PC - I FORM (Revised 2005)

PRODUCTION SECTORS
(Agriculture Production)

PROVISION OF LASER LAND LEVELERS TO FARMERS/ SERVICE PROVIDERS ON SUBSIDIZED COST

(ADP Funded)

Project Cost: **Rs. 1,350.000 Million**

(2015-16 to 2017-18)

DIRECTORATE GENERAL AGRICULTURE (WATER MANAGEMENT) PUNJAB, LAHORE

June 2015

1. NAME OF THE PROJECT

Provision of LASER Land Levelers to the Farmers/ Service Providers on Subsidized Cost

2. LOCATION

The proposed project will be implemented in the entire Punjab except Attock, Chakwal, Jhelum and Rawalpindi districts.

3. AUTHORITIES RESPONSIBLE FOR

a) Sponsoring

Agriculture Department through the Annual Development Program (ADP)

b) Execution

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

ii) District Governments through District Officers (OFWM)

iii) Supply and Service Companies (SSCs)

iv) Farmers/Service Providers

c) Monitoring

i) Directorate General Agriculture (Water Management) Punjab

ii) Project Implementation Supervision Consultants

d) Operation and Maintenance

Farmers/Service Providers

e) Concerned Federal Ministry

Not Applicable

4. PLAN PROVISION

a) If the project is included in the medium term/five year plan, specify actual allocation.

The proposed project is in line with the agriculture sectoral plan and has strong relationship with the growth objectives. Medium Term Development Framework (MTDF) of the Planning & Development Department envisages "*Efficient Water Conveyance and Application through Improved Watercourses, Precision Land Leveling and Drip and Sprinkler Irrigation*" is one of the objectives to achieve vision of self-reliance, food security, and promotion of exportable high value crops. The MTDF also lists upgrading efficient use by precision land leveling as well as vertical enhancement in crop productivity through resource conservation by promoting innovative technologies as one of the strategies to achieve envisaged objectives.

The proposed project is well aligned with the sectoral plan to enhance growth of the agriculture sector by complementing horizontal and vertical expansion helping improving

productivity of land and water resources. It aims at maximizing farm level input use efficiency through effective application of precious resources, especially water. The same has, accordingly, been included in the Medium Term Development Framework (MTDF) for 2015-18 and an allocation of Rs. 450.000 million has been made under annual development program (ADP) during 2015-16 for provision of LASER land levelers to the farmers.

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?

Not applicable.

5. PROJECT OBJECTIVES AND ITS RELATIONSHIP WITH SECTOR OBJECTIVES

a) Project Objectives

The main goal of the project is to maximize productivity of irrigation water at the farm level i.e. producing more crop per drop. The undertaking will have following key objectives.

i) Increase crop and water productivity through optimal use of water and non-water inputs.

ii) Strengthen private enterprise for provision of LASER land leveling services in rural areas to improve such technologies access to small farmers.

iii) Enhance water use efficiency for crop production through on time and precision irrigation.

iv) Build farmers' capability for better water management at grassroots level to get higher farm returns to alleviate poverty.

b) Sectoral Relationship

The proposed project has strong relationship with the agriculture sectoral objective of making every farmer progressive while targeting provision of better information, proactive management through timely actions, better network for quality inputs, mechanized farming, and maximizing efficiency for greater economic base. The underlying objectives of the envisaged initiative are consistent with those of the agriculture sector as a whole that aim at increasing agricultural productivity.

6. DESCRIPTION OF THE PROJECT

a) Irrigated Agriculture Significance

Agriculture is a crucial driver of economic development in Pakistan. It is primarily dependent on water as it consumes about 95 percent of available water supplies. The Punjab is Pakistan's agricultural and economic heartland that contributes to about 80 percent of country's food requirements by producing 80 percent cotton, almost 70 percent wheat, nearly 60 percent sugarcane, and 50 percent rice. More than 70 percent cropped area of the Pakistan's Indus food machine is situated in the Punjab and over 90 percent of province's agricultural production comes from irrigated lands.

Due to predominantly arid and semi-arid climate, more than 80 percent of the cropped area is irrigated by one of the largest contiguous gravity flow network in the world called as Indus Basin Water System (IBWS). About 60 percent of the area commanded by IBWS is located in the Punjab i.e. 8.4 million hectares (21 million acres) served through about 58,500 outlets. Irrigated agriculture is in fact the spearhead of Punjab's agro-based economy accounting for about 28 percent of GDP and employing over 50 percent of its labor force. About two third of the population resides in rural areas relying directly or indirectly on this sector for their livelihood. Despite critical significance of irrigated agriculture to national as well as provincial development, it could not perform sustainably mainly due to lack of modernization of irrigation operations leading to colossal loss of water because of conventional in-efficient irrigation practices.

b) Water Availability and Challenges

Amid various emerging challenges to irrigated agriculture like food security and climate change, inadequate water availability for crop production, poor irrigation efficiency, and over/ under irrigation are the main impediments to low water productivity from otherwise highly productive agricultural lands. According to Water Apportionment Accord of 1991, Punjab's share in total surface water availability is 55.94 million acres feet (MAF). The groundwater abstraction for crop production is about 33 MAF per annum whereas approximately 7 MAF is contributed by the rainfall. On the other hand, there are huge water losses (44 MAF) in the system including 10 MAF in the distribution network of main/branch canals, distributaries, minors, and tertiary conveyance system comprising of about 59,000 watercourses.

Pertinently, a substantial amount of irrigation water (21 MAF) is also lost during its application due to uneven fields and poor farm designs. 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 fields being not properly leveled, cause wastage of land, result in low irrigation efficiencies, and ultimately much lesser yields are obtained than the potential.

Overall, about 47 MAF of water remains available for crop use against 65 MAF of irrigation requirements of current cropped area/ cropping patterns. As such, there exists a gap of nearly 18 MAF to meet crop water requirements for present cropping intensity of nearly 135 percent.

