# On-farm water management practices in Punjab

Water is one of the most valuable resources. The agriculture sector is the largest consumer of water resources in the developing countries. Assured supply of water is necessary for sustainable agriculture. But, farmers of our country are making irrational use of water and, the level of utilization of water at the farmer's field is poor. Though water is a precious and scarce resource, its application and use-efficiencies have been quite low. Most of irrigation projects operate at a low efficiency in the range 30–40%, thereby losing 60–70% of irrigation water during conveyance and application. Also, intensive agriculture and rice–wheat cropping pattern are prevalent in most areas of Punjab, India. Lack of awareness among the farmers about the consequences of inefficient water application, and lack of appropriate tools and instruments for regulated and uniform application of the desired quantity of water at the appropriate time are among the major causes of low water-use efficiency at the field-level. This has ultimately led to a decline of water resources. Immediate steps should be taken for efficient and judicious use of this precious resource, else it will be difficult to sustain agricultural productivity. Farmers' practices need to be critically observed and modified taking into view the perceptions, concerns and constraints of the farmers in adopting better tools and techniques. So, a study was conducted in two villages of Punjab (under the NATP project) during 2002–03 to determine irrigation practices followed by farmers in rice–wheat cropping system, with the objective of identifying the gaps in terms of skills and instrumentation in the existing practices of land preparation, water application, flow regulation, irrigation scheduling and water management practices.

While selecting villages, the main criterion to be kept in mind was that one village should be irrigated only with tubewells and other should fall under canal command area. Thus, village Ramgarh in Patiala District was selected, which is only a tubewell-irrigated area, while the other village Bargari in Faridkot District, falls under the canal command area.

Ramgarh is located at 30°23′N and 76°26′E and falls in block Sanaur of tehsil Patiala. Bargari is located at 30°44′N and 74°45′E and falls in block Kotkapura of tehsil Jaiton.

In both villages, 15 farmers from each village [five each of small (up to 2 ha), medium (from 2 to 5 ha) and large (greater than 5 ha) holdings] were selected.

A preliminary plan for conducting the Participatory Rural Appraisal Survey was developed, keeping in view the field conditions prevailing in Punjab. The meeting with farmers was convened at a common place.

To collect general information and water management practices followed by the selected farmers of the two selected villages, a number of questionnaires were developed. The questionnaire included information about land holding, soil type, topography, family background and status of the selected farmer. It provides detailed information about the source of irrigation, mode of water conveyance, status of farm machinery, cropping pattern followed, sequence of land preparation done, water control and water-measuring devices adopted, irrigation scheduling criteria followed and, practices followed in the application of irrigation water in the field.

For determining the soil type, core samples from 0 to 15 cm depth were taken. The soil analysis was done using the hydrometric method. In Ramgarh village, 50% farmers have land with soil sandy loam, 38% with loamy sand and 12% with loam soil. In Bargari village, 50% of the farmers have land with loam soil, 40% with sandy loam and 10% with other soil types. So, the major soil type in Ramgarh was sandy loam and in Bargari it was loam. The farmers informed us that initially their lands were mostly undulating and they used a tractor-drawn scraper to level the fields. Although farmers had levelled the sand dunes and undulating land, the fields were not precisely levelled to ensure better water-application efficiency and uniform distribution of water.

During kharif season in Ramgarh, 84% of the area of the selected farmers was under rice, 14% under fodder and 2% under other crops and during rabi season, 85% was under wheat, 10% under fodder and 5% under other crops. In Bargari, during kharif 73% of the area was under rice, 12% under fodder, 8% under sugarcane and 7% under cotton and during rabi 80% was under wheat, 10% under fodder, 8% under sugarcane and 2% under other crops. Thus in both the selected villages, maximum area was under rice–wheat cropping system.

In irrigation scheduling, the time (i.e. when) and depth of irrigation water (i.e. how much) are decided. The farmers were asked about the criteria they follow for irrigation scheduling of crops and whether they were aware of the irrigation scheduling recommended for different crops by the Punjab Agricultural University (PAV). It was found that all the selected farmers were following irrigation scheduling based on personal judgment depending upon soil and crop conditions. Only 15% of the farmers were aware about the PAU recommendations regarding irrigation scheduling. Moreover, the farmers expressed apprehension that there is difficulty in following PAU recommendations as electricity and canal water supply were not assured. In the case of wheat, the number of irrigation was 4–7 depending on soil conditions and in case of paddy, irrigation was provided intermittently depending on the availability of electricity and water. Continuous submergence in paddy should be discouraged. Farmers should be encouraged to follow intermittent submergence as recommended by PAU, i.e. 15 days ponding followed by 2 days of drying resulting in 25% saving of water. Also, shifting the date of transplanting of paddy from the first week of May to the third week of June checks the water table decline by 70 cm without any adverse effect on the yield[1]. It has also been recommended that from the maximum rainfall conservation point-of-view, the optimum effective dike height in paddy fields should be 15, 17.5 and 22.5 cm for light, medium and heavy soils respectively[2].

