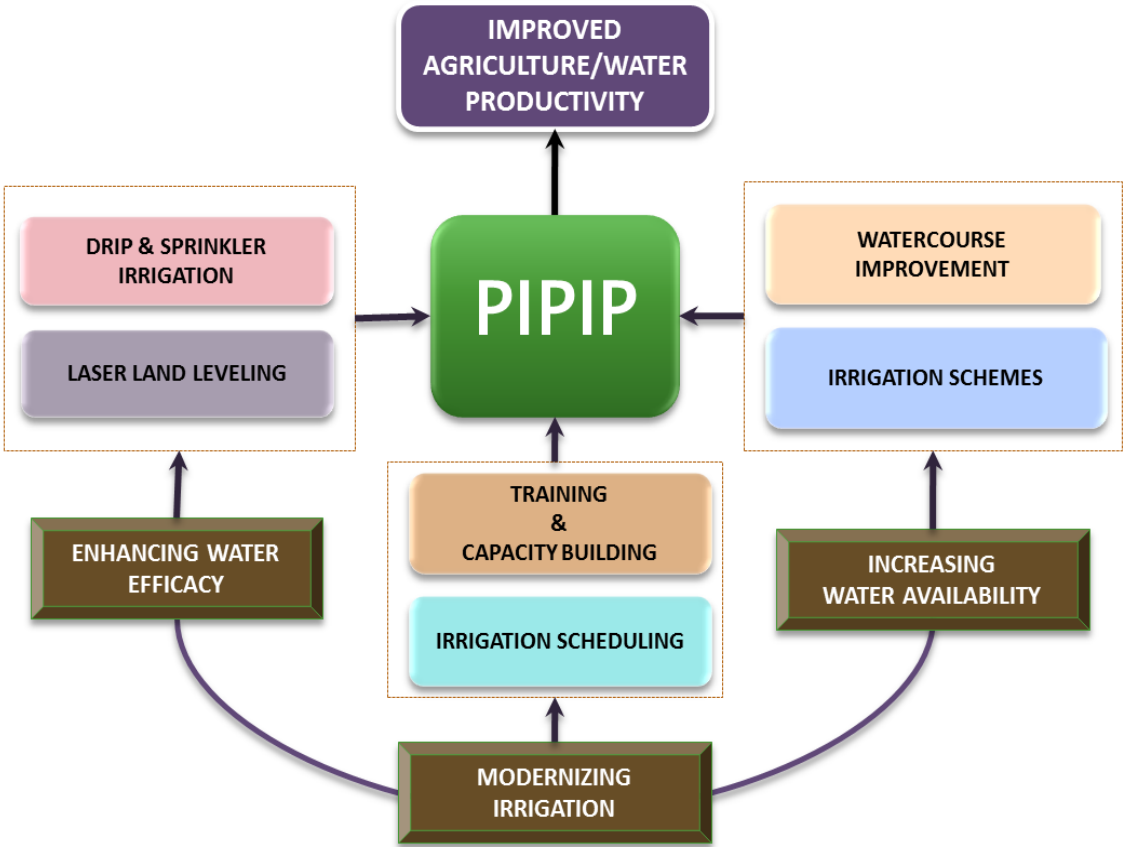


Figure-5: PIPIP Conceptual Framework

3.1 IMPACTS OF OFWM ACTIVITIES

3.4.1 HIGH EFFICIENCY IRRIGATION SYSTEMS

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 socio economic 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%











Figure-6: View of Installed Drip Irrigation Systems

3.4.2 IMPACT OF WATER COURSE 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 water course 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 water course improvements including, inter alia, the followings.

(i) Reduction in time to fill reaches of a water course, leading to increased time for field application. This is often perceived as the greatest benefit by the farmers.

(ii) Control of tampering with water course turn-outs (nuccas), particularly in lined sections.

(iii) Saving in land taken for water course right of way due to narrower cross sections of improved / lined reaches.

(iv) Decrease in water logging, particularly adjacent to water courses.

(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 Water courses 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 water course.
- 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.







Figure-7: Watercourse Improvement Process

3.4.3 LASER LAND LEVELLING

Use of LASER technology in the precision land levelling 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 culture able waste land by 2.10 percent.