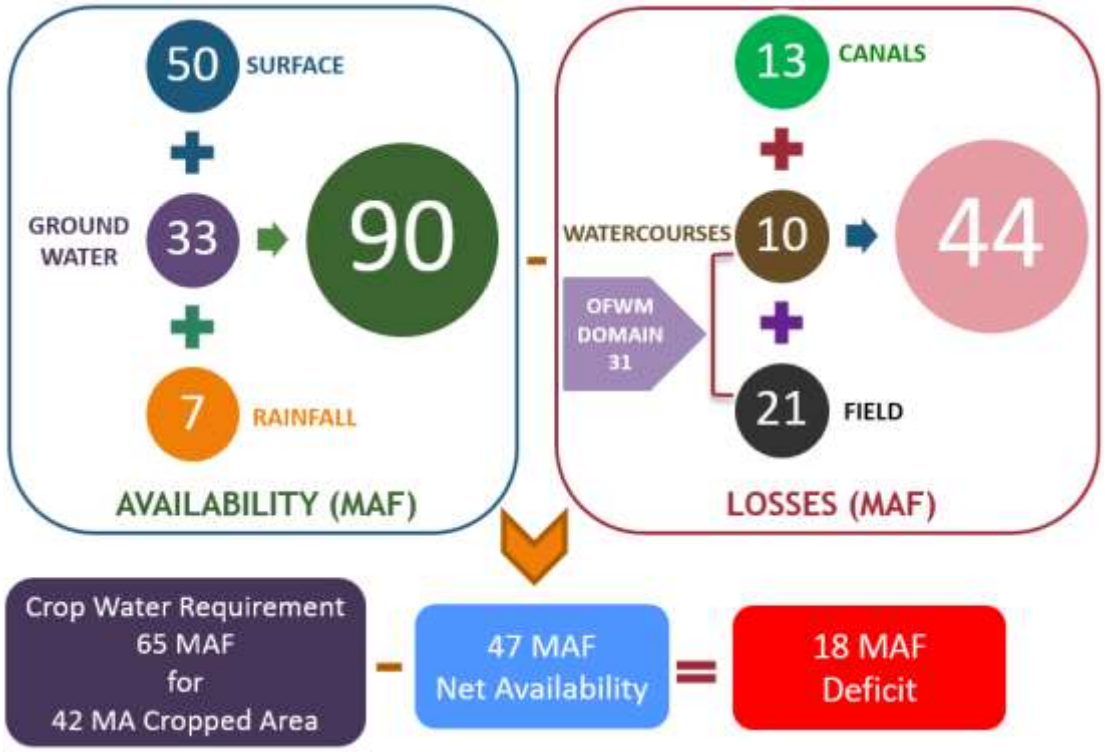

Figure-1: Punjab Water Budget

Another emerging threat to the sustainability of irrigated agriculture is over exploitation of groundwater. The groundwater is a strategic resource for the Punjab as it contributes over 55 percent out of total water utilization for crop production in the Punjab. The unchecked and unsustainable pumpage of this precious resource is a serious threat for sustainability of irrigated agriculture in the province, particularly in water scarce areas. The number of tubewells has increased from less than 10,000 in 1960 to more than one million (1,050,000) in 2010, which are causing depletion of groundwater at alarming rates.

The above situation evidently highlights how much management of scarcely available water and its judicious & efficient use becomes essential for sustainable irrigated agriculture.

There is, therefore, a dire need to use this precious resource wisely and efficiently by adopting the water conservation technologies to conserve it for future generations.

c) Farm Level Water Conservations Initiatives

There has been no incremental water resource development during last four decades in the country. The only source of increased water availability at the farm level has, however, been through adoption of conservation measures e.g. barrages modernization, canals rehabilitation, lining of distributaries/ minors, improvement of watercourses, LASER land leveling etc. Strenuous efforts are already underway to mitigate adverse irrigation related issues at the farm level, which include rehabilitation of farm level irrigation conveyance network for minimizing conveyance loss and to improve water availability and provision of LASER land leveling units to farmers/service providers to reduce water application inefficiencies as well as promotion of drip and sprinkler irrigation systems to accelerate the efforts for conservation and efficient use of irrigation water at farmers' field

Currently, a comprehensive development initiative titled "Punjab Irrigated-Agriculture Productivity Improvement Project (PIPIP)", is under implementation, which includes rehabilitation of farm level irrigation conveyance network for minimizing conveyance loss, reducing water application losses, and enhancing water use efficiency through provision of LASER land levelers to farmers/service providers together with promotion of drip and sprinkler irrigation. The combined effect of these advancements would lead to maximize productivity of available water by minimizing water losses at various levels in order to ensure its adequacy, reliability, and effectiveness at the farm level.

These interventions have significantly contributed in enhancing the conveyance, application, and water use efficiencies leading to enhanced crop and water productivity and ultimately resulting in better farm returns.

d) Water Productivity

Irrigation efficiency or water use efficiency was previously used to describe the performance of irrigation systems. More recently, the term water productivity is being used, which is the magnitude of output / benefit acquired from input quantum of water applied on a unit base. It is usually expressed as 'kg per cubic meter of water' or 'rupees per unit volume of water.

There is substantial variation in crop yields and corresponding water productivities of different crops as well as for the same crop grown in different parts of the world. For example, the water productivity of wheat and rice is much less in Punjab (Pakistan) than India and USA

as show in **Figure-2**. This gap can be attributed to many factors including improved irrigation management, use of better crop production technologies, better quality seeds, increased fertilizer applications, effective insect/ pest control etc. The efficacy of all of these measures, however, largely depends upon improved water availability and its efficient use.

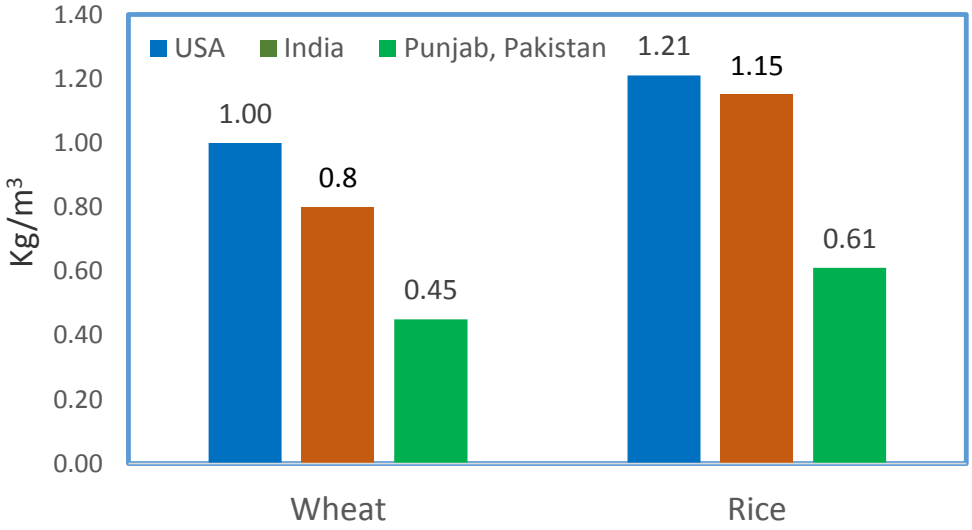

Figure-2: Water Productivity Scenario

It is pertinent to point out that the agriculture is mostly practiced using traditional non-scientific irrigation methods in in Pakistan, which cause low crop productivity per unit of water used. There is a huge scope for improving water productivity at the farm level through adoption of modern and more productive irrigation technologies by optimal use inputs, particularly water.

7. PROJECT COMPONENTS

Major activities to be carried out under the proposed project would include, inter alia, the followings.

A. Creation of awareness and mobilization of the farmers/private sector to actively participate in strengthening of LASER land leveling services in the province.

B. Provision of **6,000** LASER units to the farmers/service providers in all irrigated areas of the Punjab.

C. Impart training to **6,000** farmers/service providers/LASER operators in survey and designing for LASER land leveling, farm layout planning, and operation, maintenance & trouble shooting of LASER units.

D. Pilot testing of irrigation scheduling through provision of soil moisture measurement meters to the farmers.

The technologies proposed under the projects will result in increased irrigation application and water use efficiencies leading to enhanced crop and water productivity and

ultimately resulting in better farm returns. Brief description of project components is offered hereunder and conceptual layout is shown in **Figure-3**.

