Payments to HEIS/LASER SSCs	DGA (WM)/RDPD (HEIS)	DGA (WM)/PD	DGA(WM)/PD
17.	Third party validation of physical works	Project consultants	Acquisition of services of project consultants already engaged under NPIW	Newly selected project implementation supervision consultants

Annexure-E-1

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Job Descriptions

Project Implementation Supervision Consultants (PISCs)

1. Team Leader

The Team Leader will possess a Master's degree or its equivalent in Agricultural Engineering / Water Resources/ Irrigation Engineering after B.Sc. Agri. Engineering with 20 years experience including implementation of multi sectoral projects preferably World Bank financed and involving social mobilization. A minimum of 10 years of experience will be required in the management of similar consultancy services with demonstrated ability to work with government officials, technical field staff, NGO representatives, and farmers. In addition, the Team Leader would be required to have familiarity with the principles and practices of participatory community development, irrigated agriculture, water management related issues, and knowledge of project management information systems besides, having fluency in spoken and written English.

Responsibilities of the Project Manager/Team Leader will be but not limited to the following:

i. Reports to the Client.
ii. Assumes overall responsibility for management of the consultants.
iii. Works as the "the Engineer" as per Client's agreement with the Water Users Associations (WUAs)/beneficiary farmers/service providers to supervise construction/installation/equipment delivery with the best professional and consulting standards to ensure that the scheme/task is completed satisfactorily.
iv. Keeps the Client informed of technical issues and the progress of all works both by direct contacts and through discussions or correspondence.
v. Attends, at Project level, all meetings as required and keep a record of all such meetings.
vi. Assists the Client in any project issue which the Employer may require.
vii. Ensures preparation of a project completion report (PCR).
viii. Assists the Client in preparing the response to Audit Objections.
ix. Assists the Client in preparing response to financiers or other authority's quarries, observations, requirements etc.
x. Coordinates with all related Client's organizations for project issues.

2. Senior Irrigation Management Engineer/Deputy Team Leader

The Senior Irrigation Management Engineer/Deputy Team Leader will possess a Master's degree or its equivalent in Agricultural Engineering/ Water Resources/ Irrigation Engineering after B.Sc. Agri. Engineering with 15 years experience in implementation of participatory rural development projects. A minimum of 7 years of experience will be required in the management of irrigation water management projects with demonstrated ability to work with government officials, technical field staff, NGO representatives, and farmers. Work experience in related computer tools, World Bank rules/procedures, good communication skills, fluency in English and proven satisfactory record of similar consultancies including high efficiency irrigation would be preferred

Responsibilities of the Senior Irrigation Management Engineer/Deputy Team Leader will be but not limited to the following:

i. Report to Project Manager and in his absence to BOM.
ii. Act as deputy to Team Leader and carries out the duties of Team Leader except those of "the Engineer" in his/her absence.
iii. Assist the Team Leader in coordination issues.
iv. Represent the Team Leader in all meetings in his/her absence or if requested.
v. Assist the Team Leader in keeping the Client informed of technical issues both by direct contacts and through discussions or correspondence.
vi. Facilitate the Team Leader in preparation of monthly, quarterly and mid term reports.
vii. Succour the Team Leader in any project issue which the Project Manager may require.
viii. Support the Team Leader in preparation of the project completion report (PCR) and any other duty/assignment the Team Leader may entrust.
ix. Compile, analyze and process the reports received from subordinate offices.
x. Carry out field visits to provide necessary input to management about project implementation.
xi. Supervise checking/verification of surveys, design of watercourses and HEISs as well as other field activities to be performed by the consultants.
xii. Arrange verification of physical works and make recommendations for improvements in management modalities for smooth execution of filed activities, where required.

3. Water Management Specialist

The Water Management Specialist will possess a Master's degree or its equivalent in Agricultural Engineering/ Agricultural Water Management/ Water Resources/ Irrigation Engineering after B.Sc. Agri. Engineering with 15 years' experience in implementation of participatory rural development projects preferably irrigation water management at farm level through high efficiency irrigation systems. A minimum of 7 years of experience will be required in the management of irrigation water related projects with demonstrated ability to work with government officials, technical field staff, NGO representatives, and farmers. Work experience in high efficiency irrigation planning/ designing, related computer tools, World Bank rules/procedures, good communication skills, fluency in English, and proven satisfactory record of similar consultancies would be preferred

Responsibilities of the Water Management Specialist will be but not limited to the following:

i. Provide technical support to the Director General Agriculture (WM) Punjab for smooth implementation of project activities.
ii. Extend technical assistance to the project management.
iii. Develop formats for review and monitoring of project implementation status.
iv. Compile, analyze and process the reports received from subordinate/district offices.
v. Carry out field visits to provide necessary input to filed formations to improve project implementation.
vi. Supervise introduction of modern water management technologies and practices.

vii. Assist in planning research activities to resolve technical issues in adoption of new water management interventions.

viii. Any other relevant duty assigned by the project management.

4. Design Engineer

The Design Engineer should possess a Master's degree in Irrigation Engineering/Agricultural Engineering/ Civil Engineering/ Water Resources Engineering after B.Sc. Agricultural Engineer with 10 years work experience including at least three (3) years experience in high efficiency irrigation under irrigation water management projects. Work experience in related computer tools, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

Responsibilities of the Design Engineer will be but not limited to the following:

i. Lead the design engineering team for high efficiency (drip & sprinkler) irrigation systems (HEISs).

ii. Supervise the scoping, surveying, and designing tasks for installation of drip & sprinkler irrigation systems as well as provide technical assistance for the purpose as, where and when required.

iii. Monitor the designing process of HEISs carried out by the supply & service companies to ensure economic designs in accordance with the prescribed standards, specifications, and parameters.

iv. Carry out continuous monitoring of the designing plans and maintain liaison with implementation staff/other stakeholders.

v. Assist in reviewing and modifying the HEIS designs for cost effectiveness and technical suitability.

vi. Develop designs for showcasing modern water management technologies and practices at farmers' fields.

vii. Coordinate for ensuring adoption of international/ national standards for HEIS designs.

viii. Perform other duties as assigned.

5. Field Engineer

The Field Engineer should possess a Bachelor degree in Agricultural Engineering and five (5) years work experience including at least three (3) years in farm level water management projects preferably high efficiency irrigation. Work experience in related computer tools, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

Responsibilities of the Field Engineer will be but not limited to the following:

i. Coordinate and supervise the construction/installation activities.

ii. Ensure quality as well as quantity of works by spot-checking.

iii. Certify release of funds for ongoing as well as completed works.

iv. Bring any deficiency into the notice of the controlling officers of district and provincial governments.

v. Develop close liaison with project stakeholders including project management, SSCs and farmers.

vi. Any other relevant duties assigned by the project management.

6. Horticulturist

The Horticulturist should possess a Master's degree in Agriculture with specialization in Horticulture/Horticultural Sciences and 10 years work experience including at least three (3) years in preferably high efficiency irrigation under farm level water management projects. Work experience in related computer tools, World Bank rules/procedures, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

Responsibilities of the Horticulturist will be but not limited to the following:

i. Assist the project management in implementation of project activities related to management of orchards, vegetables, flowers under high efficiency irrigation systems.
ii. Provide support/guidance to project staff and beneficiary farmers to improve the growth, harvest, storage, processing, and shipping of agricultural plants, vegetables, and fruits grown under high efficiency irrigation.
iii. Assist in preparation of maintenance programs for high efficiency irrigated orchards to control plant diseases and insects.
iv. Prepare training curriculum and lesson plans for training programs organized under the project regarding Horticultural issues.
v. Train and supervise professional staff / beneficiary farmers in horticultural operations especially under high efficiency irrigation.
vi. Any other relevant duties assigned by the project management.

7. Soil Scientist

The Soil Scientist should possess a Master's degree in Agriculture with specialization in Soil Science and 10 years work experience including at least three (3) years in soil and water management under high efficiency irrigation systems. Work experience in related computer tools, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

Responsibilities of the Soil Scientist will be but not limited to the following:

i. Assist the project management in implementation of project activities related to soil management particularly under high efficiency irrigation.
ii. Provide technical support and guidance to project staff and beneficiary farmers regarding soil fertility/ productivity issues.
iii. Prepare training curriculum and lesson plans for training programs for capacity building of staff and farmers in fertility management under high efficiency irrigation management systems.
iv. Impart training to technical staff in processing soils and water quality data for nutrient management through fertigation.
v. Provide technical assistance to field staff for backup support to farmers in soil and fertility management under high efficiency irrigation systems.
vi. Build capacity of field staff / farmers in nutrient management for different soils under modernized irrigation techniques.

vii. Any other relevant duties assigned by the project management.

8. Irrigation Agronomist

The Irrigation Agronomist should possess a Master's degree in Agriculture with specialization in Agronomy and 10 years work experience including at least three (3) year work experience in related field (high efficiency irrigation) under water management projects. Work experience in related computer tools, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

i. Assist the project management in implementation of project activities.
ii. Develop guidelines and technical manuals about agronomy of different crops sown under drip/sprinkler irrigation for professionals and farmers for successful crop production.
iii. Prepare and implement plans for devising crop production technology including land preparation, planting, irrigation scheduling, inter-culture, fertigation, harvesting, processing and marketing under high efficiency irrigation.
iv. Estimate crop water requirements (CWR) by using climatic data (rainfall, sunshine, humidity, wind speed, temperature etc.) for soil moisture monitoring and proper irrigation scheduling.
v. Supervise demonstration and evaluation of modern irrigation techniques.
vi. Assist in preparation of cropping patterns under high efficiency irrigation based on the water availability.
vii. Compile and analyze the reports on agronomic aspects of crop and water management for proposing recommendations.
viii. Participate in field visits & provide necessary input for crop and irrigation management.
ix. Prepare training curriculum and carryout capacity building programs for technical staff and farmers about irrigation agronomy under high efficiency irrigation
x. Any other relevant duties assigned by the project management.

9. Financial Management Specialist

The Financial Management Specialist should have degree of Chartered Accountant or ACMA/ACCA with at least five (5) years of work experience in financial management in public sector organization preferably under a donor assisted project.

Financial Management Specialist will be responsible for provision of technical guidance and expertise in the financial management activities under the project within the framework of prescribed policies and guidelines of the government and the World Bank. The FMS will provide comprehensive support to the Directorate General Agriculture (WM) regarding establishment and maintenance of finance and accounting systems, processes and procedures, and ensuring adherence to the same. Major responsibilities of the consultant will include, interalia, the followings.

i. Provide technical assistance to Director General Agriculture (WM) for financial management activities.
ii. Ensure strategic guidance about overall operations of the project.
iii. Assist in managing all accounts, budget and audit matters.
iv. Supervise in preparing cash flows, their planning, and management.

v. Support in dealing with the Bank on financial management issues.

vi. Monitor the financial resources and accounting to ensure accuracy and reliability of financial reports.

vii. Establish an efficient, accurate and updated reporting mechanism, preferably a real time transaction recording and reporting system including asset register management, receipt book and cash book keeping, invoice register management, contract register, contract ledger management etc.

viii. Consolidate the periodic financial progress reports and submission to the DGA (WM) for review/approval and/or all stakeholders in accordance with the prescribed requirements.

ix. Prepare and coordinate various financial reports as may be required by any government agency.

x. Organize cash management processes, including liquidity management, recommendation about imprest level, risk assessment, bank relationship management, timely accounting and reconciliation of all transactions, security for cash assets on site etc.

xi. Carry out capacity building of the provincial, regional and district level finance & accounts teams.

xii. Ensure carrying out internal and external audits timely and regularly to improve financial process as well as suggest corrective actions on all recommendations/ observations.

xiii. Help in securing approvals of competent authority regarding budget allocations and release of funds.

xiv. Any other relevant duties assigned by the Director General Agriculture (WM).

10. GIS Specialist

GIS Specialist should possess Master degree in Remote Sensing & GIS with at least five (5) years of work experience in GIS applications in public/ private sector organization preferably under a donor assisted project.

GIS Specialist would be responsible for provision of technical guidance and expertise in the management GIS database and supervision of activities for ground truthing and updating of data sets. He/she will provide comprehensive support to the Directorate General Agriculture (WM) regarding database maintenance, data verification, updation of information, upgradation of system for use of data for planning and monitoring activities. Major responsibilities of the consultant will include, interalia, the followings.

i. Provide technical assistance to Director General Agriculture (WM) for GIS activities.

ii. Develop GIS applications on different platforms (i.e. ESRI products/ ERDAS Imagine/ ER-Mapper / MapInfo etc.).

iii. Supervise image processing/ interpretation and analysis.

iv. Carryout data digitization and geodatabase development.

v. Manage map production and printing.

vi. Administer spatial data analysis and management.

vii. Accomplish standardization of GIS data and database.

viii. Organize collection of necessary field data for completion, updating and upgradation of GIS database.

ix. Build capacity of OFWM staff in operation, application and management of GIS database, use of GPS and latest GIS software i.e. ArcView, ArcGIS etc.

x. Demonstrate ways to use OFWM GIS database as a management tool in an optimal manner for project planning and monitoring.

Annexure-E-2

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Indicative Duties / Job Description

Monitoring & Evaluation (M&E) Consultants

1. Water Management Specialist

The Water Management Specialist will be the Team Leader of consultants team who shall be responsible for providing guidance and direction to all the team members for providing technical assistance about appropriate water management interventions and will provide requisite technical support in their adoption. The WMS will possess a Master's degree or its equivalent in Agricultural Engineering / Water Resources / Irrigation Engineering after B.Sc. Agri. Engineering with 20 years experience including evaluation of modern water management interventions of multi sectoral projects preferably World Bank financed. A minimum of 10 years of experience will be required for promoting water management interventions, particularly high efficiency irrigation systems in a developed country on successful model with demonstrated ability to work with government officials, technical field staff, NGO representatives, and farmers will be preferred. In addition, the WMS would be required to have familiarity with the principles and practices of participatory community development, irrigated agriculture, water management related issues, besides, having fluency in spoken and written English.

Responsibilities of the Water Management Specialist will be but not limited to the following:

xi. Lead the M&E and TA consultant's team for provision of technical assistance to Director General Agriculture (WM) in the Punjab.

xii. Identify the most suitable new water management interventions from all over the World replicable in the Punjab.

xiii. Provide assistance in preparation of implementation plans for execution of envisaged project activities.

xiv. Assist in establishment of Irrigation Demonstration Sites (IDSs) for showcasing improved water management and conservation techniques/technologies.

xv. Identify the most efficient and cost effective tools and techniques for planning irrigation scheduling at the farmers' field.

xvi. Provide technical assistance in estimating crop water requirements of major crops and compare those with water availability for planning what to grow and how.

xvii. Design sustainable irrigation water management packages at the farm level and facilitate their demonstrations.

xviii. Guide the OFWM staff in identification and selection of appropriate irrigation methods for various areas.

xix. Prepare technical reports, guidelines and training manuals to disseminate the latest OFWM information among stakeholders for adoption/promotion of improved water management interventions.

xx. Support in training of technical staff and master trainers involved in promotion of water management technologies.

xxi. Carry out monitoring and evaluation of improved water management practices and techniques for their performance assessment as well as propose measures for improving their efficiency.

xxii. Locate successful models of water management in developed countries and arrange technology transfer through foreign visits/trainings.

xxiii. Provide technical assistance to field staff for extending back up support to farmers about new water management interventions

xxiv. Address issues and suggest solution to the problems related to engineering aspects of irrigation methods as confronted by the farmers.

xxv. Prepare/review the capacity building plans for farmers and recommendation for their improvements.

xxvi. Lead for demonstration, evaluation and indigenization of improved water management techniques/technologies under local conditions for their adoption by the farmer.

xxvii. Any other relevant duties assigned by the project management.

2. Irrigation Agronomist

The Irrigation Agronomist will possess a Master's degree in Agriculture with specialization in Agronomy and 15 years work experience including at least seven (7) year work experience in agronomy and crop water management preferably adoption/promotion of modern water management interventions with sound knowledge of crop production technologies, particularly with improved and modern irrigation methods. The work experience in a developed country on successful model for promoting water management interventions, particularly high efficiency irrigation would be preferred. In addition, the IA would be required to have demonstrated ability to work with government officials, technical field staff, NGO representatives, and farmers and work experience in related computer tools, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

Responsibilities of the Irrigation Agronomist will be but not limited to the following:

xi. Provide technical assistance to Director General Agriculture (WM) for planning agronomic water management practices.

xii. Develop irrigation schedules to meet water requirement of various crops under local conditions.

xiii. Formulate guidelines and technical manuals for OFWM professionals and farmers about agronomic aspects of water management and conservation techniques/technologies.

xiv. Identify, and recommend water efficient crop varieties based on soil and climatic conditions of the area.

xv. Recommend plans for successful crop production including land preparation, planting, irrigation scheduling, inter-culture, fertigation, harvesting, processing and marketing, etc. under new water management interventions particularly HEIS.

xvi. Provide agronomic support for training of technical staff and trainers involved in promotion of envisaged project interventions.

xvii. Address issues and suggest solution to the problems related to crop production as confronted by the farmers.

xviii. Provide support to WMT&R Institute in designing/laying out of agronomic experiments as well as data collection for proper evaluation.

xix. Formulate guidelines about agronomic practices for farmers to improve water productivity and enhance production of various crops.

xx. Any other relevant duties assigned by the project management.

3. Soil Scientist

The Soil Scientist will possess a Master's degree in Agriculture with specialization in Soil Science and 15 years work experience including at least seven (7) years in soil and water management under high efficiency irrigation systems including evaluation of modern water management interventions of multi sectoral projects preferably World Bank financed. The SS would be responsible for provision of technical assistance to project management and OFWM staff on soil and fertility management under various irrigation methods for promotion of improved water management interventions and their subsequent success among farming community. The work experience in a developed country in related field on successful model for promoting water management interventions, particularly high efficiency irrigation with demonstrated ability to work with government officials, technical field staff, NGO representatives, and farmers and work experience in related computer tools, good communication skills, fluency in English and proven satisfactory record of similar consultancies would be preferred.

