Centre for Research in Rural and Industrial Development (CRRID)

POLICY BRIEF-2

(August 2015)

Remodeling Water Use in Indian Punjab for Efficiency and Sustainability

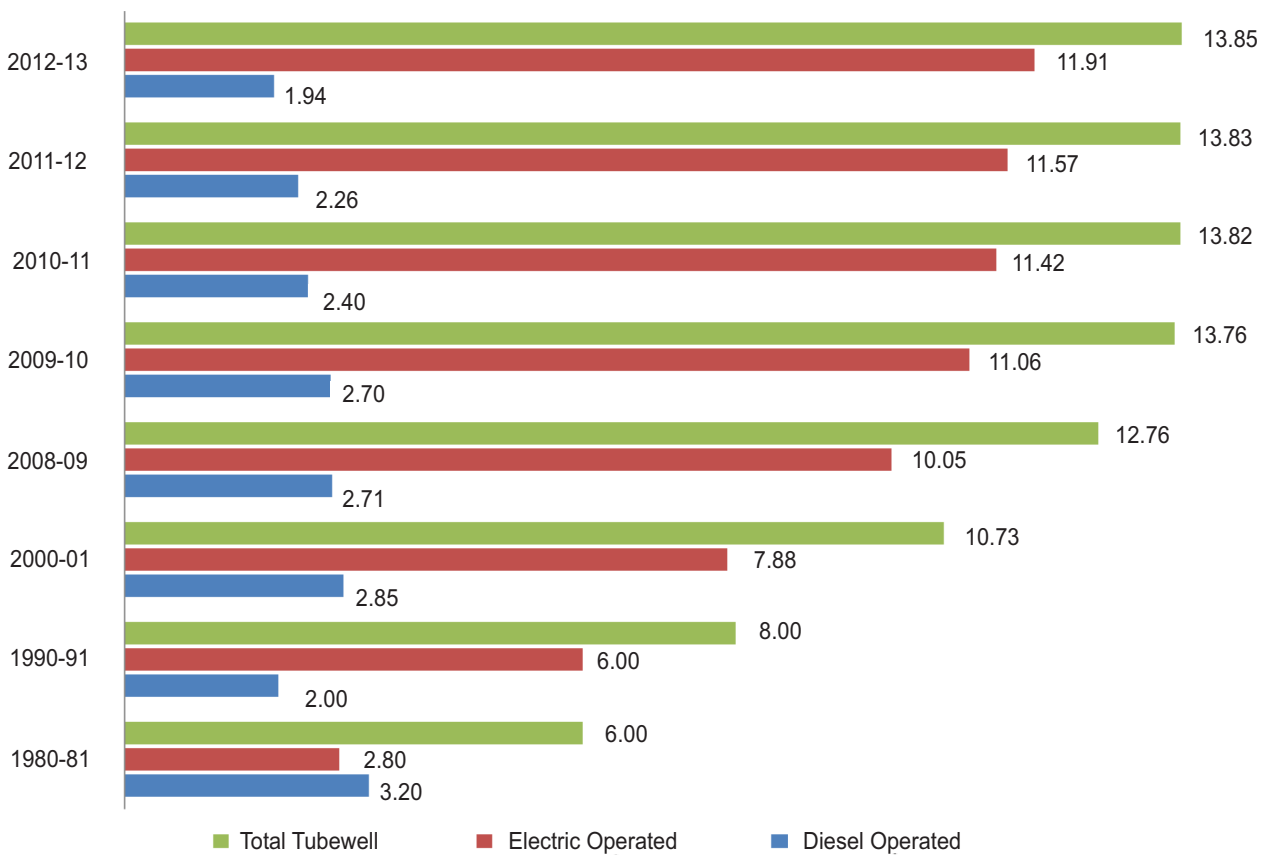
*Jaswinder Singh Brar * and Sucha Singh Gill***

Introduction

Water in all its forms and processes constitutes an integrated natural resource which provides basic sustenance to all forms of life. Punjab being the earlier one to realize Green Revolution has witnessed drastic change in the water scenario. Fast paced economic growth resulted into numerous distortions in water situation like overall availability, general access, equity, efficiency of use, pot ability, distribution across sectors, activities and sharing with neighboring states and territories. The water-intensive agricultural system based on mono-cropping pattern, involving rice-wheat rotation, has completely altered the demand and supply position with adverse implications for water sector. The rising level of urbanization, modernization and industrialization has considerably enhanced the demand for scarce water resources of the state.