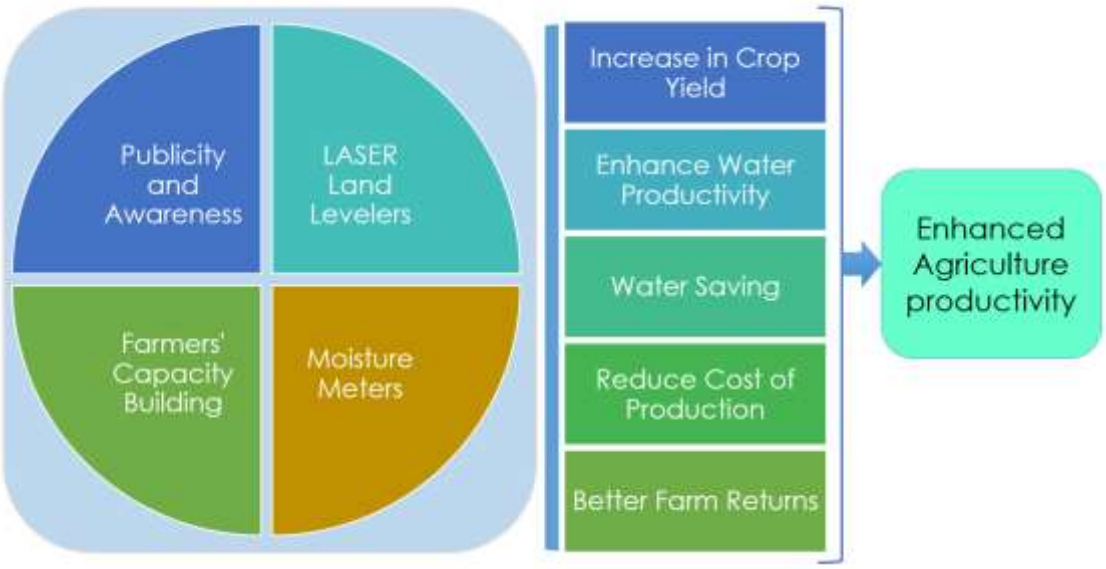

Figure-3: Project Conceptual Layout

A. Awareness Creation

Effective involvement and participation of the beneficiaries acts as a catalyst for the successful implementation of any development undertaking. This will be accomplished through OFWM staff of the District Governments. A comprehensive awareness and publicity campaign will be launched through print/ electronic media. It is indicated that awareness will be created among farming community about LASER technology, its impact on land & water productivity, financial assistance for the farmers under the proposed scheme, mobilization of farmers resources in cost sharing, proposed capacity building of the LASER Operators, potential returns of the investment etc. It is planned that promotional materials would be distributed among the farming community for the purpose and posters would be displaced on places frequently visited by farmers like agricultural offices, district courts etc.

B. Provision of LASER Units to Farmers/ Service Providers

The component will strengthen LASER land levelers services in the province through their provision to farmers/service providers on subsidized rates. A brief narrative about LASER land leveling technology, its benefits, need gap, implementation procedure, selection criteria for farmers/service providers and subsidy is described hereunder.

B-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.

Precision land leveling is being promoted since inception of OFWM Program. Use of LASER technology in the precision land leveling is the latest development, which was introduced in the Punjab during 1985. 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 (**Figure-4**). The same has 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.

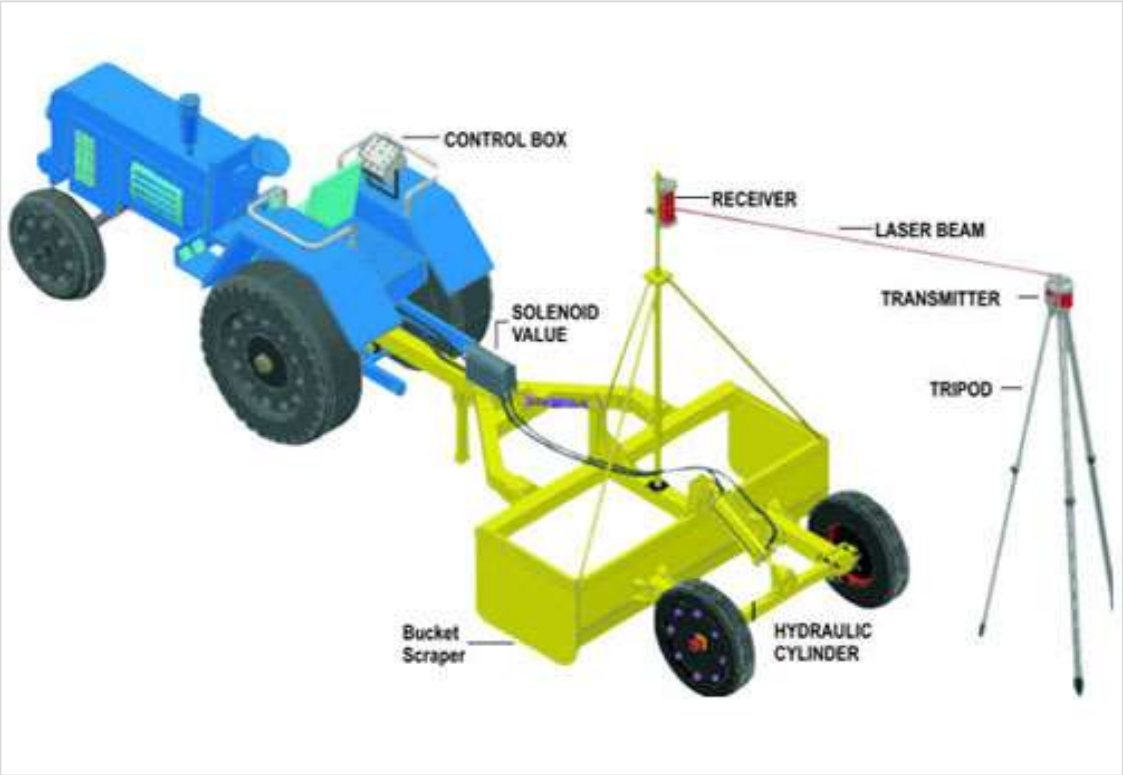

Figure-4: LASER Land Leveling Operation

B-2 Impact of LASER Land Leveling

LASER land leveling is the most effective and popular technology amid farming community because of its highly quick returns/benefits. The cost of LASER land leveling is merely Rs. 5,000-6,000 for one acre but it results in benefits valuing Rs. 25,000 per annum. As one LASER unit can level 300 acres in a year, the total annual returns come to about Rs. 8 million. As such, LASER land leveler pays back its initial investment i.e. Rs. 500,000-600,000 in less than one year. It is indicated that LASER land leveling technology is now being used adequately by the farmers in all district of the Punjab (**Figure-5**). It has been observed that LASER land leveling results in following benefits.

i) Reduces the time of irrigation and amount of water required by upto 50 percent.
ii) Results in uniform seed germination, even distribution of soil moisture, and better fertilizer uptake by the crops.
iii) Curtails the number and length of field borders and ditches and can, accordingly, increase the irrigated area by about 2 percent and reduce watercourse length upto 60 percent.
iv) Increases crop yields as much as 25 percent.

An impact assessment study was carried out by Planning & Evaluation Cell of Agriculture Department during 2008 for evaluation of LASER land leveling technology, which reveals following impacts at the farm level

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

Similarly, the economic analysis carried out under the "Punjab Irrigated-Agriculture Productivity Improvement Project (PIPIP)" rated this technology economically feasible with Economic Rate of Return of 32.7 percent.

Figure-5: Glimpses of LASER Land levelers

B-3 Technology Need Gap

The OFWM was providing subsidized rental services for LASER land leveling and nearly 168,000 acres were leveled with LASER technology in the Punjab till launching of "Strengthening of LASER Land Leveling Services in the Punjab" project during 2005-06. The same was achieved with the fleet of about 125 working LASER units owned by the district governments. Their maximum capacity was to carry out precision land leveling of about 35,000 acres in a year. The same was enhanced to about 750,000 acres per year with implementation of above said project completed during 2008. It was, however, observed that the LASER land leveling services were still inadequate to fulfill the demand of farmers and large area of the province is still unleveled having traditional farm layouts, which are a source of continuous irrigation water wastage and resultantly colossal loss of potential for increased agricultural productivity. Accordingly, 3,000 LASER units have been provided to farmers/ service providers under on-going "Punjab Irrigated-Agriculture Productivity Improvement Project" to strengthen the rental services in the private sector.

The irrigated land of the Punjab is about 27 million acres (11 million hectares). It is indicated that one LASER unit can LASER level nearly 300 acres annually due to short window of time available for land leveling between Rabi and Kharif crops. Moreover, LASER land leveling operation is required to be repeated after 3-5 years to get continued benefits of the technology. Accordingly, it has been worked out that LASER leveling of entire cultivated area in four years will require about 22,500 LASER units. This figure supports the hypothesis that there are about 25,000 villages in the Punjab and availability of one LASER unit in one village fulfill the LASER land leveling demands.

