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IRRIGATION SYSTEM IN PUNJAB: A COMPARATIVE STUDY OF LAST 20 YEARS

[1] Manpreet Singh, [2] Dr. Megha Dhiman

[1]Research Scholar, [2]Assistant Professor

[1]Department of Political Science

[1] RIMT University (Punjab), Malerkotla, India.

Abstract

Punjab has fulfil the need of food in the country. Irrigation system in Punjab is so expensive for his environment. Punjab has utilized a huge amount of water for his irrigation purposes especially for paddy crops that consume high quantity of water compare then other crops. That is why depth to water in the state has been increasing day by day and facing serious problem of water scarcity. It is a model directed by egalitarian political choices than sound financial matters. Simultaneously, the model has given the genuinely necessary food security to the nation however has raised serious biological and natural worries. Now time has to come think about seriously for irrigation system of the state and make good strategies and policies and water should be saved for our upcoming generations. This paper will explore available water resources for irrigation purposes in the state.

***Keywords*- Punjab, Irrigation, System, Water Resources.**

I. INTRODUCTION

World over the water system has gained a rising significance in farming. From only 8 million hectares (M Ha) in 1800, watered region across the world expanded fivefold to 40 M Ha (13.4 M Ha in India) in 1900, to 100 M Ha in 1950 and to a little more than 255 M Ha in 1995; with close to one fifth of that area (50.1 M Ha net flooded region), India has the most elevated inundated land in this present reality (Postel, 1999). India's water system improvement in this really long period, and especially after freedom, has seen number of huge stockpiling based frameworks, all planned and kept up with by the public authority exertion and cash. In the English period, a couple of capacity structures were fabricated exclusively in the start of this long time and the post freedom India, nonetheless, has seen in excess of 60% of water system spending plans going for major and medium ventures (Thakkar, 1999). Enormous scope water system is inseparable from trench water system in India and channel water system is an exorbitant suggestion, all the more so when given under the aegis of grave shortcomings in project execution and channel activity (Dhawan, 1997). Punjab is a silo territory of India and its feedback yield framework is vigorously one-sided for farming (Singh and Singh, 2011). Punjab model of water system is portrayed by abundance interest for water for water system combined with unconstrained digging of groundwater for meeting the food bowl prerequisites of the country. The paper, covering the advancement of the framework, assesses the presentation and portrays the strategy choices for what's to come.

II. BACKGROUND OF THE STUDY

Punjab is located in the north-western part of India. It covers the area from 73° 55' East longitude to 29° 30' North latitude. Its east and west are around 300 km apart, while its north and south are about 335 km apart. Pakistan and Punjab share a boundary in the west. Punjab is bordered to the north by Jammu and Kashmir, to the east by Himachal Pradesh, and to the south by Haryana and Rajasthan. Punjab is the western portion of India's Northern Plains, often known as the Satluj-Ganga plains. Punjab is one of the small states in India having an area of 50,362 sq. km, with 23 districts and 141 blocks including newly formed district Malerkotla. Punjab is 18th largest state of the country. The environment of the State is semi-moist and semi-bone-dry. The precipitation diminishes logically from 125 cm in Upper east to around 30 cm in Southwest (Ferozepur). The State has an obvious blustery period in summer from July to September and a long drought further comes down on man-made water system frameworks. The ground water level differs from practically close to surface to around 65m beneath the ground level. The profound water levels are kept in the Kandi belt and water logging conditions exist in certain pieces of South-Western regions. Punjab has witnessed 62% growth in population in the last fifty years. As per 2011 census, there are 12673 inhabited villages and 157 towns in Punjab State. The total population of the State is 27704236 (2011) constituting 2.29% of the total population of the country. 62.51% people live in the rural area and 37.49% live in urban localities. Punjab's economy is based mostly on agriculture, which has grown to its maximum level of output using the state's natural resources. The state's agro-ecosystem is particularly fragile in terms of water depletion, soil quality, weeds and pests, human