Water sector of the state is under serious stress from multiple dimensions. In addition to quality and quantity aspects the economics of water has equally been controversial. It primarily revolves around rising level of power subsidies provided for tube well irrigation. Number of tube wells increased substantially. During 2012-13, the number of tube wells was 13.85 lakh; 11.91 lakh electricity operated and 1.94 lakh diesels (Graph 1). Rising number of tube wells based on submersible technology led to more over-drafting than

Graph 1: Number of Tubewells in Punjab, 1980-81 to 2012-13 (Lakhs)



Source: Statistical Abstract of Punjab, ESO, Chandigarh, 2013

* Professor of Economics, Centre for Research in Economic Change, Department of Economics, Punjabi University, Patiala, Email:brar_jas@yahoo.co.in
** Professor of South Asia, CRRID, Chandigarh, Email: gsuchasingh@gmail.com

recharge; resulting in decline of ground water table particularly in Central Punjab. Ironically, the decline in water table has been accompanied by emergence of water logging in South-West Punjab. It is adversely affecting soil health with accumulation of salts in upper layer of soil. Indications are there about penetration of water from water-logged areas into adjoining sweet water zones. The attempts to solve the problem of water logging by horizontal drainage have met with limited success. The water-logged areas have been facing the problem of flooding during rainy season with questions rising about efficiency of drains. Attempts to draft water along canals through shallow tube wells have not made any noticeable dent on the problem. The state has witnessed considerable activity and contestation related to its water resources. The exact nature, quantum and precise modus operandi of sharing water of state with neighboring state of Haryana, formerly part of state of Punjab, has always been a matter of sharp controversy. Punjab figures prominently in any adjustment of water with neighboring country Pakistan; as both are part of common Indus Water Basin. So, water for Punjab is a sensitive issue with far reaching implications. Indus Water Treaty of 1960 was signed by India and Pakistan in a situation when water scarcity was not that much on the scene. In this treaty, 80.52 per cent of the Indus basin was allocated to Pakistan and 19.48 per cent was allocated to India. Now both the regions have become water stressed and have to seek solutions through improving water use efficiency and sharing of water efficient knowledge, technology and development pattern – with a perspective of give and take.