The government has so far provided 5,700 LASER units to farmers/ service providers on subsidized costs under development schemes, while farmers' have purchased nearly 2,800 units privately at their own. As such, there are about 8,500 LASER units in the province available for LASER land leveling with a gap of still over 14,000 units as given below.

- Irrigated Area Requiring Leveling (Million Acres) 27
- Annual Leveling Capacity per LASER Unit (Acres) 300
- Required Units (No.) 22,500
- Available (No.) 8,500
- Gap (No.) 14,000

B-4 Technology Adoption and Demand

The adoption of new agricultural machinery by the small farmers' depends on prevailing socio-economic conditions, market prices, access to information about valuation of such technology, availability of credit/loan facility, and most importantly financial resources or paying capacity to buy such equipment. The cost of technology plays a key role in its adoption/procurement, especially by the small farmers in developing countries like Pakistan where majority of farmers (85%) cultivate less than 12 acres of land. During the past few years, their financial capability has severely eroded because of escalated costs of production and price crash of all agricultural commodities.

It has become very difficult for small farmers to procure the agricultural technology/machinery even though government provides considerable financial assistance, LASER land leveler is no exception. It has also been observed that huge number of farmers failed to book/procure the LASER units by contributing their share mainly because of their inability to manage requisite financial resources required for their share of equipment costs (about Rs. 350,000) under the PIPIP.

An analysis of LASER land leveling technology adoption reveals significant spatial variability as LASER units available in some districts like Mianwali, Muzaffargarh, Rajanpur, D.G. Khan, and Jhang are less than 25 percent of their actual requirement. As such, these services are not adequately available in these districts, particularly to the small farmers. Majority of farmers could not book/procure LASER land levelers despite having adequate proportionate share of these districts in total allocation. The dropout cases to book the LASER land leveling unit were also higher in these districts. The situation is comparatively better in Okara, Sahiwal, R.Y. Khan etc. districts where farmers are relatively well off and more progressive to afford/contribute requisite share for procuring LASER units under government scheme. For example, the LASER units already available in Okara district fulfill 82 percent of its total requirement as majority of farmers have got LASER units under subsidy schemes or procured privately due to better financial capacity. There are yet majority of small farmers who still do not have access to LASER technology due to poor financial capacity to contribute their share to procure the LASER unit.

Similarly, the productivity gaps between progressive and average/small growers are huge, which are mostly related to the capacity of farmers' to invest on better inputs and production technologies. The yield gaps for wheat, rice, cotton, and sugarcane between progressive growers and average/small farmers' in Punjab are 78, 85, 145 and 77 percent, respectively (**Figure-6**). These yield gaps can significantly be minimized by facilitating small

farmers for enhancing their productivities through provision of such technologies, which enhances efficiency of precious/costly water and non-water inputs leading to substantial increase in yields.

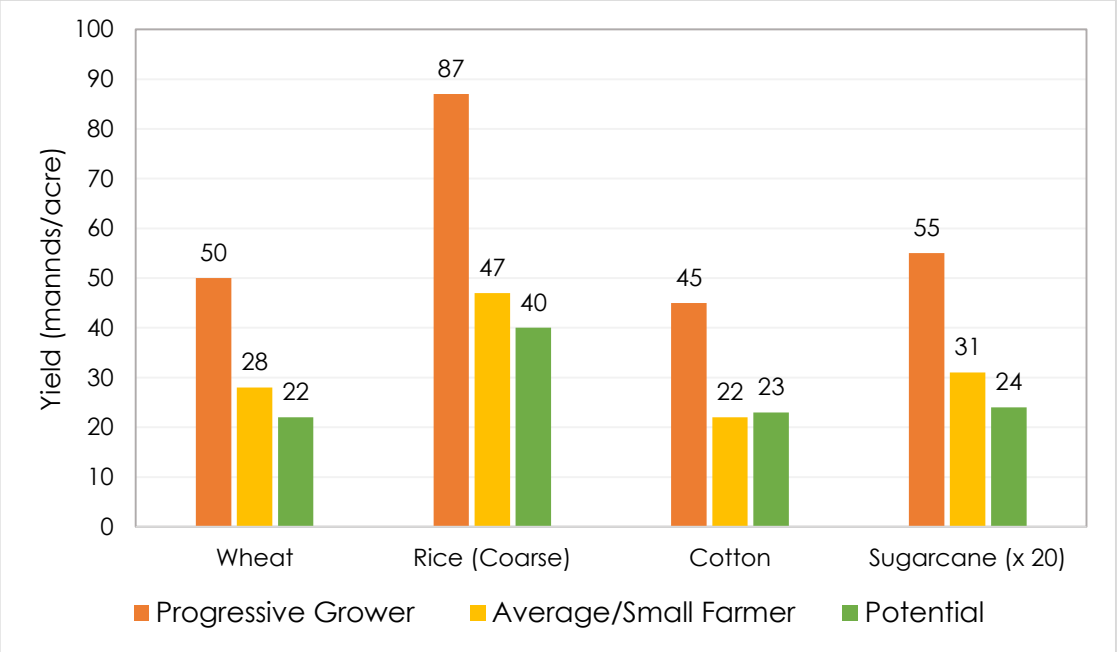

Figure-6: Yield Gaps of Major Crops

It is, accordingly, considered to provide **6,000** more LASER units under the proposed project to the small farmers by facilitating them through enhancing financial assistance from Rs. 225,000 to Rs. 450,000 keeping in view demand and financial capacity of the small farmers. The same will encourage and facilitate small farmers for accelerated adoption of the technology and support in enhancing their income by providing rental services. The requirement of LASER land levelers in various districts is enclosed (**Annexure-A**).

B-5 Selection of Service Providers/Farmers

The selection criteria approved by the Project Steering Committee (PSC) for provision of LASER land levelers under the PIPIP will be adopted under the proposed project. An applicant will be eligible for the grant of financial assistance provided that the person

a) possesses a tractor capable of operating LASER unit;

b) is owner/tenant of land not more than 12.5 acres and is preferably agricultural machinery service provider or an agricultural graduate possessing requisite land ownership;

c) will agree to rent out the equipment for LASER land leveling in the area;

d) undertakes to carry out/provide rental services for LASER land leveling of 300 acres per unit annually during project period; and

e) 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.

B-6 Supply and Service Companies

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 Agriculture Department has already approved standards & specifications of LASER equipment for supply of LASER units to the farmers/ service providers under the PIPIP. The department has prequalified seven (07) Supply & Service Companies (SSCs) for provision of LASER units under the PIPIP. These suppliers/manufactures have been short-listed alongwith their units in order to safeguard quality of the equipment to be procured under the project. It is planned that the standards & specifications already approved by the Agriculture Department would be adopted under the proposed project. Moreover, the SSCs prequalified under the PIPIP would be eligible for provision of LASER units under the proposed project. The recipient will have the option of purchasing the equipment of his/her own choice from amongst pre-qualified firms.