Bed planting of wheat results in irrigation water saving ranging from 18 to 25% compared to conventional tilled wheat[3]. But the main limitations in adoption of this technology were unavailability of bed planter, difficulty in harvesting operation, more weed management and labour requirement.

Data regarding the number of tubewells, types of bore, depth of bore, depth of water table below ground level, depth of

pit, distance of pump from water table, material of suction and delivery pipe, type of bend used on suction and delivery side, height of delivery pipe above ground level, type of pump, source of power, HP and type of drive were measured for Ramgarh and Bargari. In Ramgarh, all the tubewells were of filter-type. The depth of the water table below ground level varied from 15 to 19.5 m and the distance of the water table from the pump was 6.0 m or less. The type of bend used was LRB (long radius bend) or SRB (short radius bend). In Bargari, most of the tubewells are cavity-type. The depth of the water table below ground level ranged from 7.5 to 10 m and the distance of the pump from the water table was up to 7.0 m. The type of bend was LRB or SRB and in some cases also sharp bend. From the survey, it was clear that farmers do not follow the guidelines about proper selection, installation and maintenance of pumping sets for enhancing their operational efficiency. For example, farmers do not follow any guidelines for proper suction head, use of PVC pipes, use of LRBs, height of delivery pipes, etc. The selection of a particular pump depends upon the head and discharge conditions. For medium head and discharge conditions, centrifugal pumps are used. For high head condition where depth of pit requirement becomes greater than 10 m, use of submersible pumps becomes more economical.

Farmers were mainly using earthen channels for water conveyance in both the villages and only one farmer in Ramgarh was using underground pipeline system for conveyance of tubewell water. None of the selected farmers cared about the orientation of the earthen channels. The orientation of the channel should be done in such a way that it follows the shortest route to reach water at all places. Moreover, the same irrigation channel should irrigate fields on both sides.

The seepage losses were calculated by measuring discharges at different locations on the tubewell as well as canal irrigation channels using a digital pygmy meter. It was observed that percentage of seepage loss per 100 m length of channel in Ramgarh was in range 10–28. The high seepage losses in this village can be attributed to the fact that field channels are unlined and the soil type in this village is light-textured. These factors resulted in a large amount of seepage loss through irrigation channels. The seepage losses in Bargari were in the range 5–8%. These were less compared to Ramgarh, as in this village the studies were conducted in the canal water courses which are mostly lined. The losses reported were comparatively large as the channels have become old and with the passage of time they have developed cracks, weed growth, algae formation, etc. Weeds growing along ditch banks also reduce the carrying capacity of the ditches.

Small-holding farmers should be encouraged to install tubewells in the centre of the command area and use foldable hose pipes to convey water. Medium- and large-holding farmers should be encouraged to use lined irrigation channels/under ground pipe line system.

None of the selected farmers was using any water-measuring device. All the selected farmers in both the villages were using only a conventional tool, i.e. spade for water control. The farmers were not aware about the importance and technique of water measurement. A water measurement device should be installed at each tubewell to know the discharge.

Border (kiara) sizes adopted by the selected farmers in the case of wheat as well as paddy crop were measured. There was considerable variation in the plot sizes adopted by the farmers. In Ramgarh, during rabi season, the plot length and width ranged from 25 to 97 m and 6.3 to 15 m respectively. In kharif season, the plot length and width ranged from 25 to 97 m and 5.2 to 12 m respectively. In Bargari, District Faridkot, the length of the plot size varied from 62 to 225 m and width varied from 9.2 to 20 m during rabi season. In kharif season, the length ranged from 56 to 200 m and width from 10 to 33 m. The kiara sizes in both the villages are not based on any hydraulic principles and are kept according to the convenience of the farmers. This can cause low application efficiency and non-uniform distribution of water. The kiara size should be adopted based upon soil type, field slope, stream size, crop, etc.

From the study of two villages, a number of gaps in the existing water management practices have been identified. Rice–wheat was the major cropping sequence in both the villages, and irrigation scheduling of the crops was based on the personal judgment of the farmers. They were unaware of the quantity of water being lost during conveyance from source to field. Seepage losses were found to be 10–28% from unlined channels and about 5–8% from lined channels. It was observed that fields were not precisely levelled to ensure better water-application efficiency and uniform distribution of water. Also, farmers did not follow the guidelines for proper selection, installation and maintenance of pumping sets for enhancing their operational efficiency. Further, the kiara sizes in both the villages were not based on any hydraulic principles and were kept according to the convenience of the farmers. The kiara size should be adopted based upon soil type, field slope, stream size, crop, etc. These gaps result in wastage, low application efficiency and non-uniform distribution of water at the farmers' fields.

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