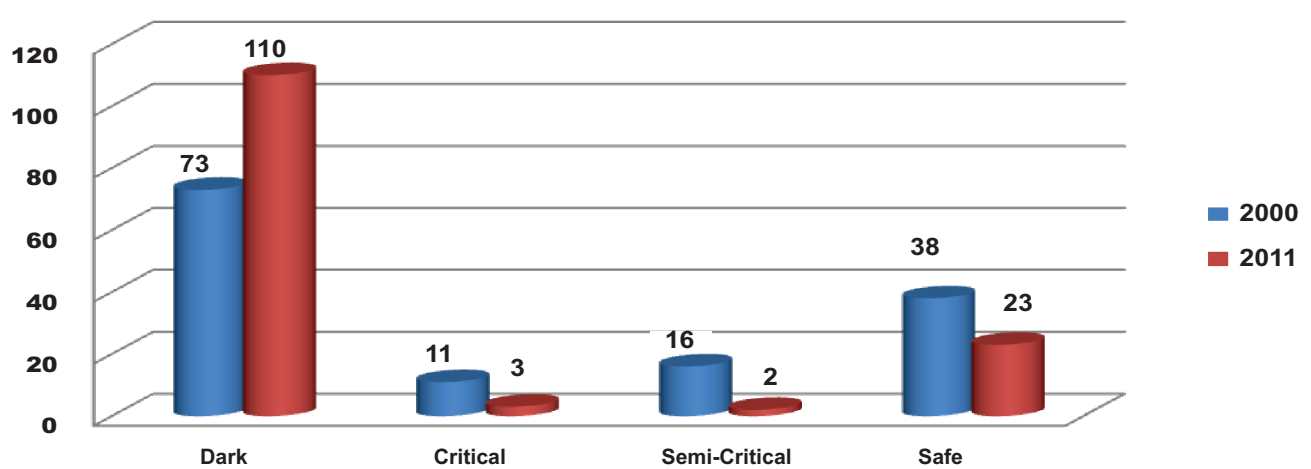
Irrigation Water Profile

Punjab has been depending upon canal and subsoil water for meeting the irrigation requirements. About 83 per cent of land in Punjab is under agriculture as compared to the national average of 40.38 per cent. Three perennial rivers Sutlej, Beas and Ravi flow through the state. In addition, the Ghaggar, which is almost a seasonal river, flows through the South-Western part. Water from these rivers is utilized for irrigation by a network of canals (14,500 kms) like Sirhind canal, Sirhind feeder, Eastern canal, Upper Bari Doab canal, Bhakra canal and Bist Doab canal. The state has about one lakh km of watercourses, providing irrigation to 1.15 million hectares; which is 28.19 per cent of total cultivable area of the State. The state has 86 per cent cropped area and 98 per cent of this is under irrigation that uses nearly 84 per cent of water resources of state: of which rice consumes 34 per cent, wheat 30 per cent and other crops 36 per cent. The water table in the state, with some decadal variations, is falling on an average by about one meter per annum. Fall in water table happens more to be in sweet water zone comprising Central Punjab. Rising crop and irrigation intensity generate tremendous pressure on water resources. Ground water recharging has remained a subdued activity. Amazingly, a land of rivers receiving sufficient rain fall has been experiencing water depletion and stress.

Climate of Punjab is typically sub-tropical with hot summers and cool winters. Average annual rainfall ranges from around 500 mm per annum in the South to more than 1000 mm in the North and North-Eastern sub-mountainous zone. During 2000, out of 138 developmental blocks of the state, 73 blocks were reported to be over-exploited, 11 blocks critical, 16 blocks semi-critical and only 38 blocks in safe category. But, during 2011, the number of over-exploited blocks increased to 110.

Noticeably, the number of safe declined to just 23 blocks. It means the number of over-exploited blocks increased by 37 and that of safe declined by 15 in just about a decade (Graph 2).

Graph 2: Number of Blocks according to Status of Underground Water



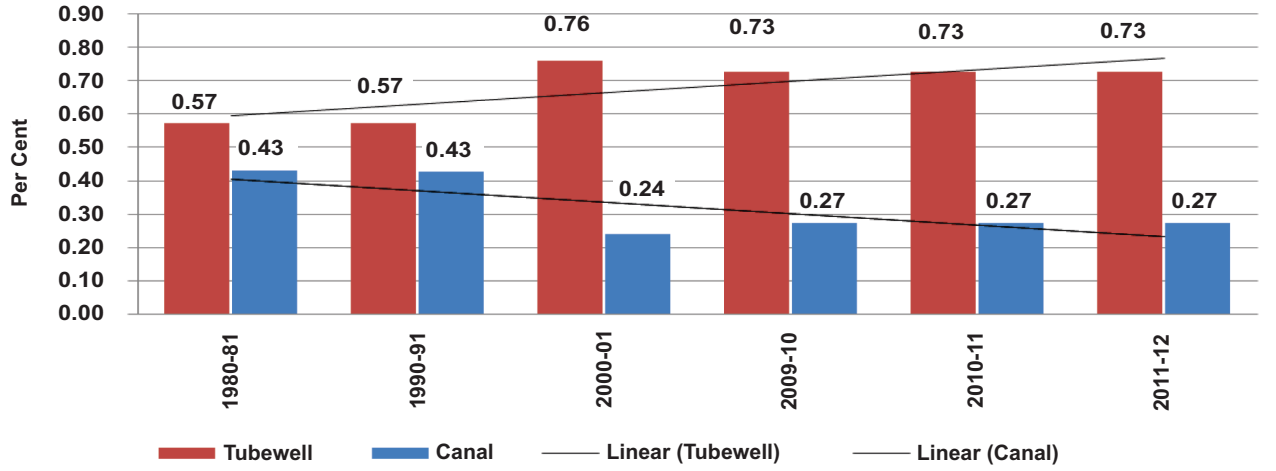
Source: Political Economy of Ground Water in Punjab, R. S. Sidhu, [ihr.ucsc.edu; accessed on 15-5-2015]