Responsibilities of the Soil Scientist will be but not limited to the following:

i. Provide technical assistance to Director General Agriculture (WM) related to soil fertility and nutrient management under various irrigation systems.
ii. Introduce speedy, cost effective, and farmer friendly soil & water testing tools and techniques among field staff.
iii. Assist OFWM staff in demonstration, promotion of soil & water testing/management tools among farmers under various irrigation systems.
iv. Provide technical assistance to WMT&R institute for establishment of soil testing and fertility management laboratory.
v. Build capacity of OFWM field staff and farmers in nutrient management for different soils and crops under modern water management techniques/technologies.
vi. Provide technical support to OFWM staff for planning and designing irrigation systems under various soil conditions and guidance to farmers regarding site specific soil issues.
vii. Prepare training curriculum and lesson plans for training programs under various irrigation methods.
viii. Formulate guidelines for technical staff and farmers for soil and fertility management.
ix. Impart training in collection and processing of soil data for proper planning and management of irrigation systems.
x. Identify successful models of soil and nutrient management under various irrigation methods and contribute in technology transfer.
xi. Any other relevant duties assigned by the project management.

4. Agricultural Economist

The Agricultural Economist will possess a Master's degree Economics/ Agricultural Economics/ Development Economics with specialization preferably in Monitoring & Evaluation and 15 years of work experience including at least 10 years in implementation of water management projects at field level in the sectors of agricultural and rural development. The work experience in a developed country in related field particularly high efficiency irrigation and demonstrated ability to work with government officials, technical field staff, NGO representatives, and

farmers would be preferred. Work experience in related computer tools, World Bank rules/procedures, good communication skills, fluency in English, and proven satisfactory record of similar consultancies would be preferred. Responsibilities of the Training Specialist will be but not limited to the following:

i. Develop formats for preparing, reporting and compilation of plans/progress of various project activities.

ii. Prepare formats for baseline and periodic surveys for establishing pre-project dataset as well as for capturing temporal changes.

iii. Lead the field staff in collection of periodic/seasonal data planning field activities, project review, impact assessment etc.

iv. Collect, compile and analyze the data regarding different components/activities against envisaged project objectives

v. Assist in modification of project implementation plans on the basis of the information collected from the field on different aspects

vi. Establish a framework for involving beneficiary communities in the M&E process and internalizing beneficiary feedback in project implementation path

vii. Provide leadership in developing monitoring mechanisms/systemsfor quality control of civil works.

viii. Impart guidance and training on M&E concepts and tools to project stakeholders

ix. Lead surveys/information collection for impact assessment of project activities.

x. Supervise M&E staff for inspection of field activities for ensuring adoption of specified standards and specifications.

xi. Any other relevant duties assigned by the project management.

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Requirement of Transport, Machinery and Equipment

(Rupees)

S.No.	Particulars	Unit	Quantity	Unit Cost (Rs.)	Year-I		Year-II		Year-III		Year-IV		Year-V		Total	
					Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost
I)	**A09501-TRANSPORT**															
A)	**Provincial**															
1	Double Cabin Pickup (3000CC)	No.	2	2,900,000	2	5,800,000	-	-	-	-	-	-	-	-	2	5,800,000
2	SUZUKI APV (3000CC)	No.	2	2,100,000	2	4,200,000	-	-	-	-	-	-	-	-	2	4,200,000
3	Car (1300 CC)	No.	3	1,500,000	3	4,500,000									3	4,500,000
4	Car (1000 CC)	No.	4	1,000,000	4	4,000,000	-	-	-	-	-	-	-	-	4	4,000,000
	Total (A)				11	**18,500,000**		**-**	**-**	**-**		**-**		**-**	11	**18,500,000**
B)	**Regional**															
1	Double Cabin Pickup (3000CC)	No.	3	2,900,000	3	8,700,000	-	-	-	-	-	-	-	-	3	8,700,000
2	Car (1000 CC)	No.	6	1,000,000	6	6,000,000		-	-	-	-	-	-	-	6	6,000,000
	Total (B)				9	**14,700,000**		**-**		**-**		**-**		**-**	9	**14,700,000**
C)	**District & Tehsil**															
1	Double Cabin Pickup (3000CC)	No.	36	2,900,000	36	104,400,000	-	-	-	-	-	-	-	-	36	104,400,000
2	Car (1000 CC)	No.	61	1,000,000	61	61,000,000		-	-	-	-	-	-	-	61	61,000,000
3	Motorcycle	No.	200	70,000	200	14,000,000	-	-	-	-	-	-	-	-	200	14,000,000
	Total (C)				297	**179,400,000**		**-**		**-**		**-**		**-**	297	**179,400,000**
	Total (I)				317	**212,600,000**		**-**		**-**		**-**		**-**	317	**212,600,000**
II)	**A09203-IT EQUIPMENT**															
A)	**Provincial**															
1	Computer Desktop	No.	4	85,000	4	340,000	-	-	-	-	-	-	-	-	4	340,000
2	Laser Printer	No.	6	30,000	6	180,000	-	-	-	-	-	-	-	-	6	180,000
3	Laptop	No.	6	125,000	6	750,000	-	-	-	-	-	-	-	-	6	750,000
	Total (A)				**16**	**1,270,000**		**-**		**-**		**-**		**-**	**16**	**1,270,000**
B)	**Regional**															
1	Computer Desktop	No.	6	85,000	6	510,000	-	-	-	-	-	-	-	-	6	510,000
2	Laser Printer	No.	6	30,000	6	180,000	-	-	-	-	-	-	-	-	6	180,000
3	Laptop	No.	3	125,000	3	375,000	-	-	-	-	-	-	-	-	3	375,000
	Total (B)				**15**	**1,065,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15**	**1,065,000**
C)	**District & Tehsil**															
1	Computer Desktop	No.	161	85,000	161	13,685,000	-	-	-	-	-	-	-	-	161	13,685,000
2	Laser Printer	No.	161	30,000	161	4,830,000	-	-	-	-	-	-	-	-	161	4,830,000
	Total (C)				**322**	**18,515,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**322**	**18,515,000**
	Total (II)				**353**	**20,850,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**353**	**20,850,000**
III)	**A09601-PLANT & MACHINERY**															
A)	**Provincial**															
1	GPS set	No.	6	40,000	6	240,000	-	-	-	-	-	-	-	-	6	240,000
2	Multimedia with Screen	No.	1	150,000	1	150,000	-	-	-	-	-	-	-	-	1	150,000
3	Vioce/Video Conferrencing System	No.	1	700,000	1	700,000	-	-	-	-	-	-	-	-	1	700,000
4	Photostat Machine	No.	1	300,000	1	300,000	-	-	-	-	-	-	-	-	1	300,000
5	Telephone	No.	6	3,000	6	18,000	-	-	-	-	-	-	-	-	6	18,000
6	Fax machine	No.	2	25,000	2	50,000	-	-	-	-	-	-	-	-	2	50,000
7	Air-conditioner	No.	4	50,000	4	200,000	-	-	-	-	-	-	-	-	4	200,000
8	Universal Access No. Charges (UAN)	No.	1	100,000	1	100,000	-	-	-	-	-	-	-	-	1	100,000
9	Water Dispenser	No.	4	15,000	4	60,000	-	-	-	-	-	-	-	-	4	60,000
10	Generator	No.	1	1,200,000	1	1,200,000									1	1,200,000
	Total (A)				**27**	**3,018,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**27**	**3,018,000**
B)	**Regional**															
1	GPS set	No.	9	40,000	9	360,000	-				-	-	-	-	9	360,000
2	Photostat Machine	No.	3	300,000	3	900,000	-	-	-	-	-	-	-	-	3	900,000
3	Telephone	No.	9	3,000	9	27,000	-	-	-	-	-	-	-	-	9	27,000
4	Fax machine	No.	3	25,000	3	75,000	-	-	-	-	-	-	-	-	3	75,000
5	Generator	No.	3	300,000	3	900,000									3	900,000
6	UAN	No.	3	100,000	3	300,000	-	-	-	-	-	-	-	-	3	300,000
7	Channel Ditcher	No.	3	500,000	3	1,500,000									9	1,500,000
	Total (B)				33	**4,062,000**		**-**		**-**		**-**		**-**	39	**4,062,000**
C)	**District & Tehsil**															
1	GPS set	No.	270	40,000	270	10,800,000	-	-	-	-	-	-	-	-	278	10,800,000
2	Photostat Machine	No.	36	300,000	36	10,800,000	-	-	-	-	-	-	-	-	36	10,800,000
3	Telephone	No.	36	3,000	36	108,000	-	-	-	-	-	-	-	-	36	108,000
4	Fax machine	No.	36	25,000	36	900,000	-	-	-	-	-	-	-	-	36	900,000
5	UAN	No.	36	100,000	36	3,600,000	-	-	-	-	-	-	-	-	36	3,600,000
	Total (C)				414	**26,208,000**		**-**		**-**		**-**		**-**	422	**26,208,000**
	Total (III)				**474**	**33,288,000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**488**	**33,288,000**
IV)	**A09701-FURNITURE & FIXTURE**															
A)	**Provincial**															
14	Furniture & Fixture	L/S	-	-	-	900,000	-	-	-	-	-	-	-	-	-	900,000
	Total (IV)					**900,000**		**-**		**-**		**-**		**-**		**900,000**
	Grand Total (I+II+III+IV)					**267,638,000**		**-**		**-**		**-**		**-**		**267,638,000**

Annexure-G-1

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 3 Acres Orchard with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump: 7.5 H.p,size 1.5" x 2", head 35 m ,Flow rate 26000 lph, efficiency 60 % with elcetric motor	Nos.	1	90,000	**90,000**
	Fitting Expenses	LS	1	17,305	**17,305**
B- Filtration and Fertigation System					
	Fertilizer Injection with tank 200 litres	Nos.	1	16,000	**16,000**
	Filteration System {Screen Filter } {Gravel Filter }	Nos.	1	45,000	**45,000**
C- PVC Pipes					
	PVC Pipe Dia 90 mm (3"), 9 bar	m	70	325	**22,750**
	PVC Pipe Dia 75 mm (2.5"), 9 bar	m	135	185	**24,975**
	Jointing Solution	Nos.	10	850	**8,500**
D- Emitting System					
	Plain Drip 13 mm (WT 1.5mm)	m	5,000	16	**79,950**
	Dripper 8 LPH	Nos.	2,200	7	**16,235**
	Rubber Gromate 13 mm	Nos.	110	7	**770**
	Connecter 13 mm	Nos.	110	7	**770**
	Joiners 13 mm	Nos.	110	7	**770**
	End Plug 13 mm	Nos.	110	3	**330**
E- Valves					
	Flush Valve	Nos.	2	550	**1,100**
	Air Relief valve	Nos.	1	1,500	**1,500**
	Foot Valve	Nos.	1	1,400	**1,400**
	Non Return Valve	Nos.	1	4,000	**4,000**
F- Additional Safety and Monitoring Equipment					
	Water Meter	Nos.	1	10,000	**10,000**
	Presure guages	Nos.	4	660	**2,640**
Sub Total -A:					**343,995**
Service Charges @ 5%					**17,200**
Excavation and Back Filling					**6,000**
Total Project Cost					**367,195**
Per Acre Cost					**122,398**

Annexure-G-2

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 3 Acre Vegetables with Drip

Sr.	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump head 39m, Flow rate 43843 lph,	Nos.	1	45,000	**45,000**
	Electric Motor 15 HP	Nos.	1	30,000	30,000
	Head Unit Fittings	Lumpsum	1	10,000	**10,000**
B- Filtration and Fertigation System					
	Sand Media Filter (Ø 2.5", 43 m3/hr)	Nos.	1	35,000	**35,000**
	Disc Filter (Ø 2", 25 m3/hr)	Nos.	2	15,000	**30,000**
	Fertilizer injector (2")	Nos.	1	7,000	**7,000**
	Foot/Check Valve	Nos.	1	1,500	**1,500**
C- PVC Pipes					
	PVC Pipe Ø 4", B-CLASS	m	85	490	**41,650**
	PVC Pipe Ø 2.5", Class C	m	155	210	**32,550**
	Estimated Fitting Expenses	Lumpsum	1	20,000	**20,000**
	Jointing Solution,500 ml	No.	12	440	**5,280**
D- Emitting System					
	LDPE pipe Ø 17mm	m	175	17	**2,975**
	Integrated LDPE pipe Ø 17mm WT	m	8,040	18	**144,720**
	End Plug (Ø 17 mm)	Nos.	175	3	**525**
	Joiner (Ø 17X16 mm)	Nos.	175	8	**1,400**
	G.T.O Rubber (Ø 16mm)	Nos.	175	9	**1,575**
	Start Connector (Ø 16mm)	Nos.	175	9	**1,575**
E- Valves					
	Ball Valve (Ø 2.5")	Nos.	4	1,430	**5,720**
	Flush Valve (Ø 2.5")	Nos.	4	200	**800**
	Air release valve	Nos.	3	1,000	**3,000**
F- Additional Safety and Monitoring					
	Pressure gauges (Ø 2.5", 10 bars)	Nos.	3	500	**1,500**
	By Pass Valve	No.	1	2,000	**2,000**
	Flow meter	No.	1	6,500	**6,500**
	Non return Valve	Nos.	1	5,000	**5,000**
Total (A to F)					**435,270**
Service Charges					**21,764**
Excavation and Back filling					**10,000**
Grand Total					**467,034**
Per Acre Cost					**155,678**

Annexure-G-3

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 3 Acre Crop with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pump Set and Prime Mover					
	Golden centrifugal pump 1.5" 2900RMP	Nos.	1	40,000	**40,000**
	Electric Motor 10HP	Nos.	1	37,000	**37,000**
	Frame AND Coupling	Nos.	1	8,000	**8,000**
	Motor Control Panel 10HP	Nos.	1	10,000	**10,000**
B- Filtration System+Fertigation					
	Disc Filter 25m³/hr L 2”	Nos.	1	15,000	**15,000**
	Hydrocyclone Separator 25 m³/hr 2”	Nos.	1	25,000	**25,000**
	Sand Media Filter 25 m³/hr	Set	1	35,000	**35,000**
	Ventury Assembly Complete 1’’	Set	1	2,500	**2,500**
	G. M. Valve 1 - 1/4”	No.	1	600	**600**
	GI Foot Valve 3"	Nos.	1	1,600	**1,600**
	Vinyl Hose Pipe 3"	m	4	400	**1,600**
	Head Unit Fittings 1	Lumpsum	1	10,000	**10,000**
C- Valves					
	Control Valve 75 mm		2	2,000	**4,000**
	Control Valve 63 mm	Nos.	2	985	**1,970**
	Double Action Air/Vacuum Release Valve 1”	Nos.	1	1,417	**1,417**
	Flush Valve 63 mm		4	202	**808**
D- PVC Pipes					
	PVC Pipe 90 mm (B-Class)	m	160	280	**44,800**
	PVC Pipe75 mm (B-Class)	m	65	230	**14,950**
	PVC Pipe 63 mm (C-Class)	m	25	90	**2,250**
	PVC Pipe 50 mm (D-Class)	m	55	60	**3,300**
	Fittings and Accessories	Lumpsum	1	20,000	**20,000**
E- Emitting System (Inline Laterals)					
	16mm OD/13.8mm ID, Minimum 11mm W.T.	m	500	17	**8,500**
	16mm Minimum 01mm W.T 2LPH, 40CMS Spacing.	m	8,800	18	**158,400**
	Poly Grommet Take Off 16 x 13 mm	Set	170	9	**1,530**
	J-Turbo Line Joiner 16 mm	Nso.	170	7	**1,190**
	Lateral End Stop “8” Shape 16 mm	Nso.	170	4	**680**
	Pressure Gauge Glycerine Filled Lateral check	Set	2	968	**1,936**
F- Additional Safety and Monitoring Equipment					
	Water Meter 2”	Nos.	1	10,000	**10,000**
	C. I. Non Return Valve 2”	Nos.	1	3,500	**3,500**
Total (A to F)					**465,531**
Service Charges					**23,277**
Excavation & Back Filling					**6,000**
Grand Total					**494,808**

Annexure-G-4

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 5 Acres Orchard with Drip

Sr.#	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump: 7.5 H.p,size 1.5" x 2", head 35 m ,Flow rate 26000 lph, efficiency 60 % **With** electric motor	Nos.	1	90,000	**90,000**
	Fitting Expenses	LS	1	23,512	**23,512**
B- Filtration and Fertigation System					
	Fertilizer Injection with tank 200 litres	Nos.	1	16,000	**16,000**
	Filtration System {Screen Filter } {Gravel Filter }	Nos.	1	45,000	**45,000**
C- PVC Pipes					
	PVC Pipe Dia 90 mm (3"), 9 bar	m	120	325	**39,000**
	PVC Pipe Dia 75 mm (2.5"), 9 bar	m	160	185	**29,600**
	Jointing Solution	Nos.	10	850	**8,500**
D- Emitting System					
	Plain Drip 13 mm (WT 1.5mm)	m	7,000	16	**110,782**
	Dripper 8 LPH	Nos.	3,800	7	**26,600**
	Rubber Gromate 13 mm	Nos.	110	7	**770**
	Connecter 13 mm	Nos.	110	7	**770**
	Joiners 13 mm	Nos.	110	7	**770**
	End Plug 13 mm	Nos.	110	3	**330**
E- Valves					
	Flush Valve	Nos.	2	550	**1,100**
	Air Relief valve	Nos.	1	1,500	**1,500**
	Foot Valve	Nos.	1	1,400	**1,400**
	Non Return Valve	Nos.	1	4,000	**4,000**
F- Additional Safety and Monitoring Equipment					
	Water Meter	Nos.	1	10,000	**10,000**
	Pressure guages	Nos.	4	660	**2,640**
Sub Total -A:					**412,274**
Service Charges @ 5%					**20,614**
Excavation and Back Filling					**10,000**
Total Project Cost					**442,888**
Per Acre Cost					**88,578**