B-7 Implementation Arrangements

It is indicated that well understood and accepted approach, introduced under previously completed scheme and replicated under the PIPIP, will be adopted for provision of LASER units to the farmers/ service providers for the proposed project as well. This involves provision of one-time financial assistance to farmers/service providers for procurement of equipment and their capacity building to carry out the envisaged task. The implementation modalities to be followed for the proposed project are described hereunder.

i) The quota for each district, preferably based on balance requirement of LASER land levelers (Annexure-A), will be approved by the Project Steering Committee (PSC) of the PIPIP and the same will be conveyed to the districts by the DGA (WM).

ii) Massive awareness and publicity campaign will be launched through print/ electronic media at the provincial level as well as in the districts.

iii) Agriculture Department will advertise for invitation of applications from the farmers interested to work as service providers for LASER land levelling rental services.

iv) All districts will be informed about the time bound action plan for provision of LASER land levelers to the farmers/service providers.

v) The applications will be received/ collected in the office of District Officer (OFWM) that will be scrutinized vis-à-vis approved criteria by the designated committee.

vi) The ineligible applicants will be informed about rejection of their applications who may submit appeal against the ineligibility within specified period and concerned authority will decide the eligibility/ ineligibility after hearing appeals within stipulated timeframe.

vii) The 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. 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.

viii) The allotment of LASER units to the eligible applicants will be made by the District Allotment Committee (DAC).

ix) The allotment letters will be issued to the successful applicants by the DO (OFWM) with the advice to book LASER units 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 concerned DO (OFWM).

x) The DO (OFWM) will forward the bank draft to DGA (WM) for issuance of work order to concerned firm.

xi) 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).

xii) The supplier firm will ensure delivery of booked unit within stipulated period and defaulting firms will be dealt as per government Rules.

xiii) 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).

xiv) A committee comprising of representative of concerned DO (OFWM), representative of concerned RPCU, recipient farmer/service provider, and Field Engineer of consultants will inspect the equipment jointly and record the make, model, serial number and other features of all components of LASER unit.

xv) The technical inspection report, duly signed by the inspection team, will be sent by DO (OFWM) to DGA (WM) for releasing payment.

xvi) DGA (WM) will hand over the original draft of concerned allotee's share to the firm alongwith project assistance.

B-8 Cost Sharing Arrangements

It is planned to provide one time financial assistance of Rs. 450,000 per unit to the farmers/service providers, out of which Rs. 225,000 will be borne by the Punjab Government and Rs. 225,000 by the World Bank under PIPIP. 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. 925,000. Moreover, the market

price of LASER unit is about Rs. 650,000. Thus, the total contribution of the farmer comes to be around Rs. 1,125,000 which is about 71 percent of total investment and the government is in fact providing only 29 percent.

C. Training of Farmers/ LASER Operators and Technical Support

OFWM staff available at tehsil level will provide technical assistance and backup support for carrying out LASER land leveling in the field. Water Management Training Institute (WMTI), Lahore will arrange training for capacity building of the service providers/farmers or their Tractor / LASER Operators in following activities.

- Survey and designing for LASER land leveling
- Planning and development of farm layouts considering soil type, farmer's tillage equipment, crops to be grown, source/quality of irrigation supplies etc.
- Operation of LASER units
- Maintenance and trouble-shooting of equipment

Training courses will be conducted for LASER Operators in "LASER Land Leveling" to train one operator for each LASER unit. It is planned that training course comprising of **25** participants each will be arranged at Water Management Training Institute (WMTI), Lahore/ other institutions during project period. Accordingly, about **240** courses are required to be conducted for **6,000** operators.

D. Pilot Testing of Irrigation Scheduling

This component will support pilot testing of irrigation scheduling through provision of soil moisture measurement meters to the farmers in selected districts of the Punjab.

D-1 Existing Practices

Soil moisture is the most critical and highly variable component of the crop root zone environment. It directly affects the plant growth through its controlling effect on availability and uptake of almost all nutrients. Application of too much water not only causes its wastage but also that of other nutrients, energy, and labor. Furthermore, excess water in the root zone reduces soil aeration retarding plant growth. Likewise, under irrigation stresses the crop by constraining availability of water as well as non-water nutrients. As such, under or over application of water, both lead to reduced crop yields and poor quality of produce. The water shortage at any stage of plant growth retards its development and hampers photosynthesis process. The over and under irrigation adverse impacts on plant growth is given in **Table-1**.

Table-1: Over and Under Irrigation Adverse Impacts on Crop Growth

Over Irrigation	Under Irrigation
♦ Restricts plant growth ♦ Leaches soil nutrients ♦ Retards root development ♦ Wastes energy ♦ Lowers produce quality	♦ Stresses crop growth ♦ Lowers produce quality ♦ Affects plant health ♦ Reduces crop yield

It is not easy for farmers to adopt proper irrigation scheduling practices in Pakistan mainly because of various system difficulties and limitations in soil moisture measurements. Primarily, there are two methods used for irrigation scheduling practiced at the farm level (**Figure-7**).

D-1-1 Feel and Appearance Method

This method is based on appearance of soil and plant in response to water stress. This is the oldest and most commonly employed way for guessing soil moisture content for irrigation purposes. It is based on personal experience of the irrigator by observing the crop condition e.g. change in color of the plant canopy, curling of the leaves, plant wilting condition etc. These changes can only be detected by looking at the crop as a whole, rather than at individual plants.

D-1-2 Warabandi Operation

The warabandi starts at the head and proceeds to the tail of the watercourse according to a prefixed schedule. A certain time allowance is given to a farmer to irrigate the field at allocated turn without considering the fact that whether crop needs water or not and how much. The groundwater is, however, playing a vital role in irrigated agriculture of the Punjab with about 60 percent contribution in overall irrigation applications. Contrary to the warabandi irrigation system, farmers irrigating fields with groundwater have the flexibility and high potential for implementation of irrigation scheduling.

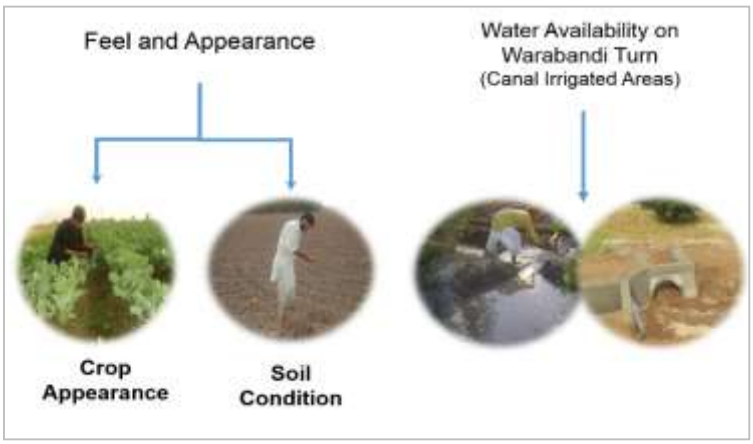

Figure-7: Existing Irrigation Scheduling Practices

D-2 Irrigation Scheduling

In order to scientifically schedule irrigation, accurate determination of "WHEN and HOW MUCH water to be applied to a field" thereby providing exact amount of water to crop at the right time is very much important. The timing of an irrigation event (WHEN) depends on plant need and soil water condition whereas "HOW MUCH" is contingent upon soil's water holding capacity, crop rooting depth, soil moisture depletion level, and planned irrigation interval. The importance of irrigation scheduling has long been recognized and a wide range of scientific and practical tools have been developed to help farmers in applying water to crops more accurately.

It has been established that best crop growth occurs when the soil moisture level remains within field capacity range (WATTAR), whereas crop growth slows down above or below it (**Figure-8).**

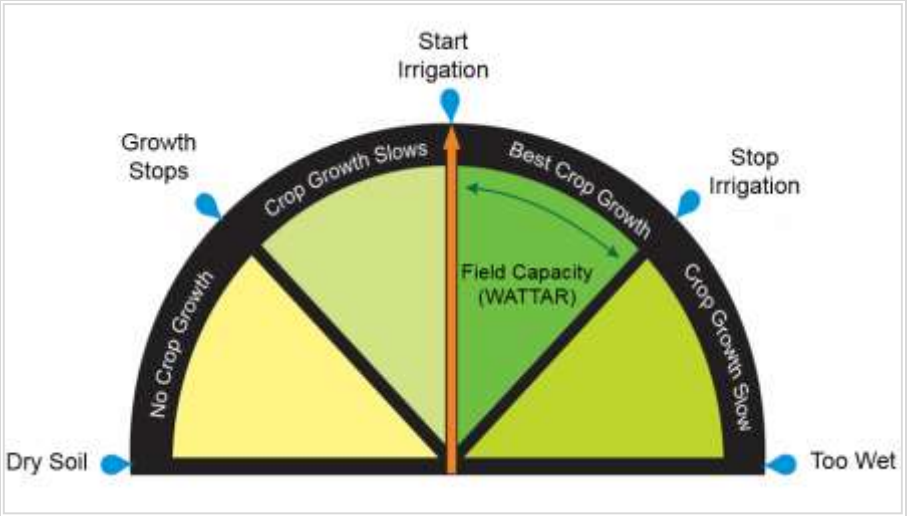

Figure-8: Irrigation Scheduling Conceptual Dial

D-3 Irrigation Scheduling Impact

There is lot of research that has been carried out for calculating irrigation scheduling impacts in terms of water saving and yield increase as well as other benefits as given below.