The irrigation system has been becoming tube well intensive over period. There is not much change in the situation of availability of surface water resources during last few years.

During 2011-12, the state met its 73 per cent irrigation requirement from tube wells and 27 per cent from canals (Graph 3). Punjab annually faces a deficit in irrigation water

met through over-exploitation of underground water reserves through tube wells. There are apprehensions that if the present trend of water use is allowed for some more years there may be total collapse of system with water tables goes beyond the reach of existing technologies or it may become too costly to draw and use.

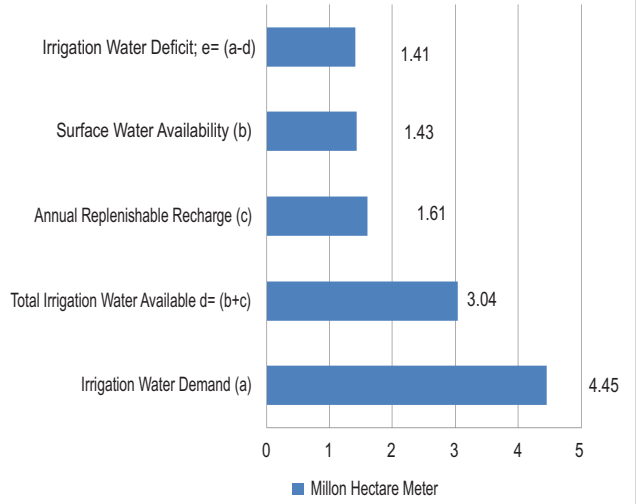
Graph 3: Relative Share of Tubewells and Canals in Irrigation in Punjab



Source: Statistical Abstract of Punjab, ESO, Chandigarh, 2013

availability to the tune of 1.41 mham (million hectare meters). The total demand of water for agricultural, based on prevalent cropping pattern and practices, during 2000-01 was 4.45 mham against the total supply of 3.04 mham. Out of this, surface water availability is 1.43 mham and ground water recharge (rains and canal seepage) provides 1.61 mham (Graph 4). The deficit is

Graph 4 : Water Demand, Availability and Deficite in Punjab



Source: Political Economy of Ground Water in Punjab, R. S. Sidhu, [ihr.ucsc.edu; accessed on 15-5-2015]

Quality Deterioration

The rapidly deteriorating quality of water in the state has emerged an area of great concern. The rising number of cancer affected patients and with it related deaths have shaken the public confidence badly in the quality of water they consume. The quality of ground water in as much as 47 per cent of area fall in the category of marginally fit to unfit (Table 1). The prevalence of various other health ailments particularly jaundices and orthopedic has also raised number of questions about the quality of drinking water. The sample taken by various agencies from different locations such as schools, villages, open fields, over the various intervals failed to meet the safety standards. Reports are also pouring in about the higher content of uranium in sub soil water of the state with debate about the exact source of such contamination. The district wise contaminants are being detailed in Table 2.

The water logged area witnessed installation of water purification systems using RO technology both for community by government bodies and also at household level by residents who can afford. But, maintenance and operation of government owned and operated purification systems has been a ticklish proposition; given the efficiency of government departments. The state also witnessed cleaning of some water rivulets by social activists in the recent past but has again been polluted by nearby industries with collusion of state machinery. The pollution of rivulets and other water bodies is a common scene

in the state. The enforcement of water safety standards particularly upon industries by the regulating bodies has met with limited success as water treatment plants by polluting units are either not installed or remained non-functional. There are reports of injecting of untreated water by many industries into the earth by provisioning of deep bores. The pollution of deep aquifers has raised much hue and cry in the state.