Annexure -G-5

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 5 Acre Vegetables with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump head 39m, Flow rate 43843 lph,	Nos.	1	45,000	**45,000**
	Electric Motor 15 HP	Nos.	1	30,000	**30,000**
	Head Unit Fittings	Lump sum	1	10,000	**10,000**
B- Filtration and Fertigation System					
	Sand Media Filter (Ø 2.5", 43 m3/hr)	Nos.	1	35,000	**35,000**
	Disc Filter (Ø 2", 25 m3/hr)	Nos.	2	15,000	**30,000**
	Fertilizer injector (2")	Nos.	1	7,000	**7,000**
	Foot/Check Valve	Nos.	1	1,500	**1,500**
C- PVC Pipes					
	PVC Pipe Ø 4", B-CLASS	m	180	490	**88,200**
	PVC Pipe Ø 2.5", Class C	m	160	210	**33,600**
	Estimated Fitting Expenses	Lump sum	1	20,000	**20,000**
	Jointing Solution,500 ml	No.	12	440	**5,280**
D- Emitting System					
	LDPE pipe Ø 17mm	m	230	17	**3,910**
	Integrated LDPE pipe Ø 17mm WT 01 mm, 40 cm Emitter spacing, 2.6 LPH	m	14,000	18	**252,000**
	End Plug (Ø 17 mm)	Nos.	250	3	**750**
	Joiner (Ø 17X16 mm)	Nos.	250	8	**2,000**
	G.T.O Rubber (Ø 16mm)	Nos.	250	9	**2,250**
	Start Connector (Ø 16mm)	Nos.	250	9	**2,250**
E- Valves					
	Ball Valve (Ø 2.5")	Nos.	4	1,430	**5,720**
	Flush Valve (Ø 2.5")	Nos.	4	200	**800**
	Air release valve	Nos.	3	1,000	**3,000**
F- Additional Safety and Monitoring Equipment					
	Pressure gauges (Ø 2.5", 10 bars)	Nos.	3	500	**1,500**
	By Pass Valve	No.	1	2,000	**2,000**
	Flow meter	No.	1	6,500	**6,500**
	Non return Valve	Nos.	1	5,000	**5,000**
Total (A to F)					**593,260**
Service Charges					**29,663**
Excavation and Back filling					**10,000**
Grand Total					**632,923**
Per Acre Cost					**126,585**

Annexure-G-6

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 5 Acre Crop with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pump Set and Prime Mover					
	Golden centrifugal pump 1.5" 2900RMP	Nos.	1	40,000	**40,000**
	electric Motor 10HP	Nos.	1	37,000	**37,000**
	Frame AND Coupling	Nos.	1	8,000	**8,000**
	Motor Control Panel 10HP	Nos.	1	10,000	**10,000**
B- Filtration System+Fertigation					
	Disc Filter 25m³/hr L 2”	Nos.	1	15,000	**15,000**
	Hydrocyclone Separator 25 m³/hr 2”	Nos.	1	25,000	**25,000**
	SAND MEDIA FILTER 25 m³/hr	Set	1	35,000	**35,000**
	Ventury Assembly Complete 1’’	Set	1	2,500	**2,500**
	G. M. Valve 1 - 1/4”	Nos.	1	600	**600**
	GI Foot Valve 3"	Nos.	1	1,600	**1,600**
	vinyl Hose Pipe 3"	m	4	400	**1,600**
	Head Unit Fittings 1	Lumpsum	1	10,000	**10,000**
C- Valves					
	Control Valve 75 mm		3	2,000	**6,000**
	Control Valve 63 mm	Nos.	2	985	**1,970**
	Double Action Air/Vacuum Release Valve 1”	Nos.	1	1,417	**1,417**
	Flush Valve 63 mm		4	202	**808**
D- PVC Pipes					
	PVC Pipe 90 mm (B-Class)	m	190	280	**53,200**
	PVC Pipe 75 mm (B-Class)	m	95	230	**21,850**
	PVC Pipe 63 mm (C-Class)	m	40	90	**3,600**
	PVC Pipe 50 mm (D-Class)	m	75	60	**4,500**
	Fittings and Accessories	Lumpsump	1	20,000	**20,000**
E- Emitting System (Inline Laterals)					
	16mm OD/13.8mm ID, Minimum 11mm W.T.	m	500	17	**8,500**
	16mm Minimum 01mm W.T 2LPH, 40CMS Spacing.	m	15,000	18	**270,000**
	Poly Grommet Take Off 16 x 13 mm	Set	250	9	**2,250**
	J-Turbo Line Joiner 16 mm	Nos.	250	7	**1,750**
	Lateral End Stop “8” Shape 16 mm	Nos.	250	4	**1,000**
	Pressure Gauge Glycerine Filled Lateral check	Set	2	968	**1,936**
F- Additional Safety and Monitoring Equipment					
	Water Meter 2”	Nos.	1	10,000	**10,000**
	C. I. Non Return Valve 2”	Nos.	1	3,500	**3,500**
Total (A to F)					**598,581**
Service Charges					**29,929**
Excavation & Back Filling					**10,000**
Grand Total					**638,510**
Per Acre Cost					**127,702**

Annexure-G-7

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 10 Acres Orchard with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump: 7.5 H.p,size 1.5" x 2", head 35 m ,Flow rate 26000 lph, efficiency 60 % with electric motor	Nos.	1	90,000	**90,000**
	Fitting Expenses	LS	1	28,003	**28,003**
B- Filtration and Fertigation System					
	Fertilizer Injection with tank 200 litres	Nos.	1	16,000	**16,000**
	Filtration System {Screen Filter } {Gravel Filter }	Nos.	1	45,000	**45,000**
C- PVC Pipes					
	PVC Pipe Dia 90 mm (3"), 9 bar	m	205	325	**66,625**
	PVC Pipe Dia 75 mm (2.5"), 9 bar	m	435	185	**80,475**
	Jointing Solution	Nos.	10	850	**8,500**
D- Emitting System					
	Plain Drip 13 mm (WT 1.5mm)	m	14,000	16	**230,930**
	Dripper 8 LPH	Nos.	7,100	7	**49,700**
	Rubber Gromate 13 mm	Nos.	250	7	**1,750**
	Connecter 13 mm	Nos.	250	7	**1,750**
	Joiners 13 mm	Nos.	250	7	**1,750**
	End Plug 13 mm	Nos.	250	3	**750**
E- Valves					
	Flush Valve	Nos.	10	600	**6,000**
	Air Relief valve	Nos.	1	1,600	**1,600**
	Foot Valve	Nos.	1	1,600	**1,600**
	Non Return Valve	Nos.	1	4,000	**4,000**
F- Additional Safety and Monitoring Equipment					
	Water Meter	Nos.	1	11,000	**11,000**
	Pressure gauges	Nos.	4	660	**2,640**
Sub Total -A:					**648,073**
Service Charges @ 5%					**32,404**
Excavation and Back Filling					**20,000**
Total Project Cost					**700,477**
Per Acre Cost					**70,048**

Annexure-G-8

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 10 Acre Vegetables with Drip (1.52 m Spacing)

Sr.	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
1	Pump head 39m, Flow rate 43843 lph,	Nos.	1	50,000	**50,000**
2	Electric Motor 15 HP	Nos.	1	42,000	42,000
3	Head Unit Fittings	Lumpsum	1	13,000	**13,000**
B Filtration and Fertigation System					
3	Media Filter & Hedro Filter (Ø 2.5", 43 m3/hr)	Nos.	1	50,000	**50,000**
4	Disc Filter (Ø 2", 25 m3/hr)	Nos.	2	15,000	**30,000**
5	Fertilizer injector (2")	Nos.	1	7,000	**7,000**
6	Foot/Check Valve	Nos.	1	1,500	**1,500**
C- PVC Pipes					
7	PVC Pipe Ø 4", B-Class	m	380	490	**186,200**
8	PVC Pipe Ø 2.5", Class C	m	360	250	**90,000**
9	Estimated Fitting Expenses	Lumpsum	1	20,000	**20,000**
10	Jointing Solution,500 ml	No.	12	440	**5,280**
D- Emitting System					
11	LDPE pipe Ø 17mm	m	480	17	**8,160**
12	Integrated LDPE pipe Ø 17mm WT 01mm, 40 cm Emitter spacing, 2.6LPH	m	28,000	18	**504,000**
13	End Plug (Ø 17 mm)	Nos.	480	10	**4,800**
14	Joiner (Ø 17X16 mm)	Nos.	480	8	**3,840**
15	G.T.O Rubber (Ø 16mm)	Nos.	480	9	**4,320**
16	Start Connector (Ø 16mm)	Nos.	480	9	**4,320**
E- Valves					
17	Ball Valve (Ø 2.5")	Nos.	8	1,430	**11,440**
18	Flush Valve (Ø 2.5")	Nos.	8	200	**1,600**
19	Air release valve	Nos.	3	1,000	**3,000**
F- Additional Safety and Monitoring Equipment					
20	Pressure gauges (Ø 2.5", 10 bars)	Nos.	3	500	**1,500**
21	By Pass Valve	No.	1	2,000	**2,000**
22	Flow meter	No.	1	6,500	**6,500**
23	Non return Valve	Nos.	1	5,000	**5,000**
Total (A to F)					**1,055,460**
Service Charges					**52,773**
Excavation and Back Filling					**20,000**
Grand Total					**1,128,233**
Per Acre Cost					**112,823**

Annexure-G-9

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 10 Acre Crop with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pump Set and Prime Mover					
	Golden centrifugal pump 1.5" 2900RMP	Nos.	1	40,000	**40,000**
	Electric Motor 10 HP	Nos.	1	37,000	**37,000**
	Frame and Coupling	Nos.	1	8,000	**8,000**
	Motor Control Panel 10HP	Nos.	1	10,000	**10,000**
B- Filtration System+Fertigation					
	Disc Filter 25m³/hr L 2”	Nos.	1	15,000	**15,000**
	Hydrocyclone Separator 25 m³/hr 2”	Nos.	1	25,000	**25,000**
	Sand Media Filter 25 m³/hr	Set	1	35,000	**35,000**
	Ventury Assembly Complete 1’’	Set	1	2,500	**2,500**
	G. M. Valve 1 - 1/4”	Nos.	1	600	**600**
	GI Foot Valve 3"	Nos.	1	1,600	**1,600**
	Vinyl Hose Pipe 3"	m	6	400	**2,400**
	Head Unit Fittings 1	lump sum	1	10,000	**10,000**
C- Valves					
	Control Valve 75 mm		3	2,000	**6,000**
	Control Valve 63 mm	Nos.	2	985	**1,970**
	Double Action Air/Vacuum Release Valve 1”	Nos.	2	1,417	**2,834**
	Flush Valve 63 mm		5	202	**1,010**
D- PVC Pipes					
	PVC Pipe 90 mm (B-Class)	m	360	280	**100,800**
	PVC Pipe 75 mm (B-Class)	m	126	230	**28,980**
	PVC Pipe 63 mm (C-Class)	m	72	90	**6,480**
	PVC Pipe 50 mm (D-Class)	m	198	60	**11,880**
	Fittings and Accessories	Lump SUM	1	15,000	**15,000**
E- Emitting System (Inline Laterals)					
	16mm OD/13.8mm ID, Minimum 11mm W.T.	m	880	17	**14,960**
	16mm Minimum 01mm W.T 2LPH, 40 cm Spacing.	m	28,800	18	**518,400**
	Poly Grommet Take Off 16 x 13 mm	Set	440	9	**3,960**
	J-Turbo Line Joiner 16 mm	Nos.	440	7	**3,080**
	Lateral End Stop “8” Shape 16 mm	Nos.	440	4	**1,760**
	Pressure Gauge Glycerine Filled Lateral check	Set	2	968	**1,936**
F- Additional Safety and Monitoring Equipment					
	Water Meter 2”	Nos.	1	7,000	**7,000**
	C. I. Non Return Valve 2”	Nos.	1	3,500	**3,500**
Total (A to F)					**916,650**
Service Charges					**45,833**
Excavation & Back Filling					**20,000**
Grand Total					**982,483**
Per Acre Cost					**98,248**

Annexure-G-10

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 15 Acres Orchard with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump: 10 H.p,size 1.5" x 2", head 50 m ,Flow rate 26160 lph, efficiency 60 % with electric motor	Nos.	1	100,000	**100,000**
	G.I Fitting for Pump and Head Unit	LS	1	29,484.00	**29,484**
B- Filtration and Fertigation System					
	Fertilizer Injection with tank 200 litres	Nos.	1	22,000	**22,000**
	Filtration System {Screen Filter } {Gravel Filter }	Nos.	1	65,000	**65,000**
C- PVC Pipes					
	PVC Pipe Dia 82.6 mm (3"),6 bar	m	215	325	**69,875**
	PVC Pipe Dia 57.6 mm (2"), 9 bar	m	925	190	**175,750**
	Tee 3"	m	6	620	**3,720**
	Elbow 3"	Nos.	7	500	**3,500**
	Elbow 2"	Nos.	6	170	**1,020**
	Reducing Bush 3" x 2"	Nos.	6	220	**1,320**
	Jointing Solution	Nos.	15	850	**12,750**
D- Emitting System					
	Plain Drip 16 mm (WT 1.5mm)	m	13,500	16	**214,515**
	Dripper 24 LPH	Nos.	1,850	15	**27,750**
	Rubber Gromate 16 mm	Nos.	500	12	**6,000**
	Connecter 16 mm	Nos.	500	12	**6,000**
	Joiners 16 mm	Nos.	500	12	**6,000**
	End Plug 16 mm	Nos.	500	12	**6,000**
E- Valves					
	Flush Valve 2"	Nos.	8	600	**4,800**
	Air Relief valve	Nos.	1	1,600	**1,600**
	PVC Compact Ball Valve 3"	Nos.	6	3,500	**21,000**
	Non Return Valve	Nos.	1	4,000	**4,000**
	Foot Valve	Nos.	1	1,400	**1,400**
F- Additional Safety and Monitoring Equipment					
	Flow Meter 2"	Nos.	1	14,000	**14,000**
	Pressure gauges	Nos.	4	660	**2,640**
Sub Total -A:					**800,124**
Service Charges @ 5%					**40,006**
Excavation and Back Filling					**30,000**
Total Project Cost					**870,130**
Per Acre Cost					**58,009**

Annexure-G-11

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 15 Acre Vegetables with Drip (1.52 m Spacing)

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pumping Unit					
	Pump head 39m, Flow rate 69225 lph, 3*2.5	Nos.	1	50,000	**50,000**
	Electric Motor 20 HP	Nos.	1	45,000	**45,000**
	Head Unit Fittings	Lumpsum	1	15,000	**15,000**
B- Filtration and Fertigation System					
	Sand Media Filter (Ø 2.5", 40 m3/hr)	Nos.	2	35,000	**70,000**
	Disk Filter (Ø 2", 30 m3/hr)	Nos.	2	15,000	**30,000**
	Fertilizer injector (2")	Nos.	1	7,000	**7,000**
	Foot/Check Valve	Nos.	1	2,000	**2,000**
C- PVC Pipes					
	PVC Pipe 6", B-Class	m	425	550	**233,750**
	PVC Pipe Ø 4", B-Class	m	460	490	**225,400**
	Estimated Fitting Expenses	Lumpsum	1	60,000	**60,000**
	Jointing Solution,500 ml	No.	20	440	**8,800**
D- Emitting System					
	LDPE pipe Ø 17mm	m	560	17	**9,520**
	Integrated LDPE pipe Ø 17mm WT 01mm, 40 cm Emitter spacing, 2.6LPH	m	40,200	18	**723,600**
	End Plug (Ø 17 mm)	Nos.	520	10	**5,200**
	Joiner (Ø 17X16 mm)	Nos.	520	8	**4,160**
	G.T.O Rubber (Ø 16mm)	Nos.	520	9	**4,680**
	Start Connector (Ø 16mm)	Nos.	520	9	**4,680**
E- Valves					
	Ball Valve (Ø 4")	Nos.	10	1,690	**16,900**
	Flush Valve (Ø 2.5")	Nos.	10	200	**2,000**
	Air release valve	Nos.	3	1,000	**3,000**
F- Additional Safety and Monitoring Equipment					
	Pressure gauges (Ø 2.5", 10 bars)	Nos.	3	500	**1,500**
	By Pass Valve	No.	1	2,000	**2,000**
	Flow meter	No.	1	10,000	**10,000**
	Non return Valve	Nos.	1	7,000	**7,000**
Total (A to F)					**1,541,190**
Service Charges					**77,060**
Excavation & Back Filling					**40,000**
Grand Total					**1,658,250**
Per Acre Cost					**110,550**

Annexure-G-12

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 15 Acre Crop with Drip

Sr. #	Description	Unit	Quantity	Unit Rate (Rs.)	Total Amount (Rs.)
A- Pump Set and Prime Mover					
	centrifugal pump	Nos.	1	55,000	**36,000**
	Electric Motor 15HP	Nos.	1	50,000	**50,000**
	Fabricated Base Frame	Nos.	1	8,000	**8,000**
	Motor Control Panel 25HP	Nos.	1	10,000	**10,000**
B- Filtration System+Fertigation					
	Disc Filter 40m³/hr L 2”	Nos.	2	12,000	**24,000**
	Jain Hydrocyclone Separator 40 m³/hr 3”	Nos.	1	25,000	**25,000**
	Sand Media Filter 50 m³/hr-M 3”	Set	1	35,000	**35,000**
	Ventury Assembly Complete 3/4’’	Set	1	2,500	**2,500**
	G. M. Valve 1 - 1/2”	Nos.	1	800	**800**
	GI Foot Valve	Nos.	1	2,000	**2,000**
	vinyl Hose Pipe 4"	m	6	500	**3,000**
	Head Unit Fittings 2	lUMPsum	1	8,000	**8,000**
C- Valves					
	Control Valve 90 mm	Nos.	1	4,000	**4,000**
	Control Valve 75 mm	Nos.	6	2,000	**12,000**
	Control Valve 63 mm	Nos.	2	1,200	**2,400**
	Control Valve 50 mm	Nos.	2	760	**1,520**
	Control Valve 40 mm	Nos.	6	500	**3,000**
	Double Action Air/Vacuum Release Valve 1”	Nos.	3	1,500	**4,500**
	Flush Valve 50 mm	Nos.	8	175	**1,400**
	Flush Valve 40 mm	Nos.	8	150	**1,200**
D- PVC Pipes					
	PVC Pipe 110 mm (B-Class)	m	596	264	**157,344**
	PVC Pipe 75 mm (B-Class)	m	122	130	**15,860**
	PVC Pipe 63 mm (D-Class)	m	500	94	**47,000**
	PVC Pipe 50 mm (D-Class)	m	258	82	**21,156**
	Fittings and Accessories	Lumpsump	1	20,000	**20,000**
E- Emitting System (Inline Laterals)					
	12mm OD/10.8mm ID, Minimum 0.8mm W.T.	m	1,320	15	**19,800**
	16mm Minimum 01mm , 50 cm Spacing.	m	35,100	18	**631,800**
	Poly Grommet Take Off 12 x 13 mm	Set	620	9	**5,580**
	J-Turbo Line Joiner 12 mm	Nos.	620	7	**4,340**
	Lateral End Stop “8” Shape 12 mm	Nos.	620	4	**2,480**
	Pressure Gauge Glycerine Filled Lateral check	Set	2	968	**1,936**
F- Additional Safety and Monitoring Equipment					
	Water Meter 3”	Nos.	1	10,000	**10,000**
	C. I. Non Return Valve 3”	Nos.	1	7,000	**7,000**
Total (A to F)					**1,178,616**
Service Charges					**58,931**
Excavation & Back Filling					**30,000**
Grand Total					**1,267,547**
Per Acre Cost					**84,503**