health, and the general living environment due to the substantial crop pattern changes caused by agricultural practises throughout time. Large dams and extensive canal networks were built on Punjab State's major rivers, which significantly reduced flood episodes and halted the inflow of fresh soil and nutrients from the catchment region, reducing soil fertility. Punjab is mainly composed of flat alluvial plains, with sand dunes in the southwest and fluvial carvings and deposits of the three rivers the Ravi, Beas, and Satluj that run through the centre of the province on the Shivalik hills in the north. It has some trees, a lot of water, and rich soil, but it has very little earth resources (mines, fossil fuels). The State's primary industry is agriculture. However, there has been substantial worry raised recently that both land and water resources have been overexploited as a result of the growth in population and other economic activity. while their conservation has been slow and inadequate, so much so that there is fear that both land and water may become inadequate to support future development activities. Assured irrigation system was the major input to build capacity and to adopt the new technology. Between 1965-66 & 1970-71 the per hectare yield of wheat doubled from 1104 kg to 2238 kg perhectare. Besides the southern sections of Punjab, the state started to follow a wheat-paddy rotation pattern in cropping in the mid-1980s, and as a result, Punjab became the country's food bowl.

It became the greatest provider to the government procurement pool of food grains, enabling India to become self- sufficient in the foodgrains.Punjab has a vast network of irrigation systems. Irrigation is carried out using both surface and ground water sources. Its ri vers' surface water contribution is restricted to 14.54 MAF, with the remainder supplied by groundwater. Furthermore, data referring t o excess Ravi-Beas waters from 1981 to 2002 indicate that the mean flow has been lowered to 14.37 MAF rather than 17.17 MAF as evaluated based on flow records 1921-60.

The state's average annual rainfall has similarly declined by 45% over the previous two decades, from 755 mm in 1990 to 418 mm in 2 006. Various reports have also showed that the snow cover/glacier in the state's river catchment area is declining due to global warming. According to several reports, the snow cover/glacier in the State's river catchment region is also falling as a result of global warming. As a result, surface run-off has decreased, and this, along with river canalization and fewer floods, has reduced natural recharge to ground water resources, placing pressure on groundwater to meet agricultural needs (Takshi & Chopra, 2010).

The net area irrigated to gross area sown has increased from 71% during 1970-71 to 97.4% during 2008-09 (Fig: 1.1).

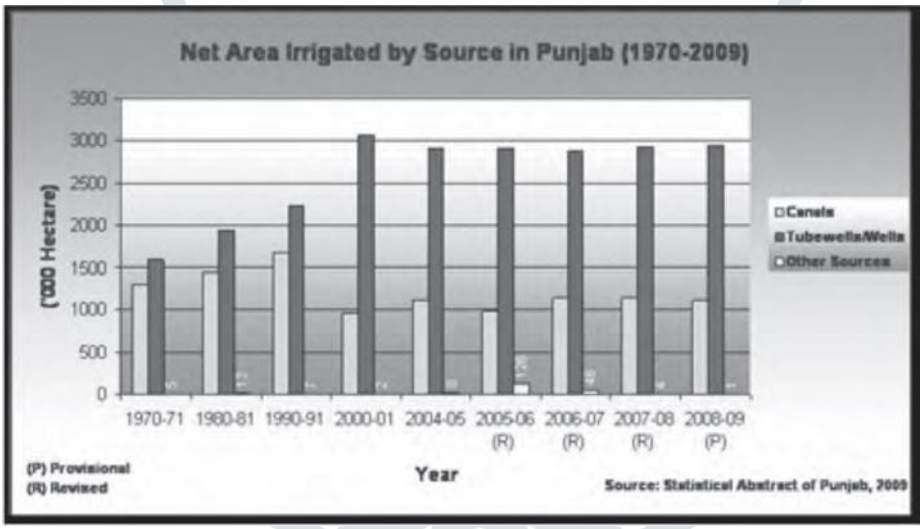


Fig: 1.1 Net irrigated area by different sources.