Rural water bodies, which were life line of villages as being reservoir of fresh water, got polluted as disposal water from households of villages has been channelized into such bodies by constructing open channels connecting all households through streets. It results into big problem of stink and unhygienic environment with further loss of life forms in such type of bodies. The problem is more serious for households surrounding to such water bodies being converted into open sewer water ponds. The state has also lost good number of water bodies in rural areas by process of encroachment by influential persons; which led to change in land use and mainly came under construction. The urban civic bodies, because of lack of funds, mal-prioritization and under governance, consisting of corporations and municipalities have not adequately addressed the problem of treatment of sewer from cities. The continuous and ever increased flow of such untreated water has been polluting the nearby rivulets and other water streams. Thus, the water scarcity and its pollution in the state accrue from numerous sources and with rising intensity and coverage and thereby threatening the livelihood of large section of population also.

Table 1: Classification of Area as Per Groundwater Quality, Punjab (2009-14)

	Fit	Marginal	Unfit
Gurdaspur	99.59	00.41	00.00
Amritsar	78.81	21.19	00.00
Tarntaran	25.81	53.78	20.41
Kapurthala	83.09	12.32	04.59
Jalandhar	88.56	10.49	00.95
Hoshiarpur	100.00	00.00	00.00
Nawan Shahr	98.03	01.97	00.00
Ropar	92.84	07.16	00.00
Mohali	76.21	23.79	00.00
Fatehgarh Sahib	73.90	26.10	00.00
Ludhiana	88.66	10.65	00.69
Moga	30.01	46.25	23.74
Faridkok	02.86	37.71	59.43
Firozepur	27.23	24.44	48.33
Muktsar	00.00	04.36	95.64
Bathinda	02.48	30.58	66.94
Barnala	27.66	51.06	21.28
Mansa	04.05	22.99	72.96
Sangrur	33.07	40.34	26.59
Patiala	64.11	27.35	08.54
Overall	53.31	21.92	24.77

Chopra RPS and krishan G (2014): Assessment of Ground Water Quality in Punjab, India, *Earth Science and Climate Challenge*, Vol. 5, Issue 10 (ISSN: 2157-7617).

Prevalent Water Use Practices

The serious imbalance and deficit of water for the purpose of irrigation has been posing formidable policy challenge. The unique situation of coexistence of water-logging (essentially involving brackish water) in one part and depletion of subsoil water (sweet water) in other part requires measured policy responses. Further, a specific equilibrium got entrenched by mutually reinforcing of specific mono-cropping pattern, support prices, assured purchases, free electric power, deep drilling and water drafting technologies. The state in recent past has taken some initiatives to check problems related to various aspects of subsoil water both through price and non-price measures. Attempt has been made to incentivize and de-incentivize the various practices and technologies directly and indirectly connected to irrigation water. Attempts to diversify the cropping pattern away from paddy in particular towards high value crops have not made any noticeable progress. The state has established a new agency namely Punjab State Farmers Commission to provide policy input and devise ways and means to attain agrarian diversification. On the recommendation of Punjab State Farmers Commission an act entitled -The Punjab Preservation of Sub Soil Water Act-2009- was passed in March 2009 which forbids the sowing of paddy nursery before May 10 and its transplantation before June 10. There are also suggestions that the state must stop giving permission and power connection to new tube wells. State Green Tribunal has banned fresh tube well connections in the state. But, it is to be noted that there is still huge demand for new tube well connections in the form of long waiting list. The process of subsidization of various activities involving growing of specific types of vegetables in specific formats involving poly and net houses have also been introduced.