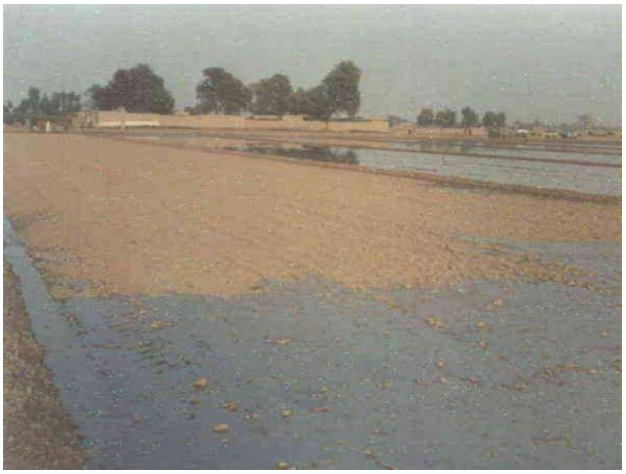


Figure-8: LASER Land Levelling

1. PROGRAM ACHIEVEMENTS

On Farm Water Management (OFWM) program has successfully promoted resource conservation technologies in Punjab which are contributing significantly in enhancing water availability at the farm level and minimizing water losses to a great extent since 1976-1977. Since there has been no incremental water resources development taken place during this period in the province, the only source of additional water at the farm level has been through adoption of conservation measures e.g. canal rehabilitation and lining, improvement of water courses, LASER land levelling, bed and furrow irrigation etc. Over the years there has been a gradual transition from elementary conservation practices like remodeling of earthen water courses to the relatively more complex interventions like high efficiency irrigation systems.

Most of early OFWM projects were funded through assistance of donor agencies till last decade when the Government implemented some major initiatives out of its own resources. A mega initiative "National Program for Improvement of Water courses (NPIW)" was launched in 2004 to improve the tertiary level irrigation conveyance system through a community driven implementation approach. Improvement of about 19,000 canal commanded water courses and development / rehabilitation of 3,734 irrigation schemes outside the canal commands have been completed during 2004-2011.

S.#	Particulars	Unit	Canal Commanded Areas	Non Canal Commanded Areas	Total
1	Watercourses/Irrigation Schemes	No.	45,770	13,000	58,770
2	Water Users Associations Registered	No.	43,615	13,000	56,615
3	Watercourses Improved/ Irrigation Scheme Installed	No.	43,467	13,000	56,467
4	**Length Improved**				
	❑ Earthen Reconstruction	Km	127,142	-	127,142
	❑ Length Lined	Km	29,679	5,334	35,013
5	Nakkas Installed	No.	1,925,273	102,834	2,028,107
6	Culverts Constructed	No.	94,995	66	95,061
7	Government Assistance	Rs.	16,303.00	1,523.93	17,826.93
8	**Farmer's Contribution**				
	❑ Labour	Rs.	4,316.00	380.98	4,696.98
	❑ Earthen Improvement	Rs.	5,395.00	-	5,395.00
	❑ Construction Material	Rs.	960.00	-	960.00

Table 2: Punjab Watercourse Improvement Fact Sheet

Similarly, a major project for provision of subsidized LASER land levelling equipment to farmers and service providers was launched in 2005, wherein 2,500 systems were provided. The scheme proved to be highly beneficial due to its immediate impact in minimizing cost of operation, better degree of accuracy in lesser time, saving of irrigation water, uniform seed germination, increased fertilizer use efficiency, and resultantly enhanced crop yields.