The potential for addressing the supply side of water is restricted, and the main scope is for regulating the demand side of water. The state has shifted from a formerly diverse agricultural mix of wheat, maize, pulses, and vegetables to dedicating over 80 percent of its crop area to rice and wheat, two of the most water-intensive commodities. Overall, central and state level agriculture policy, including minimum support prices, effective procurement of selected crops, input subsidies benefiting farmers in electricity, fertiliser, and irrigation, and increased availability of credit facilities, has played a key role in pushing farmers to grow primarily wheat and rice, to the detriment of the country's water resource sustainability. In comparison to other Kharif crops, rice has been the most profitable. As seen in table (1.2), it is also the most water-intensive crop, requiring around 24000 cubic metres of water per hectare, which is almost six times that of maize, nearly 20 times that of groundnut, and approximately ten times that of pulses. There is an urgent need at this time to modify the state's cropping mix in order to safeguard valuable water resources.

Table 1.2: Water requirements of different crops in Punjab, India

Crop	Water requirements (Cub m per ha)	Electric Motor (hrs per ha)
Paddy	24181	290
Wheat	5504	60

Maize	5474	50
Barley	4486	35
Kharif Pulses	2355	35
Gram	2243	30
Rabi Pulses	2187	30
Groundnut	1123	35

Source: Karam Singh and K.K. Jain (2002)

III. DEVELOPMENT OF CANALS: POST- INDEPENDENCE ERA

During the post-independence era, a number of multifunctional schemes were planned along the Sutlej, Beas, and Ravi rivers. In order to better utilise the stored water for irrigation, dams, and reservoirs, Punjab has begun a signific ant expansion of irrigation infrastructure by building a new network of canals and modifying old canals. A brief account of major canal infrastructure is presented in table 1. 3 Post independence network of canal covers the entire Punjab evenly.