To save water, the method of laser leveling of fields has been promoted by offering subsidy on its purchases as well as making it available through customs hiring from cooperative societies. Many studies indicate that adoption of laser-levelers saves water and also enhances yield by evenly application of water. Similarly, the state has introduced considerable amount of subsidies in case of water-saving techniques of irrigation such as sprinklers and drip systems. Farmers have been laying

the network of underground pipes to transport water across the fields which results in reduced maintenance, evaporation and wastage as compared to open water channels. But, such measures are not adopted in any impactful manner because of non-existence of mechanism to expose and educate farmers about the virtues of emerging technologies. The non-functionality of agricultural extension services compounds the problem. The state has yet to reap the potential of emerging technologies in areas of water saving and conservation.

Best Practices and Initiatives

The state has witnessed the coming up of some activities and ventures in the areas of water saving, conservation and harnessing of water resources exclusively for purpose of irrigation as well rural sanitation and hygiene. Some of these start ups in brief format are as follows:

*** Rural Sanitation, Irrigation and Environment:** This experiment, unique in itself, without any government involvement and much financial support, evolved and got firmly footed in village Chakar (population 8000, agriculture land 5700 acre) (Tehsil Jagraon, Ludhiana). The village has three well functional beautifully designed water treatment plants established by community organizations with NRI financial support, logistics, motivation and involvement; connecting every house with underground sewer pipes. The treatment plants are of varying sizes and do not involve use of machinery and thereby electric or other power. The treated water is supplied to nearby fields for irrigation through underground water pipes. Rain water from village has been channelized and accumulated into three water bodies called lakes with provision of boating. Thus, garbage ponds got converted into beautiful lakes and water treatment sites. The village has been made dirt free by providing proper space for collection of animal dung. About thirty thousand trees have been planted in the village streets with a huge target to increase the number in future. A big sized sport academy has been established which has produced players of national and international repute. Common places have been developed for the sitting and use of village elders. Village is a classic case of rural sanitation, hygiene, decline in use of chemical fertilizers in fields irrigated with treated water, water saving and development, community involvement, reduction in drug abuse and litigation, channelization of youth energy, increase in green cover, check on social evils, strengthening of brotherhood and community feeling, collective approach to common problems, reduction in out migration, linking of second and third generation of NRI to their ancestral villages, change in thinking patterns from individual-centric to social-centric, etc.

*** Sprinkler System, Diversification and Entrepreneurship:** The agrarian entrepreneurship with use of latest water-saving techniques bloomed in the form of growth of crops different from mainstream cropping pattern. It is quite visible in rural land spaces of Hoshiarpur District. Harjinder Singh purchased uneven sandy land during 2010, at a price of Rs. 7.15 lakh per acre, leveled it, installed submersible motor, created network of sprinklers by using flexible pipes, started cultivation of vegetables particularly onions and ground nut, also added poplar around fields, now multiplied land, reaped handsome profits, land price goes up to 23 lakhs per acre, emerged as successful entrepreneur worth emulating. This model stands for substantial saving of water, higher levels of yield, better quality of product, easy management of irrigation system, attracting the younger generations to agriculture, moving away from mono-cropping pattern, reduction in cost of cultivation by less use of irrigation related labour, etc.

*** Use of Check Dam Water for Irrigation:** The supplying of water from Dholbaha (Block Bhunga; Tehsil Dasuha; District Hoshiarpur) Check Dam through the system of piping instead of open water courses has enhanced the efficiency of water use and supply. It involves lesser amount of investment and more life span of projects as pipes from material other than iron has come up in a big way; which are non-rustic and not degradable. Such practices can be tried in case of other such dams and also from water bodies.

*** Drip Irrigation for Orchard:** The drip irrigation proved very successful in case of supply of water to trees in particular. In Ramtattwali and other villages surrounding the Dholbaha Dam (Tehsil: Dasuya; District: Hoshiarpur) many farmers started growing orchard of Kinnow and Mango by applying drip irrigation technology. The orchard planters have been given subsidy on drip irrigation and other associated