Annexure-G-13

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 10 Acres Dense Orchard with Drip

Parameters	Value	Units	No. Zone	Total
Total area under HEIS	2.5	Acres	4	10
Reference Evapotranspiration (ET)	7.9	mm/d		
Crop Factor (Kc)	0.70			
Plant spacing	4.57	m	15	ft
Row spacing/ Lateral spacing	4.57	m	15	ft
Canopy Diameter	4.33	m	14	ft
Canopy Area	14.7	m^2		
Canopy factor at maturity	0.70	Fraction		
Irrigation system efficiency	90	%		
Emitter flow rate	8.0	LPH		
No. of emitter/dripper per plant	6.0	Nos.		
No. of drip lines per row	2.0	Nos.		
Optimal distance between two Laterals	4.57	m		
Irrigation cycle (assume one day)	1.0	Days		
Peak daily consumptive use per day	4.33	mm/d		
Total no. of plants	484	Nos.		1,938
Total drip line length	4428	m		17,711
Total no. of emitters/drippers	2907	Nos.		11,627
Average emitter spacing	1.52	m	5	ft
Total flow rate	23253	LPH	6	lps
Application rate	2.30	mm/hr		
Operation time*	1.88	Hrs		8
No of Zones	4			
Pump Flow	6.5	lps		
H.P (H=42m & Eff=50%)	7.2	hp		
Total Time Required	7.5	hrs		

Item Description	Specification	Quantity	Rate	Amount
Head Unit & Accessories				
Pump	6.5 lps	1	75,763	75,763
Elec. Motor	7.5 hp	1	42,000	42,000
Control Panal		1	18,000	18,000
Base Frame		1	12,000	12,000
Venyle House	3", 6m	6	1,384	8,304
Foot Valve	3"	1	4,500	4,500
Water Meter	2"	1	25,000	25,000
Non Return Valve	3"	1	3,500	3,500
Pressure Gauge	0-10 Bars	2	1,073	2,146
H.U Fittings (%)	7			13,385
Sub Total				**204,598**
Filteration & Fertigation				
Hydrocylone	25 m3/hr	1	22,074	22,074
Sand Media	25 m3/hr	1	47,114	47,114
Disc Filter	25 m3/hr	1	17,155	17,155
Ventury Injector	1 "	1	5,319	5,319
Fertilizer Tank	30 Lit	1	8,839	8,839
Sub Total				**100,501**
PVC Pipes				
PVC, 6 Bar	90 mm	450	219	98,388
PVC, 6 Bar	75 mm	0	130	-
PVC, 6 Bar	63 mm	680	119	81,240
PVC, 6 Bar	50 mm	0	82	-
PVC Fittings (%)	15			26,944
Sub Total				**206,572**
PVC Valves				
Control Valve	90 mm	4	4,522	18,088
Flush Valve	63mm	8	212	1,696
Air Release Valve	1"	2	1,488	2,976
Sub Total				**22,760**
Emitting System				
Dripline Integrated	12 mm	0	10	-
Dripline Plain	12 mm	18000	12	216,000
Drippers	12mm	12000	12	144,000
G.Take Off	12mm	600	10	6,168
Lateral End Plug	12mm	600	7	4,092
Sub Total				**370,260**
Trenching	RFT	3700	16	59,200
Material Cost	Rs			**963,891**
Spare Parts (%)	1			9,639
Service Charges (%)	6			57,833
Total System Cost				**1,031,363**
Discount (%)	0			-
Net Total Sys Cost				**1,031,363**
Conclusion- (Cost/Acre-Rs.)				**103,136**

Annexure-G-14

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost for 15 Acres Dense Orchard with Drip

Parameters	Value	Units	No. Zone	Total
Total area under HEIS	**2.5**	Acres	**6**	**15**
Reference Evapotranspiration (ET)	**7.9**	mm/d		
Crop Factor (Kc)	**0.70**			
Plant spacing	**4.57**	m	**14.99**	ft
Row spacing/ Lateral spacing	**4.57**	m	**14.99**	ft
Canopy Diameter	**4.33**	m	**14.20**	ft
Canopy Area	**14.7**	m^2		
Canopy factor at maturity	**0.70**	Fraction		
Irrigation system efficiency	**90**	%		
Emitter flow rate	**8.0**	LPH		
No. of emitter/dripper per plant	**6.0**	Nos.		
No. of drip lines per row	**2.0**	Nos.		
Optimal distance between two Laterals	**4.57**	m		
Irrigation cycle (assume one day)	**1.0**	Days		
Peak daily consumptive use per day	**4.33**	mm/d		
Total no. of plants	**484**	Nos.		**2,907**
Total drip line length	**4428**	m		**26,567**
Total no. of emitters/drippers	**2907**	Nos.		**17,440**
Average emitter spacing	**1.52**	m	**5.0**	ft
Total flow rate	**23253**	LPH	**6.5**	lps
Application rate	**2.30**	mm/hr		
Operation time*	**1.88**	Hrs		**11.3**
No of Zones	**6**			
Pump Flow	6.5	lps		
H.P (H=42m & Eff=50%)	7.2	hp		
Total Time Required	11.3	hrs		

Item Description	Specification	Quantity	Rate	Amount
Head Unit & Accessories				
Pump	6.5 lps	1	75,763	75,763
Elec. Motor	7.5 hp	1	42,000	42,000
Control Panal		1	18,000	18,000
Base Frame		1	12,000	12,000
Venyle House	3", 6m	6	1,384	8,304
Foot Valve	3"	1	4,500	4,500
Water Meter	2"	1	25,000	25,000
Non Return Valve	3"	1	3,500	3,500
Pressure Gauge	0-10 Bars	2	1,073	2,146
H.U Fittings (%)	7			13,385
Sub Total				**204,598**
Filteration & Fertigation				
Hydrocylone	25 m3/hr	1	22,074	22,074
Sand Media	25 m3/hr	1	47,114	47,114
Disc Filter	25 m3/hr	1	17,155	17,155
Ventury Injector	1 "	1	5,319	5,319
Fertilizer Tank	30 Lit	1	8,839	8,839
Sub Total				**100,501**
PVC Pipes				
PVC, 6 Bar	90 mm	650	219	142,116
PVC, 6 Bar	75 mm	0	130	-
PVC, 6 Bar	63 mm	680	119	81,240
PVC, 6 Bar	50 mm	0	82	-
PVC Fittings (%)	15			33,503
Sub Total				**256,859**
PVC Valves				
Control Valve	90 mm	6	4,522	27,132
Flush Valve	63mm	12	212	2,544
Air Release Valve	1"	2	1,488	2,976
Sub Total				**32,652**
Emitting System				
Dripline Integrated	12 mm	0	10	-
Dripline Plain	12 mm	27000	12	324,000
Drippers	12mm	18000	12	216,000
G.Take Off	12mm	600	10	6,168
Lateral End Plug	12mm	600	7	4,092
Sub Total				**550,260**
Trenching	RFT	4300	16	68,800
Material Cost	Rs			**1,213,670**
Spare Parts (%)	1			12,137
Service Charges (%)	6			72,820
Total System Cost				**1,298,627**
Discount (%)	0			-
Net Total Sys Cost				**1,298,627**
Conclusion- (Cost/Acre-Rs.)				**86,575**

Annexure-H

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Unit Cost of LASER

S. No.	Item	Cost (Rs.)
1.	LASER unit with all accessories including Transmitter, Receiver, Control Box, Tripod Stand, Battery etc.	350,000
2.	LASER Scrapper	250,000
3.	Tractor	1,000,000
	Total	**1,600,000**

A.	Government Share:	14%	225,000	US$ =	2,647
B.	Farmer's Share:	86%	1,375,000	US$ =	16,176

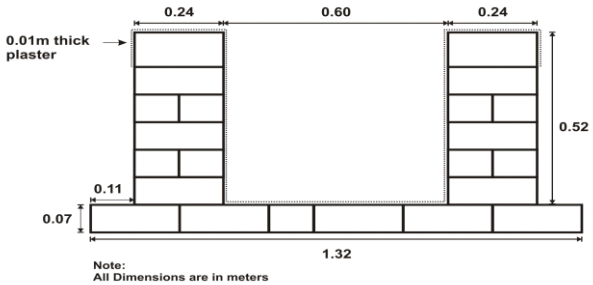
PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Improvement of Unimproved Canal Irrigated Watercourses

Unit Costs (Brick Lined)

1. Cross Section of a Typical Watercourse

Lined Section Dimensions
Depth = 52 cm (20 inches)
Bottom Width = 60 cm (24 inches)
Floor Thickness = 7 cm (2.75 inches)
Floor width = 131.5 cm (52 inches)
Wall Thickness = 23 cm (9 inches)



2. Basic Data of a Typical Watercourse to be Lined

Items	Unit	Qty	Unit Volume (Cum)	Total Volume (Cum)
Length of Watercourse	m	3,900		
Design Discharge	lps	75		
Average Slope	m/m	0.0004		
Length of Lining (30%)	m	1,170	0.3313	387.56
Nakka Structures (0.51 m dia)	number	45	0.52	23.40
Culvert	number	3	4.00	12.00
Sign Board	number	1	0.50	0.50
Drop Structure	number	5	0.25	1.25
Animal Wallows	number	0.18	15.00	2.70
				427.41

3. Estimated Materials & Cost

Items	Unit	Qty	Unit Cost (Rs.)	Total Cost (Rs.)
Bricks	Nos.	213,706	3,600 /1,000	769,343
Cement	bag	799	350 /Bag	279,741
Sand	cu m	111	600 /Cum	66,676
Nakkas	Nos.	45	570 /Nakka	25,650
Total Material cost				**1,141,410**
Material Cost per Running Meter (Rs.)				**976**

4. Cost of Labour & Masons (Farmers' Share)

Items	Labor (Rs.)	Masons (Rs.)	Total (Rs.)
Earthen improvement of 2,730 meters section (0.2 men-days/meter @ Rs.450/man-days).	245,700	-	245,700
Alternate irrigation channel for constriction of 1,170 meters lined section (0.09 men-days/meter @ Rs.450/man-days).	47,385	-	47,385
Excavation of section to be lined 1,170 meters (0.15 men-days/meter @ Rs.450/man- days)	78,975	-	78,975
Construction of lined section 1,170 meters @ Rs.250/meter.	87,750	204,750	292,500
Installation of 45 nakkas @ Rs.800/- each	18,000	18,000	36,000
Construction of 3 culverts @ Rs.5,000/- each	7,500	7,500	15,000
Construction of 0.18 Animal wallows @ Rs.20,000/- each	1,620	1,980	3,600
Construction of 05 drop structures @ Rs.700/- each	1,750	1,750	3,500
Construction, Painting and Writing of Sign Board @ Rs.2,500/- each	1,250	1,250	2,500
Total Labor & Masons	**489,930**	**235,230**	**725,160**

5. Overall Unit Cost of Watercourse Improvement

	Items	%age	Amount (Rs.)
i	Cost of Materials	61%	1,141,410
ii	Cost of Labour for Earthen Construction	13%	245,700
iii	Cost of Labour for Lining	13%	244,230
iv	Cost of Masons	13%	235,230
v	**Total (i+ii+iii+iv)**	**100%**	**1,866,570**

6. Cost Sharing

i.	Government Share	61%	1,141,410
ii.	Farmers' Share	39%	725,160
	Total	**100%**	**1,866,570**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

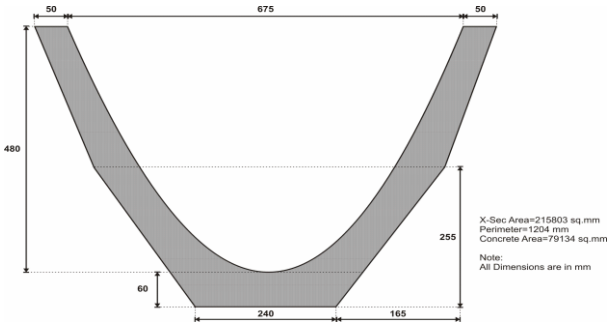
Improvement of Unimproved Canal Irrigated Watercourses

Unit Cost (PCPL)

1. Cross Section of a Typical Watercourse

PCPS Size

Maximum Height, D	48 cm
Maximum Width, T	67 cm
Designed Flow Depth, d	41 cm
Free Board, FB	7 cm



2. Basic Data of a Typical Watercourse to be Lined

Items	Unit	Quantity	Unit Volume (Cum)	Total Volume (Cum)
Length of Watercourse	m	3,900		
Design Discharge	lps	75		
Average Slope	m/m	0.0004		
Length of Lining (30%)	m	1,170		
Nakka Structures (0.51 m dia)	number	45	0.52	23.40
Culvert	number	3	4.00	12.00
Sign Board	number	1	0.50	0.50
Drop Structure	number	5	0.25	1.25
Animal Wallows	number	0.18	15.00	2.70
				39.85

3. Estimated Materials & Cost

Items	Unit	Quantity	Unit Cost (Rs.)	Total Cost (Rs.)
PCPL Segments **(# 5)**	Nos.	1,070	800 /Segment	855,916
Bricks	Nos.	19,925	3,600 /1,000	71,730
Cement (including Joints)	bag	81	350 /bag	28,523
Sand (including in bed)	cu m	58	600 /Cum	34,585
Nakkas	Nos.	45	570 /nakka	25,650
Total Cost of Material				**1,016,403**
Material Cost per Running Meter (Rs.)				**869**

4. Cost of Labor & Masons (Farmers' Share)

Items	Labor (Rs.)	Masons (Rs.)	Total
Earthen improvement of 2,730 meters section (0.2 men-days/meter @ Rs.450/man-days).	245,700	-	245,700
Alternate irrigation channel for constriction of 1,170 meters lined section (0.09 men-days/meter @ Rs.450/man-days).	43,173	-	43,173
Excavation of section to be lined 1,170 meters (0.15 men-days/meter @ Rs.450/man- days)	78,975	-	78,975
PCP Segments laying, jointing and back earth filling (1,170 meters) @ Rs.235/meter.	137,475	137,475	274,950
Installation of 45 nakkas @ Rs.800/- each	18,000	18,000	36,000
Construction of 3 culverts @ Rs.5,000/- each	7,500	7,500	15,000
Construction of 0.18 Animal wallows @ Rs.20,000/- each	1,620	1,980	3,600
Construction of 05 drop structures @ Rs.700/- each	1,750	1,750	3,500
Construction, Painting and Writing of Sign Board @ Rs.2,500/- each	1,250	1,250	2,500
Total Labor & Masons	**535,443**	**167,955**	**703,398**

5. Overall Unit Cost of Watercourse Improvement

	Items	%age	Amount (Rs.)
i	Cost of Materials	59%	1,016,403
ii	Cost of Labor for Earthen Construction	14%	245,700
iii	Cost of Labor for Lining	17%	289,743
iv	Cost of Masons	10%	167,955
v	**Total (i+ii+iii+iv)**	**100%**	**1,719,801**

6. Cost Sharing

i.	Government Share	59%	1,016,403
ii.	Farmers' Share	41%	703,398
	Total	**100%**	**1,719,801**

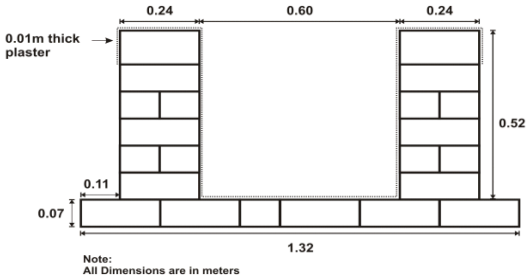
PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Completion of Partialy Improved Watercourses

Unit Cost (Brick Lined)

1. Cross Section of a Typical Watercourse

Lined Section Dimensions
Depth = 52 cm (20 inches)
Bottom Width = 60 cm (24 inches)
Floor Thickness = 7 cm (2.75 inches)
Floor width = 131.5 cm (52 inches)
Wall thickness = 23 cm (9 inches)



2. Basic Data of a Typical Watercourse to be Lined

Items	Unit	Qty	Unit Volume (Cum)	Total Volume (Cum)
Length of Watercourse	m	3,900		
Design Discharge	lps	75		
Average Slope	m/m	0.0004		
Length of Lining (30%)	m	644	0.3313	213.16
Nakka structures (0.51 m dia)	number	20	0.52	10.40
Culvert	number	2	4.00	8.00
Sign Board	number	1	0.50	0.50
Drop Structure	number	2	0.25	0.50
Animal Wallows	number	0.18	15.00	2.70
				235.26

3. Estimated Materials & Cost

Items	Unit	Qty	Unit Cost (Rs.)		Total Cost (Rs.)
Bricks	Nos.	117,630	3,600	/1,000	423,467
Cement	bag	440	350	/Bag	153,977
Sand	cu m	61	600	/Cum	36,700
Nakkas	Nos.	20	570	/Nakka	11,400
Total Material cost					**625,545**
Material Cost per Running Meter (Rs.)					**972**