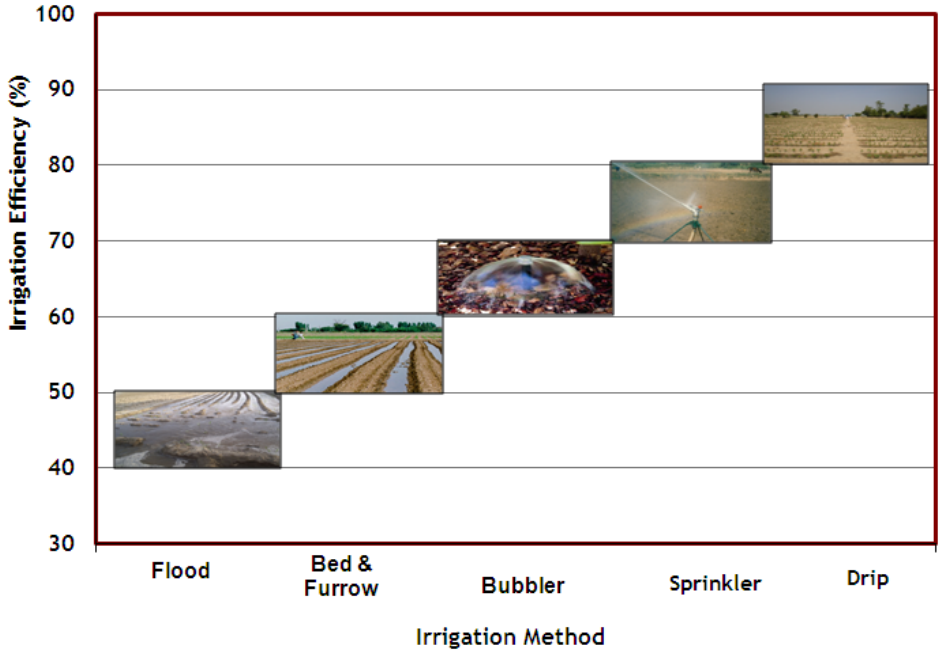


Figure-9 : Efficiency of Irrigation Methods

In the introduction of HEIS, a number of attempts were made in the past by various organizations including OFWM on a limited scale. Such efforts did not gain much acceptance among the farming community despite the obvious water saving benefits. Analysis of the reasons for failure of these projects indicated following major issues ;

a. Lack of organization / institutional support for technical assistance and capacity building.

b. Insufficient technical expertise and knowledge base in designing, installation and operation.

c. Inefficient technological package for follow-up and crop establishment i.e. irrigation schedule and fertigation schedule, plant protection and other agronomic practices.

d. Inadequate participation and know how of all stakeholders at planning, designing, installation and operation.

e. Ineffective follow-up for assisting the farmers to successfully adopt the new technology.

f. High initial cost of the system that requires fixed investment.

The project titled “Water Conservation and Productivity Enhancement through High Efficiency (Pressurized) Irrigation Systems”, called HEIS project, was launched to install drip and sprinkler irrigation on about 140,000 acres during four years (2008-2009 to 2011-2012) at a total subsidized cost of Rs. 6,917 million in the entire province. The project was implemented by OFWM through pre-qualified supply and services companies (SSCs), which installed the systems on turnkey basis in farmer’s field. Under 18th constitutional amendment, this project was, however, abandoned because of some administrative and financial problems regardless of its encouraging impacts. Under the scheme HEIS, systems were installed on 9,500 acres spread over the entire Punjab. The system-wise breakup of the installed systems is given in Table-1.

As evident from Table-1, drip technology has major share covering over 68 percent including orchards (32 percent) and row crops (26 percent). The sprinklers are installed on 32 percent of total area for cereal crops to supplement rainfall in rain-fed tracts and provide light irrigations in canal commands. This indicates a clear need and preference for drip irrigation over sprinkler irrigation systems.

Table 1: Distribution of Installed Drip Irrigation Systems in Punjab

Particulars	**Micro Irrigation**	
	Acres	**% of total**
Total Installed systems	11,500	100
Drip	*7,850*	*68*
Sprinkler	*3,650*	*32*
Drip Systems		
Orchards	4,870	62
Citrus	*2,625*	*33*
Mango	*1,200*	*15*
Others	*1,045*	*13*
Row Crops	2,980	38
Cotton	*2,135*	*27*
Sugarcane	*240*	*3*
Vegetables	*605*	*8*

The Government of Punjab also implemented an innovative undertaking for promotion of cotton cultivation under desert environment with drip irrigation on 2,000 acres at a total cost of Rs. 267 million during two years (2009-2010 to 2010-2011). The “Pilot Project for Promotion of Cotton Cultivation in Thal Region with Drip Irrigation” was designed to harness maximum potential of land, water, and other inputs for increasing agricultural productivity demonstrating cotton cultivation in water scare desert environment though effective utilization of irrigation water under drip irrigation. The farmers were provided 90 percent of the total system cost in addition to construction cost for water storage pond required for drip irrigation system. The project achieved considerable success wherein, it was reported that cotton yielded upto 1.86 tons per acre with an average of 1.12 tons per acre vis-à-vis 0.60 tons per acre average in the area. Drip irrigation also made it possible to grow cash crops first time on sand dunes without land levelling in the project area including oil seeds, onion, vegetables in tunnels, maize, water melon etc.