Table 2: Ground Water Quality Problems in Punjab, October 2010

Contaminants	Districts Affected (in part)
Salinity (EC>3000µS/cm at 25ºC)	Firozepur, Faridkot, Bathinda, Mansa, Muktsar, Sangrur
Flouride (>1.5 mg/l)	Amritsar, Bathinda, Faridkot, Fategarh Sahib, Firozepur, Gurdaspur, Mansa, Moga, Muktsar, Patiala, Sangrur
Chloride (>1000mg/l)	Firozepur, Muktsar
Iron (>1.0mg/l)	Bathinda, Faridkot, Fategarh Sahib, Firozepur, Gurdaspur, Hoshiarpur, Mansa, Rupnagar, Sangrur

Source: Rajni Sharma, *International Journal of Engineering Research and Application*, Vol. 4, Issue 12, December 2014, Pp. 70-77. (ISSN: 2248-9622). [Downloaded from www.ijera.com; 12-5-2015]

implements. The plants recorded higher growth and demonstrated better health getting water by drip system. Farmers reported better fruit quality, better demand, high prices and overall returns.

Policy Recommendations

Certain things are crystal clear related to emergent water scenario of state like high degree of stress in the domain of quantity-cum-quality along with serious mismatch between demand and supply. The prevalent practices related to water supply, water use, management, distribution, irrigation practices, and pricing have adverse implications both for farmers and state economy. Water deficit is the direct result of open flooding of fields, rise in paddy cultivation, distorted incentive pattern, neglect of recharging, less emphasis of water saving, lethargic state apparatus, erosion of extension activity etc. The following policy measures are required:

- Water use practices need to be remodeled with right policy mix based on price and non-price interventions. Farmers of state are always at the forefront so far an adoption of new technologies is concerned. Farmers have given good response to laser leveling and zero-tillage, etc. Similarly, farmers can adopt in a big way other water saving techniques once they got convinced about benefits of such technologies. For this, government must launch a vigorous campaign by the use of electronic and print media by stating the virtues of such techniques.
- Pro-active state and non-state agencies in the form of various types of organizations at village and community level can create the necessary base for adoption of water-saving techniques and methods. The state has not so far realized the tremendous potential inherent in various types of micro-irrigation techniques like drip, sprinklers, use of underground water pipes, etc.
- The state must prepare a time bound plan to bring a specific proportion of area every year under micro-irrigation by creating a dedicated fund for the purpose. For this purpose, a few blocks in Central Punjab, where water is depleting at a faster rate, can be selected for launch of micro-irrigation project in a big way to be ultimately created as model blocks of micro-irrigation along with crop diversification.
- The water bodies need to be revived and developed by also giving sufficient attention to village ponds. The need is to create more water bodies in towns, cities, urban areas and municipality where such bodies do not exist or in dilapidated condition.
- All sources of water pollution-industry, municipalities and households-be plugged by creating reliable water treatment plants. The open pollution being daily going into the rivulets and other water channels must be stopped.
- The water-intensive crops should be discouraged by promoting alternative crops by using price and non-price incentives and interventions. Alternative crops must be promoted by providing MSP and procurement facility to water saving crops like pulses, soybean, maize, oil seeds, etc.
- The efforts of NRIs, voluntary bodies and other philanthropists be recognized and channelized towards improving the water sector of state. Such persons may be encouraged to adopt the water bodies for their development and maintenance under suitable policy framework.
- Some amount of water called 'environment flow' must be maintained in Sutlej and Ghaggar rivers throughout the year in order to recharge the subsoil water and enhance marine life.
- The trans-plantation of paddy before the cutoff date must be strictly stopped by adoption of proper surveillance system and fixing of responsibility of concerned officials.
- Sharing of knowledge of best practices within the state and outside (including across boundary region of Pakistan) can go a long way to improve water use efficiency and help in water conservation.

This document has been produced by Centre for Research in Rural and Industrial Development (CRRID) with the financial assistance from CUTS International, Jaipur under the project entitled Sustainable Development Investment Portfolio (SDIP) funded by Department of Foreign Affairs and Trade (DFAT), Government of Australia. The views expressed here are those of authors and can therefore in no way be taken to reflect the position of CUTS International or DFAT or CRRID.

Centre for Research in Rural and Industrial Development (CRRID)
Sector 19-A, Madhya Marg, Chandigarh (India)