4. Cost of Labor & Masons (Farmers' Share)

Items	Labor (Rs.)	Masons (Rs.)	Total (Rs.)
Earthen improvement of 2,730 meters section (0.2 men-days/meter @ Rs.450/man-days).	245,700	-	245,700
Alternate irrigation channel for constriction of 644 meters lined section (0.09 men-days/meter @ Rs.450/man-days).	26,062	-	26,062
Excavation of section to be lined 644 meters (0.15 men-days/meter @ Rs.450/man- days)	43,436	-	43,436
Construction of lined section 644 meters @ Rs.250/meter.	48,263	112,613	160,875
Installation of 20 nakkas @ Rs.800/- each	8,000	8,000	16,000
Construction of 2 culverts @ Rs.5,000/- each	5,000	5,000	10,000
Construction of 0.18 Animal wallows @ Rs.20,000/- each	1,620	1,980	3,600
Construction of 02 drop structures @ Rs.700/- each	700	700	1,400
Construction, Painting and Writing of Sign Board @ Rs.2,500/- each	1,250	1,250	2,500
Total Labor & Masons	**380,031**	**129,543**	**509,573**

5. Overall Unit Cost of Watercourse Improvement

	Items	%age	Amount (Rs.)
i	Cost of Materials	55%	625,545
ii	Cost of Labor for Earthen Construction	22%	245,700
iii	Cost of Labor for Lining	12%	134,331
iv	Cost of Masons	11%	129,543
v	**Total (i+ii+iii+iv)**	**100%**	**1,135,118**

6. Cost Sharing

i.	Government Share	55%	625,545
ii.	Farmers' Share	45%	509,573
	Total	**100%**	**1,135,118**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

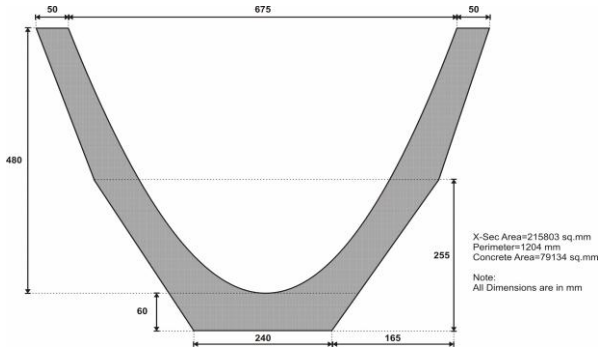
Completion of Partially Improved Watercourses

Unit Cost (PCPL)

1. Cross Section of a Typical Watercourse

PCPS Size

Maximum Height, D	48 cm
Maximum Width, T	67 cm
Designed Flow Depth, d	41 cm
Free Board, FB	7 cm



2. Basic Data of a Typical Watercourse to be Lined

Items	Unit	Qty	Unit Volume (Cum)	Total Volume (Cum)
Length of Watercourse	m	3,900		
Design Discharge	lps	75		
Average Slope	m/m	0.0004		
Length of Lining	m	644		
Nakka Structures (0.51 m dia)	number	20	0.52	10.40
Culvert	number	2	4.00	8.00
Sign Board	number	1	0.50	0.50
Drop Structure	number	2	0.25	0.50
Animal Wallows	number	0.18	15.00	2.70
				22.10

3. Estimated Materials & Cost

Items	Unit	Qty	Unit Cost (Rs.)	Total Cost (Rs.)
PCPL Segments **(# 5)**	Nos.	588	800 /Segment	470,754
Bricks	Nos.	11,050	3,600 /1,000	39,780
Cement (including Joints)	bag	45	350 /bag	15,808
Sand (including in bed)	cu m	19	600 /Cum	11,368
Nakkas	Nos.	20	570 /nakka	11,401
Total Cost of Material				**549,111**
Material Cost per Running Meter (Rs.)				**853**

4. Cost of Labor & Masons (Farmers' Share)

Items	Labor (Rs.)	Masons (Rs.)	Total (Rs.)
Earthen improvement of 2,730 meters section (0.2 men-days/meter @ Rs.450/man-days).	245,700	-	245,700
Alternate irrigation channel for constriction of 644 meters lined section (0.09 men-days/meter @ Rs.450/man-days).	26,062	-	26,062
Excavation of section to be lined 644 meters (0.15 men-days/meter @ Rs.450/man- days)	43,436	-	43,436
PCP Segments laying, jointing and back earthfilling (644 meters) @ Rs.235/meter.	75,611	75,611	151,223
Installation of 20 nakkas @ Rs.800/- each	8,000	8,000	16,000
Construction of 2 culverts @ Rs.5,000/- each	5,000	5,000	10,000
Construction of 0.18 Animal wallows @ Rs.20,000/- each	1,620	1,980	3,600
Construction of 02 drop structures @ Rs.700/- each	700	700	1,400
Construction, Painting and Writing of Sign Board @ Rs.2,500/- each	1,250	1,250	2,500
Total Labour & Masons	**407,379**	**92,541**	**499,921**

5. Overall Unit Cost of Watercourse Improvement

	Items	%age	Amount (Rs.)
i	Cost of Materials	52%	549,111
ii	Cost of Labour for Earthen Construction	23%	245,700
iii	Cost of Labour for Lining	15%	161,679
iv	Cost of Masons	9%	92,541
v	**Total (i+ii+iii+iv)**	**100%**	**1,049,031**

6. Cost Sharing

i.	Government Share	52%	549,111
ii.	Farmers' Share	48%	499,921
	Total	**100%**	**1,049,031**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Rehablitation of Irrigation Conveyance Systems in Non-Canal Commanded Areas

Unit Cost (Pipe Lining)

1. Basic Parameters

Items	Unit	Qty
Area	acre	12
Discharge	lps	14
Length of Scheme	m	450
Pvc pipe 4"	m	444
GI pipe 4"	m	6
Sluice valves	number	6
N.R.V	number	1
D. Points	number	7
Centrifugal pump	number	1

2. Estimated Materials

A-Pipe line

S.#	Items	Size	Unit	Qty	Unit Rate (Rs.)	Amount (Rs.)
1	Pvc pipe	4"	m	444	365	162,060
2	GI pipe	4"	m	6	1,200	7,200
3	Sluice valves	4"	No.	6	4,200	25,200
4	N.R.V	4"	No.	1	2,000	2,000
5	Valve socket	4"	No.	10	161	1,610
6	T. PVC	4"	No.	6	710	4,260
7	Bend PVC	4"	No.	25	200	5,000
8	Bend GI	4"	No.	12	1,200	14,400
9	M.S flange	4"	No.	22	250	5,500
10	Solution	500 gm	No.	5	200	1,000
11	Gas kit	4"	No.	23	30	690
12	Nut bolt	-	No.	95	30	2,850
13	Centrifugal pump	5"x 4"	No.	1	38,000	38,000
14	Diesel engine		No.	1	44,000	44,000
15	V-Belt		No.	1	2,000	2,000
16	Pulley		No.	2	1,300	2,600
17	Iron template for pumping unit		No.	1	1,500	1,500
18	Foundation bolts		No.	8	100	800
19	Suction pipe	5"	ft	15	300	4,500
20	Foot Valve Brass		No.	1	4,500	4,500
Total						**329,670**

B- Construction Works for Seven (7) Distribution Points

Items	Unit	Qty	Unit Rate (Rs.)	Amount (Rs.)
Bricks	No./1,000	1,225	3,700	4,533
Cement	Bag	8	360	2,869
Sand	Cum	0.79	600	471
Crush	Cum	1.19	1,450	1,726
Total:				**9,598**
Total Material Cost (A+B)				**339,268**

C- Labor+ installation Cost

S.#	Items	Size	Unit	Quantity	Unit Rate (Rs.)	Amount (Rs.)
1	Distribution points		No.	7	1,000	7,000
2	Fixing of sluice valves and N.R.V		No.	7	160	1,120
3	Pumping unit fitting and foundation		No.	1	5,000	5,000
4	Excavation of trenches		Cum	179	80	14,280
5	Laying and jointing of pvc pipes	4"	Meter	320	8	2,624
6	Laying and jointing of GI pipes	4"	Meter	4	24	97
7	Back filling	320x90%	Cum	161	6	884
Total						**31,005**
Total Cost (A+B+C)						**370,273**

3. Overall Unit Cost of Installation of Irrigation Scheme

	Items	%age	Amount (Rs.)
i	Cost of Materials	92%	339,268
ii	Cost of Labor	8%	31,005
iii	**Total Cost (i+ii)**	**100%**	**370,273**

4. Cost Sharing

i.	**Government Share**	**68%**	250,000
ii.	**Farmers' Share**	**32%**	120,273
	Total	**100%**	**370,273**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

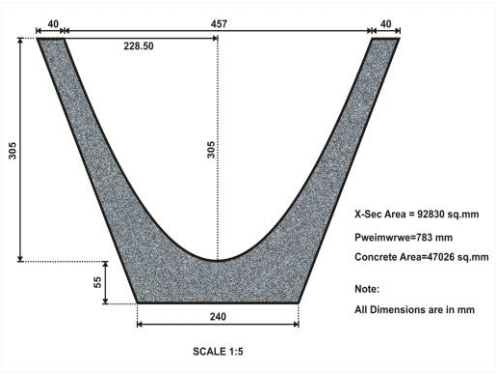
Rehablitation of IrrigationConveyance Systems in Non-Canal Commanded Areas

Unit Cost (PCPL)

1. Cross Section of a Typical Watercourse

PCPS Size

Maximum Height, D	31 cm
Maximum Width, T	45.7 cm
Designed Flow Depth, d	23 cm
Free Board, FB	8 cm



2. Basic Data of a Typical Watercourse to be Lined

Items	Unit	Quantity	Unit Volume (Cum)	Total Volume (Cum)
Length of Watercourse	m	2,000		
Design Discharge	lps	28		
Average Slope	m/m	0.0010		
Length of Lining	m	600		
Nakka Structures (0.38 m dia)	number	25	0.38	9.50
Culvert	number	2	3.00	6.00
Sign Board	number	1	0.50	0.50
Drop Structure	number	5	0.20	1.00
				17.00

3. Estimated Materials & Cost

Items	Unit	Quantity	Unit Cost (Rs.)	Total Cost (Rs.)
PCPL Segments **(# 2)**	Nos.	549	475 /Segment	260,615
Bricks	Nos.	8,500	3,600 /1,000	30,600
Cement (including Joints)	bag	34	350 /bag	11,841
Sand (including in bed)	cu m	28	600 /Cum	17,071
Nakkas	Nos.	25	300 /nakka	7,500
Total Cost of Material				**327,627**
Material Cost per Running Meter (Rs.)				**546**

4. Cost of Labor & Masons (Farmers' Share)

Items	Labor (Rs.)	Masons (Rs.)	Total (Rs.)
Earthen improvement of 1,400 meters section (0.2 men-days/meter @ Rs.439/man-days).	126,000	-	126,000
Alternate irrigation channel for constriction of 600 meters lined section (0.09 men-days/meter @ Rs.439/man-days).	24,300	-	24,300
Excavation of section to be lined 600 meters (0.15 men-days/meter @ Rs.439/man- days)	35,550	-	35,550
PCP Segments laying, jointing and back earthfilling (600 meters) @ Rs.100/meter.	30,000	30,000	60,000
Installation of 25 nakkas @ Rs.600/- each	7,500	7,500	15,000
Construction of 2 culverts @ Rs.3,000/- each	3,000	3,000	6,000
Construction of 05 drop structures @ Rs.500/- each	1,250	1,250	2,500
Construction, Painting and Writing of Sign Board @ Rs.2,000/- each	1,000	1,000	2,000
Total Labor & Masons	**228,600**	**42,750**	**271,350**

5. Overall Unit Cost of Watercourse Improvement

	Items	%age	Amount (Rs.)
i	Cost of Materials	55%	327,627
ii	Cost of Labor for Earthen Construction	21%	126,000
iii	Cost of Labor for Lining	17%	102,600
iv	Cost of Masons	7%	42,750
v	**Total (i+ii+iii+iv)**	**100%**	**598,977**

6. Cost Sharing

i.	Government Share	42%	250,000
ii.	Farmers' Share	58%	348,977
	Total	**100%**	**598,977**

Annexure-J-1

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Phasing of Physical Targets

Sr.No.	Particulars	Units	Year-I	Year-II	Year-III	Year-IV	Year-V	Total
1	**Establishment of Project Offices**							
a)	Project Coordination Unit (PCU)	Cumulative	1	-	-	-	-	1
b)	Regional Project Coordination Unit (RPCU)	Cumulative	3	-	-	-	-	3
c)	HEIS Field Teams at District Level	Cumulative	36	-	-	-	-	36
d)	Deputy District Offices at Tehsil Level	Cumulative	25	-	-	-	-	25
2	**Installation of High Efficiency Irrigation Systems**	Acres	18,000	28,500	28,500	28,500	16,500	120,000
3	**Strengthening of Precision Land Leveling Services in Private Sector**	No.	400	700	700	700	500	3,000
4	**Upgrading Farm Level Irrigation Conveyance System**							
a)	Improvement of Unimproved Canal Irrigated Watercourse	No.	700	1,200	1,200	1,200	1,200	5,500
b)	Completion of Partially Improved Watercourses	No.	200	325	325	325	325	1,500
c)	Rehabilitation of Irrigation Conveyance Systems in Non-Canal Commanded Areas	No.	200	450	450	450	450	2,000
5	**Project Implementation Supervision Consultants**	MM	460	800	800	800	800	3,660

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Phasing of Financial Implications (Rs. Million)

Sr. #	Particulars	Year-I	Year-II	Year-III	Year-IV	Year-V	Total	%age	
								Total	Works
A.	**Improving Water Productivity**								
A1.	**Installation of High Efficiency Irrigation Systems**								
I)	Government Share	1,234.566	1,954.730	1,954.730	1,954.730	1,131.686	8,230.440		
						US$	**96.829**		
II)	Farmers' Contribution	822.960	1,303.020	1,303.020	1,303.020	754.380	5,486.400		
						US$	**64.546**		
	Sub-Total (A1):	**2,057.526**	**3,257.750**	**3,257.750**	**3,257.750**	**1,886.066**	**13,716.840**		
						US$	**161.37**		
A2.	**Provision of LASER Units**								
I)	Government Share	90.000	157.500	157.500	157.500	112.500	675.000	**1.87**	**14.06**
						US$	**7.941**		
II)	Farmers' Contribution	550.000	962.500	962.500	962.500	687.500	4,125.000	**11.46**	**85.94**
						US$	**48.529**		
	Sub-Total (A2):	**640.000**	**1,120.000**	**1,120.000**	**1,120.000**	**800.000**	**4,800.000**		
						US$	**56.47**		
	Total (A):	**2,697.526**	**4,377.750**	**4,377.750**	**4,377.750**	**2,686.066**	**18,516.840**	**51.43**	
						US$	**217.85**		
B.	**Upgrading Farm Level Irrigation Conveyance System**								
I)	**Government Share**								
B1)	Improvement of Unimproved Canal Irrigated Watercourses	744.893	1,276.960	1,276.960	1,276.960	1,276.960	5,852.732		
B2)	Completion of Partially Improved Watercourses	115.937	188.397	188.397	188.397	188.397	869.526		
B3)	Rehabilitation of Irrigation Conveyance Systems in Non-Canal Commanded Areas	50.000	112.500	112.500	112.500	112.500	500.000		
	Sub-Total (I):	**910.830**	**1,577.857**	**1,577.857**	**1,577.857**	**1,577.857**	**7,222.258**	**20.06**	**58.43**
						US$	**84.968**		
II)	**Farmers' Contribution**								
B1)	Improvement of Unimproved Canal Irrigated Watercourses	498.195	854.048	854.048	854.048	854.048	3,914.389		
B2)	Completion of Partially Improved Watercourses	100.756	163.729	163.729	163.729	163.729	755.672		
B3)	Rehabilitation of Irrigation Conveyance Systems in Non-Canal Commanded Areas	46.925	105.581	105.581	105.581	105.581	469.248		
	Sub-Total (II):	**645.876**	**1,123.358**	**1,123.358**	**1,123.358**	**1,123.358**	**5,139.309**	**14.28**	**41.57**
						US$	**60.462**		
	Total (B):	**1,556.706**	**2,701.215**	**2,701.215**	**2,701.215**	**2,701.215**	**12,361.566**	**34.34**	
						US$	**145.430**		
	Total (A+B):	**4,254.232**	**7,078.965**	**7,078.965**	**7,078.965**	**5,387.281**	**30,878.406**		
						US$	**363.275**		
C	**Adoption and Promotion of Modern Irrigation Technologies & Practices and Monitoring & Evaluation**								
C1	Adoption and Promotion of Modern Irrigation Technologies & Practices	119.000	119.000	119.000	119.000	119.000	595.000		
C2	Monitoring and Evaluation of Project Impacts	35.000	35.000	35.000	35.000	35.000	175.000		
	Total (C):	**154.000**	**154.000**	**154.000**	**154.000**	**154.000**	**770.000**	**2.14**	
						US$	**9.059**		
D	**Project Management**								
D1)	i) Supervision & Administrative Cost	640.312	624.339	633.732	643.474	652.859	3,194.715	**8.87**	
						US$	**37.585**		
	ii) Non-Recurring Cost	267.638	-	-	-	-	267.638	**0.74**	
						US$	**3.149**		
	Sub-Total (D1):	**907.950**	**624.339**	**633.732**	**643.474**	**652.859**	**3,462.353**	**9.62**	
						US$	**40.734**		
D2)	Project Supervision and Third Party Validation	101.168	175.944	175.944	175.944	175.944	804.946	**2.24**	
						US$	**9.470**		
D3)	Strategic Studies, TA and Training etc.	17.000	17.000	17.000	17.000	17.000	85.000	**0.24**	
						US$	**1.000**		
	Total (D):	**1,026.118**	**817.284**	**826.676**	**836.418**	**845.803**	**4,352.299**		
						US$	**51.204**		
	Total Project Cost :	**5,434.350**	**8,050.248**	**8,059.640**	**8,069.383**	**6,387.084**	**36,000.705**	**100.00**	
						US$	**423.538**		
	a) Donar	**3,415.514**	**4,661.370**	**4,670.762**	**4,680.505**	**3,821.845**	**21,249.997**	**59.03**	
						US$	**250.000**		
	b) Farmers Contribution	**2,018.836**	**3,388.878**	**3,388.878**	**3,388.878**	**2,565.238**	**14,750.709**	**40.97**	
						US$	**173.538**		