2. WAY FORWARD

Water scarcity is the biggest challenge confronted by irrigated agriculture in the Punjab. The level of agricultural production heavily depends on water availability and its efficient use as a major input. Under prevailing water scarceness, the sustainability of irrigated agriculture is at risk and adoption of high efficient irrigation modern irrigation techniques and methods, offering water conservation and yield enhancement, is inescapable. Punjab has about 1.57 M i.e. eight percent of total geographical area, of cultivable wastelands. To cope with the dwindling land and water resources, it is viable to exploit all the available resources sustainable for producing enough foods to meet the future demands. A logical way forward is to develop the cultivable wastelands for crop production. These include two major areas of the Pothowar Plateau and Thal Region in the province.

5.1 POTHWAR PLATEAU

The Pothwar Plateau, covering an area of 2.2 Mha, is an arid landscape with denuded and broken terrain characterized by undulations and irregularities. The climate is favorable for crop production on fertile soils having no major problem of salinity and water logging. The occurrence of rainfall is, however, highly erratic both in space and time that demands water harvesting, storage, and

supplemental irrigation for successful crop production in the region. Reportedly, about 3.40 MAF water is lost from the area due to surface runoff annually. The total area under cultivation in this area is about 1.0 Mha and agriculture is at sustenance level mainly because of assured irrigation supplies shortages.

The Small Dams Organization (SDO) of Provincial Irrigation Department, so far, has constructed 48 dams in Pothwar region, which are designed to irrigate over 50,000 acres. The command area of these dams has, however, not been developed substantially. The cropping intensity is also very low (about 50 percent) against planned average of provincial Irrigation Department. Nevertheless, there is high potential for the development of irrigated agriculture in the region by managing supplemental irrigation through storage of runoff water and irrigating crops with high efficiency irrigation systems i.e. drip and sprinkle.

5.2 THAL REGION

Thal is a vast desert in Punjab with undulating topography consisting of large sand dunes, which often keep on shifting from one place to another due to random wind storms action. It encompasses entire districts of Bhakkar and Layyah as well as parts of Khushab, Mianwali, Jhang, and part of Muzaffargarh district spreading over an area of about 7 MA. The land in the Thal is generally undulating and soils are sandy in nature having extremely low water holding capacity. The gravity irrigation through conventional practices on such soils is grossly inefficient resulting in precious water wastage through seepages. Thal has following comparative advantages for application of drip irrigation.

- The groundwater is mostly suitable for irrigation and available at appropriate depth, which is recharged by perennial rivers (Indus and Jhelum).
- The upper layer of the sandy soils in the area is very fertile having no water logging and salinity problems.
- Drip irrigation does not require levelling of undulating sand dunes that entails huge capital investment, time, and heavy machinery.
- Desert environment is less susceptible to insect/pest and diseases due to dry conditions.
- Climate is very conducive for cultivation of high value sensitive crops e.g. cotton, vegetables.

The command areas of newly developed canal systems like Greater Thal Canal (GTC) may be developed using modern irrigation. There are some areas where the canal water supplies are limited only for 80 percent of cropping intensity because of which vast land remains uncultivated every year which could be brought under cultivation through drip irrigation systems under limited water supplies.

The preceding discussion suggests that the potential of drip and sprinkler irrigation is huge in different regions across the Punjab. The adoption of these technologies is, however, not appreciable as fraction of a percent of total cultivated land is under micro irrigation. Given the benefits of high efficiency irrigation in terms of water saving and productivity increase, its gross benefits would be enormous, if the available potential is utilized.

The study clearly demonstrates that drip irrigation have many advantages over conventional flooding that is primarily followed in Punjab. Drip irrigation, being the most efficient irrigation system, reduces cost of production as well as increases crop productivity. Drip irrigation facilitates raising of tropical crops like sugarcane in arid climates and offers dense planting of orchard as well as cotton cultivation under drip irrigation in Thal has proved highly efficacious. Acquired benefits of this resource conserving technology suggest its adoption on larger scale, especially in the potential areas in first stage. Since the adoption of drip and sprinkler systems is in the take-off phase in Pakistan, an active role of the major stakeholders is pivotal in promoting these technologies as well as developing confidence among the farming community about the utility of this new technology.

3. GLIMPSES OF OFWM ACTIVITIES

























A RESOURCE CONSERVED

IS

A RESOURCE GENERATED