- Saves Water upto 35 percent
- Increases Yield by 8 percent
- Reduces Energy Use upto 35 percent
- Improves Produce Quality
- Curtails Nutrient Costs

The quantification of irrigation scheduling impacts has been carried out for major cropping systems considering the average values of cost of production, which on an average comes to about Rs. 14,000 /acre per annum (**Table-2**).

Table-2: Irrigation Scheduling Benefits

Sr. No.	Cropping system	Benefits (Rs./Acre)
1	Wheat- Rice	11,000
2	Wheat-Cotton	13,000
3	Sugarcane	14,000
4	Maize-Rice-Potato	18,000
	Average	***14,000***

D-4 Use of Irrigation Scheduling Devices

Over the years, several devices and gadgets have emerged up for accurate measurement of soil moisture leading towards efficient use of irrigation water to conserve water, enhance crop yields, and improve quality of produce. Unlike in Pakistan, the 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".

The use of irrigation scheduling devices can remove the guess work in irrigation management by providing an accurate assessment of the soil water status. There are numerous instruments used for moisture measurement ranging from highly sophisticated such as Weather Stations, Enviroscan, Time Domain Reflectometry, Time Delay Transmission to relatively simple devices like Tensiometer, Gypsum Blocks, Neutron Probes, Soil Moisture Meters/Sensors, FullStop etc.

It is proposed to promote irrigation scheduling amongst the farmers on pilot basis by providing them soil moisture devices and sensors. The plan is to create awareness among the farming community about the impact of these soil moisture measurement devices and sensors and then select the progressive farmers who are willing to adopt the irrigation scheduling techniques as well as offer services to the community at the local level. After training and capacity building of the selected farmers about use of soil moisture measurement meters, such devices would be provided to them for experimenting at their farms and afterwards would provide services to other interested farmers. A conceptual layout of the proposed plan is shown in **Figure-9**.

Figure-9: Implementation Concept

The quantity and placement of moisture meters depends on rooting depth of the crop as only one moisture meter will be required for shallow root crops like vegetables and two for deep rotted crops such as wheat, citrus etc. as shown in **Figure-10**.

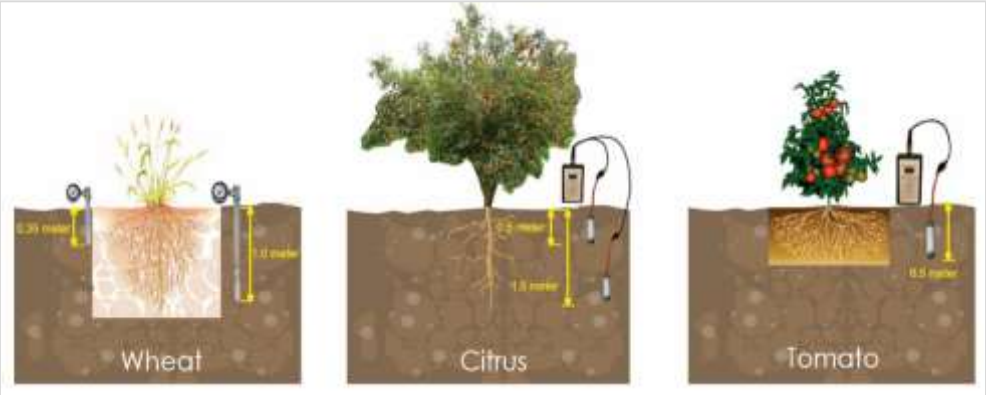

Figure-10: Placement of Moisture Meters for Different Crops

D-5 Selection Criteria

Pilot testing of irrigation scheduling through provision of moisture meters have been envisaged to be piloted in two districts of the Punjab. These pilot distribution will be selected by the Project Steering Committee. It is planned to provide moisture meters to 4-5 farmers, preferably tubewell farmer, in each village of two districts (about 700 villages in a district) on cost sharing ratio of 80:20 (Government: Farmer) for their own use as well as service provision to other farmers. The first year of implementation will cover around 1,400 farmers i.e. one in each village of 1,400 villages of districts, which will subsequently be increased to 2,800 in second and third years of project based on evaluation/results/uptake of these gadgets.

An applicant will be eligible for the grant of financial assistance, who

a) is a progressive farmer and has already carried out LASER levelling of his fields or installed High Efficiency Irrigation System;
b) owns an irrigation tubewell;
c) agrees to irrigate his crops as per recommended irrigation schedule;
d) undertakes to provide rental services of moisture measurements to other farmers in the village; and
e) is willing to demonstrate irrigation scheduling techniques to other farmers at his farm.

D-6 Cost Sharing

Keeping in view that the irrigation scheduling concept is very new in Pakistan, it is proposed that moisture meters/sensors will be provided to the farmers on 80 percent subsidy. The entire cost of government share under the component will be met from the Punjab Irrigated-Agriculture Productivity Improvement Project (PIPIP). The same has been agreed in the Aide Memoire of 5th World Bank Implementation Review Mission of the PIPIP. It has been indicated therein that an amount of US $ 1 million (Rs. 100 million) would be used from component C of the PIPIP for piloting such technologies (**Annexure-B**).

D-7 Implementation Arrangements

It is planned to adopt following procedure and sequence of activities for provision of Moisture Meters/Sensors to the farmers.

i) The pre-qualification committee (PQC) will develop standards and specification of the Moisture Meters/Sensors to be subsidized under the proposed project.
ii) The supply and services companies (SSCs) will be selected who will supply the irrigation scheduling equipment to the farmers. The SSCs would also provide the after sales services for capacity building and training of farmers and technical assistance in its operation & maintenance for one crop under warranty.
iii) The bids will be invited from supply and services companies (SSCs) as per approved standards and specifications.
iv) Directorate General Agriculture (WM) will advertise for invitation of applications from the interested farmers.
v) The District Officer (OFWM) will scrutinize the applications against approved criteria and will carry out balloting, in case there is more than five applications from one village.
vi) The Water Management Training Institute (WMTI) will carry out training of the applicant/farmers. The selected SSCs will also support the WMTI in this regard.
vii) After training, the moisture meters/sensors will be provided to the farmers for use application in the field.

viii) After one crop cultivation and/or six months, the District Officer (OFWM) will submit report to the Director General Agriculture (Water Management) about operation and impact of these devices.

E. Project Implementation, Supervision, Monitoring and Coordination Mechanism

The proposed project will be implemented with the existing infrastructure and human resource of Water Management wing. The coordination, supervision, administration, and monitoring arrangements approved under the PIPIP will be adopted for proposed project. Director General Agriculture (Water Management), Punjab would act as Project Director who will supervise, manage, and monitor the proposed project from provincial headquarters through existing establishment. Three Regional Project Directors, one each at Lahore, Multan, and Rawalpindi, already established under the PIPIP, will provide necessary technical support to the District Governments as well as coordinate activities between provincial headquarters and field formations. The District Office (OFWM) would be responsible for supervision, coordination and internal monitoring at the district level and Deputy District Officer (OFWM) at the tehsil level.