Annexure-K

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

Summary

Sr. No.	Particulars	Year-I	Year-II	Year-III	Year-IV	Year-V	Total
1	Pay of Officer & Staff	195,103,051	203,550,211	211,997,371	220,444,531	228,891,691	1,059,986,853
2	Regular Allowances	224,476,635	202,479,585	202,479,585	202,479,585	202,479,585	1,034,394,975
3	Other Allowances Excluding T.A.	4,898,120	4,898,120	4,898,120	4,898,120	4,898,120	24,490,600
4	**Total Pay & Allowances (1+2+3):-**	**424,477,806**	**410,927,916**	**419,375,076**	**427,822,236**	**436,269,396**	**2,118,872,428**
5	**Operating Expenses**	**215,834,632**	**213,411,332**	**214,356,432**	**215,651,532**	**216,589,132**	**1,075,843,060**
6	**Total (4+5)**	**640,312,438**	**624,339,248**	**633,731,508**	**643,473,768**	**652,858,528**	**3,194,715,488**
7	**Non Recurring Cost**	**267,638,000**	**-**	**-**	**-**	**-**	**267,638,000**
8	**Total Cost (Rs.)**	**907,950,438**	**624,339,248**	**633,731,508**	**643,473,768**	**652,858,528**	**3,462,353,488**

Annexure-K-1

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

A. Provincial Project Coordination Unit (PCU)

Sr. No.	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
1	Pay of Officer & Staff		7,804,042	8,103,442	8,402,842	8,702,242	9,001,642	42,014,208
2	Regular Allowances		7,598,982	7,598,982	7,598,982	7,598,982	7,598,982	37,994,910
3	Other Allowances Excluding T.A.		1,129,000	1,129,000	1,129,000	1,129,000	1,129,000	5,645,000
4	Total Employee Related Expenses (1+2+3):-		**16,532,024**	**16,831,424**	**17,130,824**	**17,430,224**	**17,729,624**	**85,654,118**
5	Operating Expenses		**18,853,920**	**18,601,420**	**18,858,920**	**19,216,420**	**19,416,420**	**94,947,100**
6	**Total Administration Cost (4+5):**		**35,385,944**	**35,432,844**	**35,989,744**	**36,646,644**	**37,146,044**	**180,601,218**

Annexure-K-1-1

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

A. Provincial Project Coordination Unit (PCU)

Sr. No.	Object Code	Post	No. of Post	Basic Scale	Year-I	Year-II	Year-III	Year-IV	Year-V	Total
	A01	**Employees Related Expenses**								
I.	**A01101**	**Basic Pay of Officers**								
		Deputy Project Director (Watercourses)	1	19	660,000	679,200	698,400	717,600	736,800	3,492,000
		Deputy Project Director (HEIS& LASER)	1	19	660,000	679,200	698,400	717,600	736,800	3,492,000
		Deputy Director (Farms)	1	18+SP	493,980	511,980	529,980	547,980	565,980	2,649,900
		Deputy Director (Accounts)	1	18	492,000	510,000	528,000	546,000	564,000	2,640,000
		Assistant Director (Tech.)	4	18	2,005,462	2,063,062	2,120,662	2,178,262	2,235,862	10,603,308
		Accountant	2	16	297,600	316,800	336,000	355,200	374,400	1,680,000
		Superintendent	2	16	297,600	316,800	336,000	355,200	374,400	1,680,000
		Total :-	**12**		**4,906,642**	**5,077,042**	**5,247,442**	**5,417,842**	**5,588,242**	**26,237,208**
II.	**A01151**	**Basic Pay of other Staff**								
		Assistant	4	14	471,840	501,120	530,400	559,680	588,960	2,652,000
		Computer Operator	8	11+CA	766,080	810,240	854,400	898,560	942,720	4,272,000
		Vehicle Driver	11	4	777,480	807,840	838,200	868,560	898,920	4,191,000
		Naib Qasid	10	1	630,000	648,000	666,000	684,000	702,000	3,330,000
		Chowkidar	2	1	126,000	129,600	133,200	136,800	140,400	666,000
		Sweeper	2	1	126,000	129,600	133,200	136,800	140,400	666,000
		Total :-	**37**		**2,897,400**	**3,026,400**	**3,155,400**	**3,284,400**	**3,413,400**	**15,777,000**
		Total Pay (I+II) :-	**49**		**7,804,042**	**8,103,442**	**8,402,842**	**8,702,242**	**9,001,642**	**42,014,208**
III.	**A012-1**	**Regular Allowance**								
	A01202	House Rent Allowance			1,265,502	1,265,502	1,265,502	1,265,502	1,265,502	6,327,510
	A01203	Conveyance Allowance			756,960	756,960	756,960	756,960	756,960	3,784,800
	A0120D	Integrated Allowance			97,200	97,200	97,200	97,200	97,200	486,000
	A01217	Medical Allowance			924,636	924,636	924,636	924,636	924,636	4,623,180
	A0120X	50% Adhoc Allowance (2010)			2,654,880	2,654,880	2,654,880	2,654,880	2,654,880	13,274,400
	A01270	Others (30 % S.S.B and Ph.D. Allowance)			975,168	975,168	975,168	975,168	975,168	4,875,840
		15% Adhoc Allowance 2011			924,636	924,636	924,636	924,636	924,636	4,623,180
		Total :-			**7,598,982**	**7,598,982**	**7,598,982**	**7,598,982**	**7,598,982**	**37,994,910**
IV.	**A012-2**	**Other Allowances Exl. T.A**								
	A01273	Honoraria			980,000	980,000	980,000	980,000	980,000	4,900,000
	A01274	Medical Charges			49,000	49,000	49,000	49,000	49,000	245,000
	A01278	Leave salary			100,000	100,000	100,000	100,000	100,000	500,000
		Total:-			**1,129,000**	**1,129,000**	**1,129,000**	**1,129,000**	**1,129,000**	**5,645,000**
	A01	**Total Employees Related Expenses**			**16,532,024**	**16,831,424**	**17,130,824**	**17,430,224**	**17,729,624**	**85,654,118**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

A Provincial Project Coordination Unit (PCU)

Sr. No.	Object Code	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
V.	A03	**Operating Expenses**							
	A032	**Communication**							
	A03201	Postage & Telegraph		60,000	60,000	60,000	60,000	60,000	300,000
	A03202	Telephone & T/Calls		1,728,000	1,728,000	1,728,000	1,728,000	1,728,000	8,640,000
	A03203	Telex & Teleprinter		6,000	6,000	6,000	6,000	6,000	30,000
	A03204	Electronic Communication		36,000	36,000	36,000	36,000	36,000	180,000
	A03205	Courier & Pilot Services		36,000	36,000	36,000	36,000	36,000	180,000
	A03270	Others		12,000	12,000	12,000	12,000	12,000	60,000
		Total:-		**1,878,000**	**1,878,000**	**1,878,000**	**1,878,000**	**1,878,000**	**9,390,000**
	A033	**Utilities**							-
	A03301	Gas		120,000	120,000	120,000	120,000	120,000	600,000
	A03302	Water		120,000	120,000	120,000	120,000	120,000	600,000
	A03303	Electricity		2,400,000	2,400,000	2,400,000	2,400,000	2,400,000	12,000,000
	A03304	Hot & Cold Charges		24,000	24,000	24,000	24,000	24,000	120,000
	A03370	Others		12,000	12,000	12,000	12,000	12,000	60,000
		Total:-		**2,676,000**	**2,676,000**	**2,676,000**	**2,676,000**	**2,676,000**	**13,380,000**
	A034	**Occupancy Costs**							-
	A03402	Rent for Officer Building							-
	A03407	Rate & Taxes		555,000	55,000	55,000	55,000	55,000	775,000
		Total:-		**555,000**	**55,000**	**55,000**	**55,000**	**55,000**	**775,000**
	A038	**Travel & Transportation**							-
	A03805	Travelling Allowance		1,180,800	1,180,800	1,180,800	1,180,800	1,180,800	5,904,000
	A03807	P.O.L. Charges		4,212,120	4,212,120	4,212,120	4,212,120	4,212,120	21,060,600
	A03820	Others		-	-	-	-	-	-
		Total:-		**5,392,920**	**5,392,920**	**5,392,920**	**5,392,920**	**5,392,920**	**26,964,600**
	A039	**General**							-
	A03901	Office Stationery		1,440,000	1,440,000	1,440,000	1,440,000	1,440,000	7,200,000
	A03902	Printing & Publication		960,000	980,000	1,000,000	1,020,000	1,020,000	4,980,000
	A03903	Seminars		96,000	96,000	96,000	96,000	96,000	480,000
	A03905	News Papers & Periodical Books		42,000	42,000	42,000	42,000	42,000	210,000
	A03906	Uniform & Liveries		24,000	24,000	24,000	24,000	24,000	120,000
	A03907	Advertising & Publicity Charges		480,000	480,000	480,000	480,000	480,000	2,400,000
	A03908	Exhibition, etc.		900,000	900,000	900,000	900,000	900,000	4,500,000
	A03970	Other		120,000	120,000	120,000	120,000	120,000	600,000
		Total General:-		**4,062,000**	**4,082,000**	**4,102,000**	**4,122,000**	**4,122,000**	**20,490,000**
		Total Operating Expenses:-		**14,563,920**	**14,083,920**	**14,103,920**	**14,123,920**	**14,123,920**	**70,999,600**
VI	A13	**Repair & Maintenance of Durable Goods**							-
	A13001	Transport		2,640,000	2,640,000	2,640,000	2,640,000	2,640,000	13,200,000
	A13101	Machinery & Equipment		550,000	577,500	615,000	652,500	652,500	3,047,500
	A13201	Furniture & Fixture		450,000	450,000	450,000	550,000	550,000	2,450,000
	A13370	Others		-	-	-	-	-	-
		Total:-		**3,640,000**	**3,667,500**	**3,705,000**	**3,842,500**	**3,842,500**	**18,697,500**
VII	A137	**Computer Equipment**							-
	A13701	Hardware		500,000	600,000	700,000	800,000	1,000,000	3,600,000
	A13702	Software		-	-	-	-	-	-
	A13703	IT Equipment		150,000	250,000	350,000	450,000	450,000	1,650,000
		Total:-		**650,000**	**850,000**	**1,050,000**	**1,250,000**	**1,450,000**	**5,250,000**
		Total (V+VI+VII)		**18,853,920**	**18,601,420**	**18,858,920**	**19,216,420**	**19,416,420**	**94,947,100**

Annexure-K-2

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

B. Regional Project Coordination Unit (RPCU)

Sr. No.	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
1	Pay of Officer & Staff		7,956,916	8,247,076	8,537,236	8,827,396	9,117,556	42,686,181
2	Regular Allowances		7,621,290	7,621,290	7,621,290	7,621,290	7,621,290	38,106,450
3	Other Allowances Excluding T.A.		172,800	172,800	172,800	172,800	172,800	864,000
4	Total Employee Related Expenses (1+2+3):-		**15,751,006**	**16,041,166**	**16,331,326**	**16,621,486**	**16,911,646**	**81,656,631**
5	Operating Expenses		**8,204,200**	**8,104,200**	**8,154,200**	**8,354,200**	**8,454,200**	**41,271,000**
6	**Total Administration Cost (4+5):**		**23,955,206**	**24,145,366**	**24,485,526**	**24,975,686**	**25,365,846**	**122,927,631**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

B. Regional Project Coordination Unit (RPCU)

Sr. No.	Object Code	Post	No. of Post	Basic Scale	Year-I	Year-II	Year-III	Year-IV	Year-V	Total
	A01	**Employees Related Expenses**								
I.	**A01101**	**Basic Pay of Officers**								
		Regional Project Director	3	19	1,980,000	2,037,600	2,095,200	2,152,800	2,210,400	10,476,000
		Deputy Director (Tech.)	3	18+Sp	1,481,940	1,535,940	1,589,940	1,643,940	1,697,940	7,949,700
		Assistant Director (Tech.)	3	18	1,514,896	1,568,896	1,622,896	1,676,896	1,730,896	8,114,481
		Superintendent	3	16	446,400	475,200	504,000	532,800	561,600	2,520,000
		Total :-	**12**		**5,423,236**	**5,617,636**	**5,812,036**	**6,006,436**	**6,200,836**	**29,060,181**
II.	**A01151**	**Basic Pay of other Staff**								
		Computer Operator	6	11+CA	574,560	607,680	640,800	673,920	707,040	3,204,000
		Vehicle Driver	9	4	636,120	660,960	685,800	710,640	735,480	3,429,000
		Naib Qasid	9	1	567,000	583,200	599,400	615,600	631,800	2,997,000
		Chowkidar	6	1	378,000	388,800	399,600	410,400	421,200	1,998,000
		Sweeper	6	1	378,000	388,800	399,600	410,400	421,200	1,998,000
		Total :-	**36**		**2,533,680**	**2,629,440**	**2,725,200**	**2,820,960**	**2,916,720**	**13,626,000**
		Total Pay (I+II) :-	**48**		**7,956,916**	**8,247,076**	**8,537,236**	**8,827,396**	**9,117,556**	**42,686,181**
III.	**A012-1**	**Regular Allowance**								
	A01202	House Rent Allowance			1,289,250	1,289,250	1,289,250	1,289,250	1,289,250	6,446,250
	A01203	Conveyance Allowance			699,840	699,840	699,840	699,840	699,840	3,499,200
	A0120D	Integrated Allowance			91,800	91,800	91,800	91,800	91,800	459,000
	A01217	Medical Allowance			957,420	957,420	957,420	957,420	957,420	4,787,100
	A01227	Project Allowance			-	-	-	-	-	-
	A0120X	50% Adhoc Allowance (2010)			2,650,320	2,650,320	2,650,320	2,650,320	2,650,320	13,251,600
	A01270	Others (30 % S.S.B and Ph.D. Allowance)			975,240	975,240	975,240	975,240	975,240	4,876,200
		15% Adhoc Allowance 2011			957,420	957,420	957,420	957,420	957,420	4,787,100
		Total :-			**7,621,290**	**7,621,290**	**7,621,290**	**7,621,290**	**7,621,290**	**38,106,450**
IV.	**A012-2**	**Other Allowances Exl. T.A**								
	A01273	Honoraria			144,000	144,000	144,000	144,000	144,000	720,000
	A01274	Medical Charges			28,800	28,800	28,800	28,800	28,800	144,000
	A01275	Contingent Paid Staff			-	-	-	-	-	-
		Total:-			**172,800**	**172,800**	**172,800**	**172,800**	**172,800**	**864,000**
	A01	**Total Employees Related Expenses**			**15,751,006**	**16,041,166**	**16,331,326**	**16,621,486**	**16,911,646**	**81,656,631**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

B. Regional Project Coordination Unit (RPCU)

Sr. No.	Object Code	Particulars			Year-I	Year-II	Year-III	Year-IV	Year-V	Total
V.	**A03**	**Operating Expenses**								
	A032	**Communication**								
	A03201	Postage & Telegraph			72,000	72,000	72,000	72,000	72,000	360,000
	A03202	Telephone & T/Calls			360,000	360,000	360,000	360,000	360,000	1,800,000
	A03203	Telex & Teleprinter			10,800	10,800	10,800	10,800	10,800	54,000
	A03204	Electronic Communication			36,000	36,000	36,000	36,000	36,000	180,000
	A03205	Courier & Pilot Services			36,000	36,000	36,000	36,000	36,000	180,000
	A03270	Others			36,000	36,000	36,000	36,000	36,000	180,000
		Total:-			**550,800**	**550,800**	**550,800**	**550,800**	**550,800**	**2,754,000**
	A033	**Utilities**								-
	A03301	Gas			144,000	144,000	144,000	144,000	144,000	720,000
	A03302	Water			36,000	36,000	36,000	36,000	36,000	180,000
	A03303	Electricity			540,000	540,000	540,000	540,000	540,000	2,700,000
	A03304	Hot & Cold Charges			36,000	36,000	36,000	36,000	36,000	180,000
	A03370	Others			36,000	36,000	36,000	36,000	36,000	180,000
		Total:-			**792,000**	**792,000**	**792,000**	**792,000**	**792,000**	**3,960,000**
	A034	**Occupancy Costs**								-
	A03402	Rent for Officer Building			900,000	900,000	900,000	900,000	900,000	4,500,000
	A03407	Rate & Taxes			236,000	36,000	36,000	36,000	36,000	380,000
		Total:-			**1,136,000**	**936,000**	**936,000**	**936,000**	**936,000**	**4,880,000**
	A038	**Travel & Transportation**								-
	A03805	Travelling Allowance			630,000	630,000	630,000	630,000	630,000	3,150,000
	A03807	P.O.L. Charges			2,916,000	2,916,000	2,916,000	2,916,000	2,916,000	14,580,000
	A03820	Others			-	-	-	-	-	-
		Total:-			**3,546,000**	**3,546,000**	**3,546,000**	**3,546,000**	**3,546,000**	**17,730,000**
	A039	**General**								-
	A03901	Office Stationery			216,000	216,000	216,000	216,000	216,000	1,080,000
	A03902	Printing & Publication			180,000	180,000	180,000	180,000	180,000	900,000
	A03903	Seminars			216,000	216,000	216,000	216,000	216,000	1,080,000
	A03905	News Papers & Periodical Books			37,800	37,800	37,800	37,800	37,800	189,000
	A03906	Uniform & Liveries			21,600	21,600	21,600	21,600	21,600	108,000
	A03907	Advertising & Publicity Charges			72,000	72,000	72,000	72,000	72,000	360,000
	A03908	Exhibition, etc.			-	-	-	-	-	-
	A03970	Other			36,000	36,000	36,000	36,000	36,000	180,000
		Total General:-			**779,400**	**779,400**	**779,400**	**779,400**	**779,400**	**3,897,000**
		Total Operating Expenses:-			**6,804,200**	**6,604,200**	**6,604,200**	**6,604,200**	**6,604,200**	**33,221,000**
VI	**A13**	**Repair & Maintenance of Durable Goods**								-
	A13001	Transport			1,080,000	1,080,000	1,080,000	1,080,000	1,080,000	5,400,000
	A13101	Machinery & Equipment			75,000	75,000	75,000	75,000	75,000	375,000
	A13201	Furniture & Fixture			45,000	45,000	45,000	45,000	45,000	225,000
		Total:-			**1,200,000**	**1,200,000**	**1,200,000**	**1,200,000**	**1,200,000**	**6,000,000**
VII	**A137**	**Computer Equipment**								
	A13701	Hardware			100,000	150,000	200,000	300,000	400,000	1,150,000
	A13702	Software			-	-	-	-	-	-
	A13703	IT Equipment			100,000	150,000	150,000	250,000	250,000	900,000
		Total:-			**200,000**	**300,000**	**350,000**	**550,000**	**650,000**	**2,050,000**
		Total (V+VI+VII)			**8,204,200**	**8,104,200**	**8,154,200**	**8,354,200**	**8,454,200**	**41,271,000**