F. Project Management

The project management arrangements approved under the PIPIP will be adopted for successful execution of envisaged activities under the proposed project. The coordination, administration, and monitoring will, however, be achieved through already established committees under the PIPIP as given below.

a) Project Steering Committee (PSC)
b) Pre-qualification Committee (PQC)
c) Project Implementation Committee (PIC)
d) District Implementation Committee (DIC)
e) District Allotment Committee (DAC)

G. Monitoring of Project Activities

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.

H. Consultancy Services

It is indicated that M/s National Engineering Services Pakistan (Pvt) Ltd. (NESPAK) led consortia have been recruited as Project Implementation Supervision Consultants (PISC)

under the PIPIP for provision of technical support to OFWM staff at provincial, regional, district, and field level in implementation of project interventions. It is planned that Field Engineers of PISC will continue to provide services for inspection of the LASER equipment jointly with designated committee under the supervision of DO (OFWM).

8. MATERIALS, SUPPLIES AND EQUIPMENT REQUIREMENT

It is envisaged to utilize existing facilities and infrastructure as well as available under the PIPIP for implementation of the scheme.

9. CAPITAL COST ESTIMATES

a) Indicate date of estimation of project cost estimates

The cost estimates of the project have been prepared during June 2015.

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 June 2015.

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-C**).

d) Year-wise/Component-wise Financial Requirements

The year-wise/component-wise phasing of financial requirements out of annual development program (ADP) is provided at **Annexure-C**. The overall financial layout including financing through PIPIP for the proposed project is given as under.

A.	**Provision of LASER Units**						
1	Mobilization of Farmers/Service Providers	Nos.	2,000	2,000	2,000	6,000	
2	Provision of LASER Units	Nos.	2,000	2,000	2,000	6,000	
3	Training of LASER Operators	Nos.	2,000	2,000	2,000	6,000	
B.	**Pilot Testing of Irrigation Scheduling**						
1	Demonstration of Moisture Meters on Farms	Nos.	1,400	2,800	2,800	7,000	
2	Training of Farmers	Nos.	1,400	2,800	2,800	7,000	
3	Organization of Farmers' Days	Nos.	14	28	28	70	
II.	**FINANCIAL (Rs. million)**						
A.	**Provision of LASER Units**						
	Government Share	0.450	900.000	900.000	900.000	2,700.000	
	Farmers' Contribution	1.125	2,250.000	2,250.000	2,250.000	6,750.000	
	Sub Total (A)		**3,150.000**	**3,150.000**	**3,150.000**	**9,450.000**	96.07
B.	**Pilot Testing of Irrigation Scheduling**						
1	Demonstration of Moisture Meters on Farms	0.050	70.000	140.000	140.000	350.000	
	Government Share (80%)	0.040	56.000	112.000	112.000	280.000	
	Farmers' Contribution (20%)	0.010	14.000	28.000	28.000	70.000	
2	Training of Farmers	0.005	7.000	14.000	14.000	35.000	
3	Organization of Farmers' Days	0.025	0.350	0.700	0.700	1.750	
	Sub Total (B)		**77.350**	**154.700**	**154.700**	**386.750**	
	Base Cost of the Project		**963.350**	**1,026.700**	**1,026.700**	**3,016.750**	30.67
	Total Project Cost						
	Government Share		963.350	1,026.700	1,026.700	3,016.750	30.67
	(i) (For LASER Land Levelers Subsidy) GOP Allocation (ADP)		450.000	450.000	450.000	1,350.000	12.50
	(ii) World Bank Allocation (PIPIP)		513.350	576.700	576.700	1,666.750	12.50
	Farmers' Contribution		2,264.000	2,278.000	2,278.000	6,820.000	69.33
	G. Total		**3,227.350**	**3,304.700**	**3,304.700**	**9,836.750**	100.00

10. ANNUAL OPERATING AND MAINTENANCE COST AFTER COMPLETION OF PROJECT

It is envisaged that the farmers/service providers would be responsible for the operation and maintenance of LASER units provided under the proposed project. Similarly, the moisture meters provided under the project will be used and maintained by the beneficiary farmers. As such, there would be no recurring expenditure for activities carried out under the proposed project.

11. DEMAND AND SUPPLY ANALYSIS

It is well established fact that irrigation water is the most critical factor in crop production and its regular supply can ensure enhanced productivities of other non-water inputs for higher crop yields. The Punjab is facing acute shortage of irrigation water particularly in its southern parts for last few years on one hand and there are food security threats for exponentially growing population on the other. Accordingly, it is needed to improve efficiency of agricultural inputs, particularly the irrigation water through efficient utilization of available resources for enhancing crop yields and lowering the cost of production. The gravity of the situation gains further significance under WTO regime of open markets that would allow free international trade, which will make survival of inefficient agriculture highly difficult. LASER technology offers a great opportunity in meeting these challenges through minimizing water application losses and improving water productivity for efficient utilization of other inputs under irrigated agriculture.

The existing facilities of LASER land leveling services available in the public and private sector are not fulfilling the demand, especially of small farmers. The proposed project would help to strengthen the service provision infrastructure in the private sector and sustainability of technology transfer.

12. 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	-	-
ii- Grant	-	-
iii- Technical Assistance	-	-
(b) Federal Government	-	-
i- Grant	-	-
ii- Loan	-	-
iii- Investment	-	-
iv- Direct Expenditure	-	-
(c) Provincial Government	-	-
i- Grant	*1,350.000*	-
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	-	-
(i) Other sources (e.g. Recoveries)	-	-

d) Weighted Cost of Capital

NA

e) Flow of Funds

An Assignment Account/Special Drawing Account (SDA) will be opened in the name of DGA(WM) after authorization of the Finance Department and fulfilling prescribed codal formalities in National Bank of Pakistan, Main Branch, Lahore. The DGA (WM) would be allowed to maintain and operate the said account for channeling the funding released by the provincial government. Accordingly, the funds from provincial government will be transferred directly into specified Assignment Account for disbursement by DGA (WM). The allocations will be approved by the Project Steering Committee (PSC) for payment of financial assistance against LASER units provided to the farmers/ service providers as well as other procurements. 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.

13. 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. The implementation of the project activities would result in substantial increase in farm incomes and provide enhanced employment opportunities to the rural population. LASER land leveling of one acre results in annual returns of Rs. 25,000 and one LASER unit would result in annual benefits of about Rs. 8

million by leveling 300 acres in a year in terms of water saving, yield increase, cultivated area enhancement and labour saving. Similarly, irrigation scheduling would result in benefits of Rs. 14,000 /acre per annum owing to water saving, yield increase and better input utilization.

b) Economic Benefits

The interventions proposed under the project are technically viable and economically feasible with IRR of 60 percent (**Annexure-D**) with following economic returns.

i) Curtailment of irrigation application losses upto the extent of 50 percent. LASER land leveling of about 1.80 million acres every year, after project completion, will result in annual incremental water savings of approximately 1.34 MAF at the farm level.

ii) Reduction of labor requirements for irrigation by about 35 percent.

iii) Enhancement of the irrigated area by about 2 percent by minimizing the number as well as length of field ditches and dikes.

iv) Increase in crop yields by about 20 percent.

v) Control of waterlogging and salinity.

vi) Facilitation in efficient use of farm machinery.

vii) Ensure more productive utilization of seeds, fertilizers, and other non-water inputs.

c) Social Benefits

The project interventions would have substantial impact on social lives of the rural people. The increased crop and water productivities through LASER land leveled fields would enhance income level of the farmers using the technology. Improved water productivity would help in growing more crops with less water and less competition to get more water eliminating conflicts among the farmers which often results in loss of lives and litigations with heavy financial losses. The implementation of the project would provide direct and indirect employment opportunities to the rural population of project area as **6,000** persons could get direct employment as LASER Operators and Helpers. Moreover, establishment of repair and maintenance facilities for LASER land leveling equipment will open new avenues of employment for skilled workers.