Annexure-K-3

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

C. District Level

Sr. No.	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
1	Pay of Officer & Staff		35,467,478	37,249,718	39,031,958	40,814,198	42,596,438	195,159,789
2	Regular Allowances		39,684,399	39,684,399	39,684,399	39,684,399	39,684,399	198,421,995
3	Other Allowances Excluding T.A.		834,720	834,720	834,720	834,720	834,720	4,173,600
4	Total Employee Related Expenses (1+2+3):-		**75,986,597**	**77,768,837**	**79,551,077**	**81,333,317**	**83,115,557**	**397,755,384**
5	Operating Expenses		**61,454,000**	**59,839,200**	**60,276,800**	**60,814,400**	**61,252,000**	**303,636,400**
6	**Total Administration Cost (4+5):**		**137,440,597**	**137,608,037**	**139,827,877**	**142,147,717**	**144,367,557**	**701,391,784**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

C. District Level

Sr. No.	Object Code	Post	No. of Post	Basic Scale	Year-I	Year-II	Year-III	Year-IV	Year-V	Total
	A01	**Employees Related Expenses**								
I.	**A01101**	**Basic Pay of Officers**								
		Assistant Director (Tech.)	7	18	3,534,758	3,660,758	3,786,758	3,912,758	4,038,758	18,933,789
		Water Management Officer	72	17	16,934,400	17,971,200	19,008,000	20,044,800	21,081,600	95,040,000
		Total :-	**79**		**20,469,158**	**21,631,958**	**22,794,758**	**23,957,558**	**25,120,358**	**113,973,789**
II.	**A01151**	**Basic Pay of other Staff**								
		Computer Operator	59	11+CA	5,649,840	5,975,520	6,301,200	6,626,880	6,952,560	31,506,000
		Vehicle Driver	36	4	2,544,480	2,643,840	2,743,200	2,842,560	2,941,920	13,716,000
		Rodman	72	1	4,536,000	4,665,600	4,795,200	4,924,800	5,054,400	23,976,000
		Naib Qasid	36	1	2,268,000	2,332,800	2,397,600	2,462,400	2,527,200	11,988,000
		Total :-	**203**		**14,998,320**	**15,617,760**	**16,237,200**	**16,856,640**	**17,476,080**	**81,186,000**
		Total Pay (I+II) :-	**282**		**35,467,478**	**37,249,718**	**39,031,958**	**40,814,198**	**42,596,438**	**195,159,789**
III.	**A012-1**	**Regular Allowance**								
	A01202	House Rent Allowance			6,694,713	6,694,713	6,694,713	6,694,713	6,694,713	33,473,565
	A01203	Conveyance Allowance			4,488,960	4,488,960	4,488,960	4,488,960	4,488,960	22,444,800
	A0120D	Integrated Allowance			725,400	725,400	725,400	725,400	725,400	3,627,000
	A01217	Medical Allowance			4,722,324	4,722,324	4,722,324	4,722,324	4,722,324	23,611,620
	A01227	Project Allowance			-	-	-	-	-	-
	A0120X	50% Adhoc Allowance (2010)			13,003,560	13,003,560	13,003,560	13,003,560	13,003,560	65,017,800
	A01270	Others (30 % S.S.B and Ph.D. Allowance)			5,327,118	5,327,118	5,327,118	5,327,118	5,327,118	26,635,590
		15% Adhoc Allowance 2011			4,722,324	4,722,324	4,722,324	4,722,324	4,722,324	23,611,620
		Total :-			**39,684,399**	**39,684,399**	**39,684,399**	**39,684,399**	**39,684,399**	**198,421,995**
IV.	**A012-2**	**Other Allowances Exl. T.A**								
	A01273	Honoraria			564,000	564,000	564,000	564,000	564,000	2,820,000
	A01274	Medical Charges			270,720	270,720	270,720	270,720	270,720	1,353,600
	A01275	Contingent Paid Staff			-	-	-	-	-	-
		Total:-			**834,720**	**834,720**	**834,720**	**834,720**	**834,720**	**4,173,600**
	A01	**Total Employees Related Expenses**			**75,986,597**	**77,768,837**	**79,551,077**	**81,333,317**	**83,115,557**	**397,755,384**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

C. District Level

Sr. No.	Object Code	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
V.	**A03**	**Operating Expenses**							
	A032	**Communication**							
	A03201	Postage & Telegraph		864,000	864,000	864,000	864,000	864,000	4,320,000
	A03202	Telephone & T/Calls		1,728,000	1,728,000	1,728,000	1,728,000	1,728,000	8,640,000
	A03203	Telex & Teleprinter		216,000	216,000	216,000	216,000	216,000	1,080,000
	A03204	Electronic Communication		129,600	129,600	129,600	129,600	129,600	648,000
	A03205	Courier & Pilot Services		216,000	216,000	216,000	216,000	216,000	1,080,000
	A03270	Others		-	-	-	-	-	-
		Total:-		**3,153,600**	**3,153,600**	**3,153,600**	**3,153,600**	**3,153,600**	**15,768,000**
	A033	**Utilities**							-
	A03301	Gas		432,000	432,000	432,000	432,000	432,000	2,160,000
	A03302	Water		216,000	216,000	216,000	216,000	216,000	1,080,000
	A03303	Electricity		2,160,000	2,160,000	2,160,000	2,160,000	2,160,000	10,800,000
	A03304	Hot & Cold Charges		216,000	216,000	216,000	216,000	216,000	1,080,000
	A03370	Others		-	-	-	-	-	-
		Total:-		**3,024,000**	**3,024,000**	**3,024,000**	**3,024,000**	**3,024,000**	**15,120,000**
	A034	**Occupancy Costs**							-
	A03402	Rent for Officer Building		-	-	-	-	-	-
	A03407	Rate & Taxes		2,288,000	288,000	288,000	288,000	288,000	3,440,000
		Total:-		**2,288,000**	**288,000**	**288,000**	**288,000**	**288,000**	**3,440,000**
	A038	**Travel & Transportation**							-
	A03805	Travelling Allowance		13,590,000	13,590,000	13,590,000	13,590,000	13,590,000	67,950,000
	A03807	P.O.L. Charges		28,512,000	28,749,600	28,987,200	29,224,800	29,462,400	144,936,000
	A03820	Others		-	-	-	-	-	-
		Total:-		**42,102,000**	**42,339,600**	**42,577,200**	**42,814,800**	**43,052,400**	**212,886,000**
	A039	**General**							-
	A03901	Office Stationery		864,000	864,000	864,000	864,000	864,000	4,320,000
	A03902	Printing & Publication		864,000	864,000	864,000	864,000	864,000	4,320,000
	A03903	Seminars		432,000	432,000	432,000	432,000	432,000	2,160,000
	A03905	News Papers & Periodical Books		151,200	151,200	151,200	151,200	151,200	756,000
	A03906	Uniform & Liveries		86,400	86,400	86,400	86,400	86,400	432,000
	A03907	Advertising & Publicity Charges		432,000	432,000	432,000	432,000	432,000	2,160,000
	A03908	Exhibition, etc.		360,000	360,000	360,000	360,000	360,000	1,800,000
	A03970	Other		-	-	-	-	-	-
		Total General:-		**3,189,600**	**3,189,600**	**3,189,600**	**3,189,600**	**3,189,600**	**15,948,000**
		Total Operating Expenses:-		**53,757,200**	**51,994,800**	**52,232,400**	**52,470,000**	**52,707,600**	**263,162,000**
VI	**A13**	**Repair & Maintenance of Durable Goods**							-
	A13001	Transport		6,480,000	6,480,000	6,480,000	6,480,000	6,480,000	32,400,000
	A13101	Machinery & Equipment		432,000	432,000	432,000	432,000	432,000	2,160,000
	A13201	Furniture & Fixture		180,000	180,000	180,000	180,000	180,000	900,000
		Total:-		**7,092,000**	**7,092,000**	**7,092,000**	**7,092,000**	**7,092,000**	**35,460,000**
VII	**A137**	**Computer Equipment**							-
	A13701	Hardware		302,400	402,400	602,400	802,400	1,002,400	3,112,000
	A13702	Software							-
	A13703	IT Equipment		302,400	350,000	350,000	450,000	450,000	1,902,400
		Total:-		**604,800**	**752,400**	**952,400**	**1,252,400**	**1,452,400**	**5,014,400**
		Total (V+VI+VII)		**61,454,000**	**59,839,200**	**60,276,800**	**60,814,400**	**61,252,000**	**303,636,400**

Annexure-K-4

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)
Supervision and Administration Cost

D. Tehsil Level

Sr. No.	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
1	Pay of Officer & Staff		143,874,615	149,949,975	156,025,335	162,100,695	168,176,055	780,126,675
2	Regular Allowances		169,571,964	147,574,914	147,574,914	147,574,914	147,574,914	759,871,620
3	Other Allowances Excluding T.A.		2,761,600	2,761,600	2,761,600	2,761,600	2,761,600	13,808,000
4	Total Employee Related Expenses (1+2+3):-		**316,208,179**	**300,286,489**	**306,361,849**	**312,437,209**	**318,512,569**	**1,553,806,295**
5	Operating Expenses		**127,322,512**	**126,866,512**	**127,066,512**	**127,266,512**	**127,466,512**	**635,988,560**
6	**Total Administration Cost (4+5):**		**443,530,691**	**427,153,001**	**433,428,361**	**439,703,721**	**445,979,081**	**2,189,794,855**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)

Supervision and Administration Cost

D. Tehsil Level

Sr. No.	Object Code	Post	No. of Post	Basic Scale	Year-I	Year-II	Year-III	Year-IV	Year-V	Total
	A01	**Employees Related Expenses**								
I.	**A01101**	**Basic Pay of Officers**								
		Deputy District Officer	25	18	12,624,135	13,074,135	13,524,135	13,974,135	14,424,135	67,620,675
		Water Management Officer	25	17	5,880,000	6,240,000	6,600,000	6,960,000	7,320,000	33,000,000
		Total :-	**50**		**18,504,135**	**19,314,135**	**20,124,135**	**20,934,135**	**21,744,135**	**100,620,675**
II.	**A01151**	**Basic Pay of other Staff**								
		Water Management Supervioser	573	11	54,870,480	58,033,440	61,196,400	64,359,360	67,522,320	305,982,000
		Computer Operator	25	11+CA	2,394,000	2,532,000	2,670,000	2,808,000	2,946,000	13,350,000
		Vehicle Driver	25	4	1,767,000	1,836,000	1,905,000	1,974,000	2,043,000	9,525,000
		Rodman	1003	1	63,189,000	64,994,400	66,799,800	68,605,200	70,410,600	333,999,000
		Naib Qasid	25	1	1,575,000	1,620,000	1,665,000	1,710,000	1,755,000	8,325,000
		Chowkidar	25	1	1,575,000	1,620,000	1,665,000	1,710,000	1,755,000	8,325,000
		Total :-	**1,676**		**125,370,480**	**130,635,840**	**135,901,200**	**141,166,560**	**146,431,920**	**679,506,000**
		Total Pay (I+II) :-	**1,726**		**143,874,615**	**149,949,975**	**156,025,335**	**162,100,695**	**168,176,055**	**780,126,675**
III.	**A012-1**	**Regular Allowance**								
	A01202	House Rent Allowance			26,541,756	26,541,756	26,541,756	26,541,756	26,541,756	132,708,780
	A01203	Conveyance Allowance			20,043,840	20,043,840	20,043,840	20,043,840	20,043,840	100,219,200
	A0120D	Integrated Allowance			5,202,000	5,202,000	5,202,000	5,202,000	5,202,000	26,010,000
	A01217	Medical Allowance			21,997,050	21,997,050	21,997,050	21,997,050	21,997,050	109,985,250
	A01227	Project Allowance			-	-	-	-	-	-
	A0120X	50% Adhoc Allowance (2010)			51,332,820	51,332,820	51,332,820	51,332,820	51,332,820	256,664,100
	A01270	Others (30 % S.S.B and Ph.D. Allowance)			22,457,448	22,457,448	22,457,448	22,457,448	22,457,448	112,287,240
		15% Adhoc Allowance 2011			21,997,050	21,997,050	21,997,050	21,997,050	21,997,050	109,985,250
		Total :-			**169,571,964**	**147,574,914**	**147,574,914**	**147,574,914**	**147,574,914**	**737,874,570**
IV.	**A012-2**	**Other Allowances Exl. T.A**								
	A01273	Honoraria			1,726,000	1,726,000	1,726,000	1,726,000	1,726,000	8,630,000
	A01274	Medical Charges			1,035,600	1,035,600	1,035,600	1,035,600	1,035,600	5,178,000
	A01275	Contingent Paid Staff			-	-	-	-	-	-
		Total:-			**2,761,600**	**2,761,600**	**2,761,600**	**2,761,600**	**2,761,600**	**13,808,000**
	A01	**Total Employees Related Expenses**			**316,208,179**	**300,286,489**	**306,361,849**	**312,437,209**	**318,512,569**	**1,531,809,245**

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT (PIPIP)
Supervision and Administration Cost

D. Tehsil Level

Sr. No.	Object Code	Particulars		Year-I	Year-II	Year-III	Year-IV	Year-V	Total
V.	**A03**	**Operating Expenses**							
	A032	**Communication**							
	A03201	Postage & Telegraph		1,512,000	1,512,000	1,512,000	1,512,000	1,512,000	7,560,000
	A03202	Telephone & T/Calls		1,512,000	1,512,000	1,512,000	1,512,000	1,512,000	7,560,000
	A03203	Telex & Teleprinter		453,600	453,600	453,600	453,600	453,600	2,268,000
	A03204	Electronic Communication		756,000	756,000	756,000	756,000	756,000	3,780,000
	A03205	Courier & Pilot Services		756,000	756,000	756,000	756,000	756,000	3,780,000
	A03270	Others		-	-	-	-	-	-
		Total:-		**4,989,600**	**4,989,600**	**4,989,600**	**4,989,600**	**4,989,600**	**24,948,000**
	A033	**Utilities**							-
	A03301	Gas		604,800	604,800	604,800	604,800	604,800	3,024,000
	A03302	Water		756,000	756,000	756,000	756,000	756,000	3,780,000
	A03303	Electricity		1,512,000	1,512,000	1,512,000	1,512,000	1,512,000	7,560,000
	A03304	Hot & Cold Charges		756,000	756,000	756,000	756,000	756,000	3,780,000
	A03370	Others		-	-	-	-	-	-
		Total:-		**3,628,800**	**3,628,800**	**3,628,800**	**3,628,800**	**3,628,800**	**18,144,000**
	A034	**Occupancy Costs**							-
	A03402	Rent for Officer Building		4,050,000	4,050,000	4,050,000	4,050,000	4,050,000	20,250,000
	A03407	Rate & Taxes		675,000	75,000	75,000	75,000	75,000	975,000
		Total:-		**4,725,000**	**4,125,000**	**4,125,000**	**4,125,000**	**4,125,000**	**21,225,000**
	A038	**Travel & Transportation**							-
	A03805	Travelling Allowance		66,915,312	66,915,312	66,915,312	66,915,312	66,915,312	334,576,560
	A03807	P.O.L. Charges		34,020,000	34,020,000	34,020,000	34,020,000	34,020,000	170,100,000
	A03820	Others		-	-	-	-	-	-
		Total:-		**100,935,312**	**100,935,312**	**100,935,312**	**100,935,312**	**100,935,312**	**504,676,560**
	A039	**General**							-
	A03901	Office Stationery		3,024,000	3,024,000	3,024,000	3,024,000	3,024,000	15,120,000
	A03902	Printing & Publication		1,512,000	1,512,000	1,512,000	1,512,000	1,512,000	7,560,000
	A03903	Seminars		453,600	453,600	453,600	453,600	453,600	2,268,000
	A03905	News Papers & Periodical Books		529,200	529,200	529,200	529,200	529,200	2,646,000
	A03906	Uniform & Liveries		378,000	378,000	378,000	378,000	378,000	1,890,000
	A03907	Advertising & Publicity Charges		-	-	-	-	-	-
	A03908	Exhibition, etc.		-	-	-	-	-	-
	A03919	Payment of Services		-	-	-	-	-	-
	A03942	Cost of other Stores		-	-	-	-	-	-
	A03970	Other		-	-	-	-	-	-
		Total General:-		**5,896,800**	**5,896,800**	**5,896,800**	**5,896,800**	**5,896,800**	**29,484,000**
		Total Operating Expenses:-		**120,175,512**	**119,575,512**	**119,575,512**	**119,575,512**	**119,575,512**	**598,477,560**
VI	**A13**	**Repair & Maintenance of Durable Goods**							-
	A13001	Transport		4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	22,500,000
	A13101	Machinery & Equipment		1,386,000	1,386,000	1,386,000	1,386,000	1,386,000	6,930,000
	A13201	Furniture & Fixture		378,000	378,000	378,000	378,000	378,000	1,890,000
	A13370	Others		-	-	-	-	-	-
		Total:-		**6,264,000**	**6,264,000**	**6,264,000**	**6,264,000**	**6,264,000**	**31,320,000**
VII	**A137**	**Computer Equipment**							-
	A13701	Hardware		378,000	522,000	722,000	922,000	1,122,000	3,666,000
	A13702	Software		-	-	-	-	-	-
	A13703	IT Equipment		505,000	505,000	505,000	505,000	505,000	2,525,000
		Total:-		**883,000**	**1,027,000**	**1,227,000**	**1,427,000**	**1,627,000**	**6,191,000**
		Total (V+VI+VII)		**127,322,512**	**126,866,512**	**127,066,512**	**127,266,512**	**127,466,512**	**635,988,560**