d) Environmental Benefits

The project builds on existing infrastructure to bring operational improvements in crop production system. It would, therefore, not cause any adverse environmental affects normally associated with new developments, e.g. resettlement, depletion of land and water resources, loss of wildlife habitat etc. The project interventions will indirectly result in reduction of unwanted dikes and ditches leading to decreasing the cultivable wasteland and

increase in area available for crop production. Moreover, reduction in unnecessary dikes/ditches has resulted in less weed infestation and destruction of insects' shelter leading to less use of herbicides and pesticides

e) Employment Generation

The implementation of the project would provide enhanced employment opportunities to the rural population of project area. It is estimated that about **6,000** persons will get direct employment as LASER Operators and Helpers. Furthermore, repair shops for LASER units will be established in the private sector throughout the province that will open new avenues of employment for skilled workers. An addition of fleet of about **6,000** tractors will create more jobs in maintenance workshops already functioning in rural areas. Improvement in crop yields will also boost economic activity in rural areas of the province that will also create further employment options. It is estimated that an amount of about Rs. **6,820.00** million would be contributed by farmers/service providers for strengthening of LASER land leveling services as cost sharing for the equipment under the project. It is, therefore, concluded that project implementation will stimulate employment generation not only for skilled and unskilled labour 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 increase in project costs due to price escalation of materials.

14. IMPLEMENTATION SCHEDULE (INCLUDING STARTING AND COMPLETION DATES)

Indicate starting and completion date of the project:-

Starting Date	Completion Date
July 2015	June 2018

15. 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.

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Annexure-A

Provision of LASER Land Levelers to the Farmers/ Service Providers on Subsidized Cost

Proposed District-Wise Distribution of LASER Land Levelers

Sr. No.	District	Irrigated Land (Acres)	Total Requirement of LASER Units (Nos.)	LASER Units Available (Nos.)	Balance Requirement (Nos.)	Proposed Quota (Nos.)
1	R.Y. Khan	1,381,859	1,152	756	396	173
2	Bahawalnagar	1,490,203	1,242	503	739	322
3	Bahawalpur	1,243,103	1,036	322	714	311
4	Faisalabad	1,309,630	1,091	409	682	298
5	Chiniot	509,406	425	136	289	126
6	Jhang	1,113,851	928	245	683	298
7	Toba Tek Singh	735,598	613	287	326	142
8	D.G.Khan	600,643	501	124	377	164
9	Layyah	737,498	615	210	405	176
10	Muzaffargarh	1,197,485	998	222	776	338
11	Rajanpur	617,750	515	132	383	167
12	Gujranwala	1,047,324	873	304	569	248
13	Gujrat	300,322	250	92	158	69
14	Hafizabad	638,658	532	134	398	174
15	M.B.Din	644,361	537	198	339	148
16	Narowal	456,185	380	98	282	123
17	Sialkot	762,208	635	203	432	188
18	Lahore	306,024	255	115	140	61
19	Kasur	971,293	809	320	489	213
20	Nankana Saheb	549,322	458	137	321	140
21	Sheikhupura	1,001,705	835	265	570	248
22	Multan	826,835	689	312	377	164
23	Khanewal	1,024,515	854	293	561	245
24	Lodhran	809,728	675	286	389	170
25	Vehari	1,174,675	979	332	647	282
26	Sahiwal	798,323	665	271	394	172
27	Okara	1,155,668	963	726	237	103
28	Pakpattan	727,995	607	369	238	104
29	Sargodha	1,018,812	849	291	558	243
30	Bhakkar	741,300	618	177	441	192
31	Khushab	249,001	208	79	129	56
32	Mianwali	477,093	398	77	321	140
Total		**26,618,372**	**22,182**	**8,425**	**13,757**	**6,000**

Annexure-B

Provision of Laser Land Levelers to Farmers/ Service Providers on Subsidized Cost

AIDE MEMOIRE AGREED ACTIONS

IV Summary of Agreed Actions

4.1 Key actions agreed on during the mission are as follows:

(i) Remaining 43 vehicles needed for the Project would procured and supplied by June 2015;
(ii) Implementation of the HEIS component would be accelerated and in this context various measures discussed in the aide-memoire and during the mission would be implemented in particular the programs under component C would be accelerated;
(iii) Overall target of 50% of the watercourse, improved using the precast concrete long parabolic sections instead of bricks, should be achieved. In this context the W/Cs improvements with bricks would be rescheduled if needed to achieve this overall target;
(iv) Implementation of Component C needs to be expedited and work on all of its activities, in addition to professional and technical training needs, be started as soon as possible. This also requires designation of coordinators for each set of activities and overall coordinator for the component. It was agreed that an international consultant would be recruited to upgrade the implementation plan for this component;
(v) Pilots for field irrigation with gated pipes and for providing equipment for improving irrigation scheduling would be started as soon as possible and for this purpose US$1.0 million would be used from component C of the Project.
(vi) Bids for construction of building at Renala Khurd research center would be invited by May 15, 2015;
(vii) M&E consultants would concentrate on M&E of project impact in addition to other tasks. They would provide baseline data report by June 2015;
(viii) Project Database and Management Information system would be made fully operational by June 2015;
(ix) GoPunjab would send at least 30 specialists from the DGAWM for Master's Degree in HEIS to create a cadre of professionals in HEIS which is required to meet the demands of technical specialists in future in Punjab;
(x) Quarterly Progress report should be shared with Bank on a regular basis.

Annexure-C

Provision of LASER Land Levelers to the Farmers/ Service Providers on Subsidized Cost

Phasing of Physical and Financial Implications

Sr.No.	Particulars	Units	2015-16	2016-17	2017-18	Total	%age
I.	**PHYSICAL**						
A.	**Provision of LASER Units**						
1	Mobilization of Farmers/Service Providers	Nos.	2,000	2,000	2,000	6,000	
2	Provision of LASER Units	Nos.	2,000	2,000	2,000	6,000	
3	Training of LASER Operators	Nos.	2,000	2,000	2,000	6,000	
B.	**Pilot Testing of Irrigation Scheduling**						
1	Demonstration of Moisture Meters on Farms	Nos.	1,400	2,800	2,800	7,000	
2	Training of Farmers	Nos.	1,400	2,800	2,800	7,000	
3	Organization of Farmers' Days	Nos.	14	28	28	70	
II.	**FINANCIAL (Rs. million)**						
	Provision of LASER Units						
	Government Share	0.225	**450.000**	**450.000**	**450.000**	**1,350.000**	

Annexure-D

PROVISION OF LASER LAND LEVELERS TO FARMERS/ SERVICE PROVIDERS ON SUBSIDIZED COST

Economic Analysis

YEARS	P. COST	BENEFITS	NET BENEFITS
2015-16	3062.20	0.00	-3062.20
2016-17	3042.48	773.13	-2269.35
2017-18	3026.84	5777.07	2750.23
	5033.00	8873.50	3840.50
	3000.00	9086.59	6086.59
	3000.00	9129.05	6129.05
	3000.00	9171.05	6171.05
	3000.00	9213.51	6213.51
	3000.00	9255.97	6255.97
	3000.00	9297.97	6297.97
	3000.00	9339.97	6339.97
	3000.00	9339.97	6339.97
	3000.00	9382.43	6382.43
	3000.00	9424.89	6424.89
			0.60
RESULTS OF ECONOMIC ANALYSIS			
		(RS.)	
NPV OF COST =			21,285
NPV OF BENEFITS =			43,511
NPV@12%			22,226
B-C Ratio			2.04
IRR			60%