Annexure-L

Punjab Irrigated-Agriculture Productivity Improvement Project

Economic Analysis

Table 1: ERR (%) By Project Major Components

Project Intervention	ERR %
High Efficiency Irrigation System (HEIS)	43.2
LASER Land Leveling	32.7
Watercourse Improvement in Canal Command Area	28.1
Completion of Partially Improved Watercourses	23.1
Rehabilitation of Irrigation Systems in Non-Canal Command Area	19.7
Overall Project	32.6

Table 2: Sensitivity Analysis: ERR Response

Scenario	ERR %
Base Case	32.6
Cost Increased by 20%	25.7
Benefits Reduced by 20%	24.2
Cost Increased by 20% & Benefits reduced by 20% at the same time	18.5
Benefits Delayed by Two Years	19.6

Table 3: ERR Analysis (Rs. Million)

Year	Project Capital Costs	Component-Wise Operational Costs					Total Cost	Component-Wise Net Incremental Benefits					Total Benefits	Net Incremental Benefits
		HEIS Agronomic and Other Costs	Laser Leveling	WC Improvement in Canal Command Area	Rehabilitation of Partially Improved WC	WC Improvement in Barani Area		HEIS Agronomic and Other Costs	Laser Leveling	WC Improvement in Canal Command Area	Rehabilitation of Partially Improved WC	WC Improvement in Barani Area		
1	2,851	209	6	67	11	7	3,150	466	-	-	-	-	466	(2,685)
2	5,701	490	108	143	24	14	6,481	1,168	130	112	15	8	1,433	(5,048)
3	5,701	717	382	160	27	16	7,002	2,129	648	449	60	30	3,317	(3,685)
4	5,701	1,002	656	177	29	18	7,583	3,403	1,556	1,010	136	69	6,173	(1,410)
5	5,701	1,290	912	194	32	19	8,149	4,583	2,723	1,683	226	114	9,329	1,180
6	2,851	1,386	912	144	24	14	5,331	5,429	2,205	2,356	316	160	10,466	5,135
7	-	1,452	912	85	14	8	2,471	5,890	2,205	2,916	392	198	11,601	9,130
8	-	1,560	912	85	14	8	2,580	6,355	2,205	3,253	437	221	12,470	9,890
9	-	1,655	912	85	14	8	2,675	6,771	2,205	3,365	452	228	13,021	10,346
10	-	1,726	912	85	14	8	2,746	7,062	2,205	3,365	452	228	13,312	10,566
11	-	1,916	988	85	14	8	3,012	7,362	2,205	3,365	452	228	13,612	10,600
12	-	2,114	1,140	85	14	8	3,362	7,659	2,205	3,365	452	228	13,909	10,547
13	-	2,184	1,140	85	14	8	3,432	7,900	2,205	3,365	452	228	14,150	10,719
14	-	2,243	1,140	85	14	8	3,491	8,084	2,205	3,365	452	228	14,334	10,842
15	-	2,283	912	85	14	8	3,302	8,182	2,205	3,365	452	228	14,432	11,130
16		2,182	912	85	14	8	3,201	8,238	2,205	3,365	452	228	14,488	11,287
17	-	2,062	912	85	14	8	3,082	8,238	2,205	3,365	452	228	14,488	11,406
18	-	2,062	912	85	14	8	3,082	8,238	2,205	3,365	452	228	14,488	11,406
19	-	2,062	912	85	14	8	3,082	8,238	2,205	3,365	452	228	14,488	11,406
20	-	2,062	912	85	14	8	3,082	8,238	2,205	3,365	452	228	14,488	11,406
21	-	2,182	988	85	14	8	3,278	8,238	2,205	3,365	452	228	14,488	11,211
22	-	2,301	1,140	85	14	8	3,549	8,238	2,205	3,365	452	228	14,488	10,939
23	-	2,301	1,140	85	14	8	3,549	8,238	2,205	3,365	452	228	14,488	10,939
24	-	2,301	1,140	85	14	8	3,549	8,238	2,205	3,365	452	228	14,488	10,939
25	-	2,301	912	85	14	8	3,321	8,238	2,205	3,365	452	228	14,488	11,167

SUMMARY OF ECONOMIC INDICES

Rs Million

DESCRIPTION	DISCOUNT RATE				
	5%	10%	12%	15%	20%
PRESENT WORTH OF COSTS	59,345	40,989	36,285	30,868	15,630
PRESENT WORTH OF BENEFITS	149,260	84,284	68,955	52,352	35,055
PRESENT WORTH OF NET BENEFITS	89,915	43,294	32,670	21,484	10,446
BENEFIT/COST RATIO		2.1	1.9	1.7	
Base Case				**ERR**	**32.6%**

Table 4: Financial and Economic Prices of Inputs and Outputs

Items		Unit	Unit Price (Rupees)	
			Financial	Economic
A. OUTPUTS				
Mango		Ton	19,500.0	17,550.0
Citrus		Ton	18,500.0	16,650.0
Guava		Ton	18,000.0	16,200.0
Sugarcane		Ton	3,750.0	3,474.2
Wheat				
	Grains	Ton	19,000.0	29,265.5
	Straw	Ton	1.5	1.4
Pulses		Ton	40,000.0	36,000.0
Cotton		Ton	125,000.0	117,670.5
Tomatoes		Ton	9,000.0	8,100.0
Potato		Ton	9,200.0	8,250.0
Chilies		Ton	65,000.0	58,500.0
B. INPUTS				
Fertilizers				
	Urea	Kg.	25.0	38.5
	DAP	Kg.	47.2	56.8
	TSP	Kg.	33.0	47.8
	SSP	Kg.	11.0	15.8
-N		Kg.	54.3	83.6
-P		Kg.	102.6	123.4
-K		Kg.	66.0	95.7
-F.Y.M.		Tones	450.0	405.0
	Plant Protection Chemical	Liter	650.0	585.0
	Ground Chemical		200.0	180.0
	Seeds Treatment		250.0	225.0
Seed/Plants				
	Mango	No.	50.0	45.0
	Citrus	No.	38.0	34.2
	Guava	No.	28.0	25.2
	Sugarcane	No.	0.5	0.4
	Wheat	Kg.	19.0	17.1
	Pulses	Kg.	60.0	54.0
	Cotton	Kg.	213.6	192.2
	Tomato(Seed)	Kg.	400.0	360.0
	Tomato(Plants)	No.	0.3	0.2
	Chilies	Kg.	460.0	414.0
	Roses	Nos	8.0	7.2
Labour				
	Hired	M/Days	250.0	325.0
Others				
	Tractor	Rs./Hours	175.0	157.5
	Diesel	Rs./Gallon	85.0	76.5
	Prod. Material (Sticks)	Rs./Stick	0.1	0.1
	Land Development	Rs./Acre	2,400.0	2,160.0
	Gunny Bags	Rs./Bag	20.0	18.0
	Packing Material (Basket)	Rs./Basket	10.0	9.0
	Packing Material (Crate)	Rs./Crate	20.0	18.0

Source: *- Agricultural Statistics of Pakistan 2010; Open Market & Published Data*

Annexure-M

PUNJAB IRRIGATED-AGRICULTURE PRODUCTIVITY IMPROVEMENT PROJECT
List of Standards for Drip and Sprinkler Irrigation

a. ANSI/ASAE Standards

ANSI/ASAE S330.1 February 2003	Procedure for Sprinkler Distribution Testing for Research Purposes
ANSI/ASAE S376.2 February 2003	Design, installation and Performance of Underground, Thermoplastic Irrigation Pipelines
ANSI/ASAE S395 February 2003	Safety for Self-Propelled, Hose-Drag Agricultural Irrigation Systems
ANSI/ASAE S397.2 February 2003	Electrical Service and Equipment for Irrigation
ANSI/ASAE S436.1 December 2001	Test Procedure for Determining the Uniformity of Water Distribution of Center Pivot and Lateral Move Irrigation Machines Equipped with Spray or Sprinkler Nozzles
ANSI/ASAE S539 February 2003	Media Filters for Irrigation – Testing and Performance Reporting
ANSI/ASAE S553 March 2001	Collapsible Emitting Hose (Drip Tape) – Specifications and Performance Testing
ASAE EP367.2 February 2003	Guide for Preparing Field Sprayer Calibration Procedures
ASAE EP405.1 February 2003	Design and Installation of Microirrigation Systems
ASAE EP458	Field Evaluation of Microirrigation Systems
ASAE S263	Minimum Standards for Aluminum Tubing
ASAE S327.2 February 2003	Terminology and Definitions for Agricultural Chemical Application

ASAE S398.1 January 2001	Procedure for Sprinkler Testing and Performance Reporting
ASAE S435 February 2003	Drip/Trickle Polyethylene Pipe Used for Microirrigation Laterals
ASAE S447 February 2003	Procedure for Testing and Reporting Pressure Losses in Irrigation Valves
ASAE S471 February 2003	Procedure for Measuring Sprayer Nozzle Wear Rate
ASAE S491 February 2003	Graphic Symbols for Pressurized Irrigation System Design
ASTM D-1785	Standard specifications for poly (vinyl chloride) (PVC) plastic pipe, schedules 40, 80, and 120
ASTM D-2104	Standard specifications for olyethylene (PE) plastic pipe, schedule 40
ASTM D-2447-03	Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D-2464-99	Standard specification for threaded poly (vinyl chloride) (PVC) plastic pipe fittings, Schedule 80
ASTM D-2466-02	Standard specifications for socket-type poly (vinyl chloride) (PVC) plastic pipe fittings, Schedule 40
ASTM D-2467-02	Standard specifications for socket-type poly (vinyl chloride) (PVC) plastic pipe fittings, Schedule 80
ASTM D-2468	Standard specification for Acrylonitrile Butadiene Styrene (ABS) plastic pipe fittings, Schedule 40
ASTM D-2469	Standard specifications for socket type Acrylonitrile-Butadiene-Styrene (ABS) plastic pipe fittings, Schedule 40
ASTM D-2609	Standard specifications for plastic insert fittings for polyethylene (PE) plastic pipes
ASTM D-2683-98	Standard specification for socket-type polyethylene (PE) fittings for outside diameter controlled polyethylene pipe

ASTM D-2855	Standard practice for making solvent cemented joints with poly (vinyl chloride) (PVC) pipe and fittngs
ASTM D-3036	Standard specifications for Socket-type poly (vinyl chloride) (PVC) plastic line couplings
ASTM D-3139-98	Standard specifications for joints for plastic pressure pipes using flexible elastometric seals
ASTM D-3261-03	Standard specifications for butt heat fusion polyethylene (PE) plastic fittings for polyethylene (PE) plastic pipe tubing

b. <u>BS Standards</u>

BS 1387: 1985 (1990)	Specification for screwed and socketed steel tubes and tubulars and for plain and for steel tubes suitable for welding or for screwing to BS 21 pipe threads
BS 143 & 1256: 1986	Specification for malleable cast iron and cast copper alloy threaded pipe fittings
BS 21: 1985	Specification for pipe threads for tubes and fittings where pressure tight joints are made on the threads (equivalent to ISO 7/1, 7/2: 1982)
BS 3867: 1987	Method of specifying outside diameters and pressure ratings for pipe of thermoplastics materials (inch series)
BS 4346: Part 1-3	Joints and fittings for use with unplasticised PVC pressure pipes
BS 5556: 1978 (1986)	Specification for general requirements for dimensions and pressure ratings for pipe of thermoplastic materials (metric series) (ISO 161/1)
BSR/ASAE S577-200x	Specification for Poly (Vinyl Chloride) (PVC) Irrigation Pipe (PIP) Fittings

c. DIN Standards

DIN 2440/41/42	Steel tubes (Medium-Weight) Suitable for Screwing
DIN 2999 (1-6)	Pipe threads for tubes and fittings
DIN 8062 (1988)	Unplasticised polyvinyl chloride (PVC-U, PVC-HI) pipes – Dimensions
DIN 8072 (1987)	Pipes of Low-density PE (Low-density Polyethylene) – Dimensions
DIN 8074 (1999)	High-density polyethylene (PE-HD) pipes – dimensions
DIN 8075 (1999)	High – density polyethylene (PE-HD) pipes; Testing
DIN 8161 (1994)	Unplasticised polyvinyl chloride pipes – General quality requirements and testing

d. ISO Standards

ISO 10522: 1993	Agricultural irrigation equipment – Direct-acting pressure-regulating valves
ISO 11419: 1997	Agricultural irrigation equipment – Float type air release valves
ISO 11545: 2001	Agricultural irrigation equipment – Center-pivot and moving lateral irrigation machines with sprayer or sprinkler nozzles – Determination of uniformity of water distribution
ISO 11678: 1996	Agricultural irrigation equipment – Aluminium irrigation tubes
ISO 1167: 1996	Thermoplastics pipes for the conveyance of fluids – Resistance to internal pressure – Test method
ISO 11738: 2000	Agricultural irrigation equipment – Control heads
ISO 11922-1: 1997	Thermoplastics pipes for the conveyance of fluids – Dimensions and tolerances – Part 1: Metric series
ISO 11922-2: 1997	Thermoplastics pipes for the conveyance of fluids – Dimensions

	and tolerances – Part 2: Inch-based series
ISO 12347: 1995	Agricultural irrigation – Wiring and equipment for electrically driven or controlled irrigation machines
ISO 13457: 2000	Agricultural irrigation equipment – Water driven chemical injector pumps
ISO 13460: 1998	Agricultural irrigation equipment – Plastics saddles for polyethylene pressure pipes
ISO 15873: 2002	Irrigation equipment – Differential pressure Venturi-type liquid additive injectors
ISO 161-1: 1996	Thermoplastics pipes for the conveyance of fluids – Nominal outside diameters and nominal pressures – Part 1: Metric series
ISO 161-2: 1996	Thermoplastics pipes for the conveyance of fluids – Nominal outside diameters and nominal pressures – Part 2: Inch- based series
ISO 3126: 1997	Plastics pipes – Measurements of dimensions
ISO 3460: 1975	Unplasticized polyvinyl chloride (PVC) pressures pipes – Metric series – Dimensions of adapter for backing flange
ISO 3501: 1976	Assembled joints between fittings and polyethylene (PE) pressure pipes – Test of resistance to pull out
ISO 3503: 1976	Assembled joints between fittings and polyethylene (PE) pressure pipes – Test of leak proofness under internal pressure when subjected to bending
ISO 3603: 1977	Fittings for unplasticized polyvinyl chloride (PVC) pressure pipes with elastic sealing ring type joints – Pressure test for leakproofness
ISO 3604: 1976	Fittings for unplasticized polyvinyl chloride (PVC) pressure pipes with elastic sealing ring type joints – Pressure test for leakproofness under conditions of external hydraulic pressure
ISO 49: 1994	Malleable cast iron fittings threaded to ISO 7-1

ISO 7-1: 1994	Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation
ISO 7-2: 2000	Pipe threads where pressure-tight joints are made on the threads – Part 2: Verification by means of limit gauges
ISO 7714: 2000	Agricultural irrigation equipment – Volumetric valves – General requirements and test methods
ISO 7749-1: 1995	Agricultural irrigation equipment – Rotating sprinklers – Part 1: Design and operational requirements
ISO 7749-2: 1990	Agricultural irrigation equipment – Rotating sprinklers – Part 2: Uniformity of distribution and test methods
ISO 8026: 1995/Amd 1: 2000	Agricultural irrigation equipment – Sprayers – General requirements and test methods
ISO 8224-1: 2003	Traveller irrigation machines -- Part 1: Operational characteristics and laboratory and field test methods
ISO 8224-2: 1991	Traveller irrigation machines -- Part 2: Softwall hose and couplings -- Test methods
ISO 8779: 2001	Polyethylene (PE) pipes for irrigation laterals -- Specifications
ISO 8796: 1989	Polyethylene (PE) 25 pipes for irrigation laterals -- Susceptibility to environmental stress-cracking induced by insert-type fittings -- Test method and specifications
ISO 9260: 1991	Agricultural irrigation equipment -- Emitters -- Specification and test methods
ISO 9261: 1991	Agricultural irrigation equipment -- Emitting pipe systems -- Specification and test methods
ISO 9624: 1997	Thermoplastics pipes for fluids under pressure -- Mating dimensions of flange adapters and loose backing flange
ISO 9625: 1993	Mechanical joint fittings for use with polyethylene pressure pipes for irrigation purposes
ISO 9635: 1990	Irrigation equipment -- Hydraulically operated irrigation valves
ISO 9644: 1993/Amd 1:	Agricultural irrigation equipment -- Pressure losses in irrigation

1998	valves -- Test methods
ISO 9911: 1993	Agricultural irrigation equipment -- Manually operated small plastic valves
ISO 9912-1: 2004	Agricultural irrigation equipment -- Filters -- Part 1: Terms, definitions and classification
ISO 9912-2: 1992	Agricultural irrigation equipment -- Filters -- Part 2: Strainer-type filters
ISO 9912-3: 1992	Agricultural irrigation equipment -- Filters -- Part 3: Automatic self-cleaning strainer-type filters
ISO 9952: 1993	Agricultural irrigation equipment -- Check valves
ISO/TR 10501: 1993	Thermoplastics pipes for the transport of liquids under pressure -- Calculation of head losses
ISO/TR 8059: 1986	Irrigation equipment -- Automatic irrigation systems -- Hydraulic control