Table 1.3 Details of canal infrastructure after independence

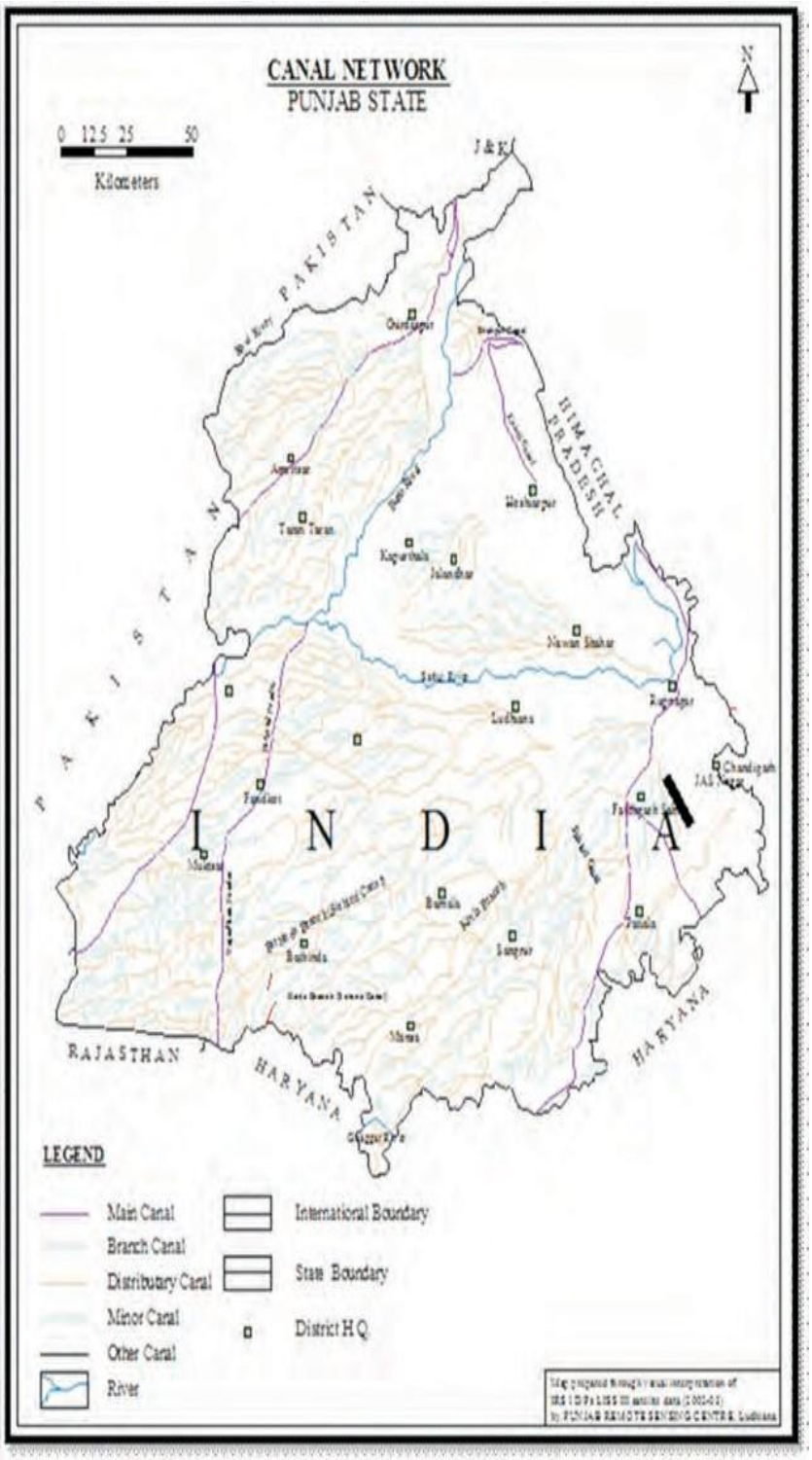
Sr. No.	Project Name	Year	River	Location
1.	Bhakra Dam	1963	Satlej	Bhakra (H.P)
2.	Nangal Dam	1948	Satlej	Downstream (Bhakra Dam)
3.	Nangal Hydel Channel	1954	Satlej	Nangal Dam
4.	Bhakra Main Line Canal	1950-54	Satlej	Extension of Nangal Hydel Channel
5.	Old Sirhind Canal System	1952-54	Satlej	Ropar Headworks
6.	Harike Headwork	1954-55	Satlej-Beas	Harike
7.	Madhopur Beas link	1955-57	Beas-Satlej	Madhopur
8.	Rajasthan canal	1958-1961	Satlej-Beas	Harike Headworks
9.	Ferozepur Feeder	1952-53	Ravi-Beas	Harike Headwork
10.	Pong Dam	1974	Beas	Pong
11.	Beas Sutlej Link	1977	Beas-Satlej	Pandoh (H.P.)
12.	Shanehar Headwork	1983	Beas	Downstream of Pong Dam.
13.	Mukerian Hydel Channel	1982	Beas	Shanehar Headwork
14	Ranjit Sagar Dam	2000	Ravi	Upstream of Madhopur Headworks
15	Shahpur Kandi dam	2006-07	Ravi	Downstream of Ranjit Sagar Dam

Source: Govt. of Punjab, Punjab Irrigation Department

IV. SURFACE WATER RESOURCES FOR IRRIGATION IN PUNJAB

Since prehistoric times, irrigation has been utilised in Punjab. The Persian Wheel gained popularity in the 13th century, and the 'Shah Nahar' was built in the 17th century, bringing irrigation benefits to the Majha and Bist Doab districts. Upper Bari Doab Canal (UBDC) was completed in 1859, and the Sirhind Canal System was completed in 1884. As a result, the so-called forests became Punjab's most fruitful locations. These canal colonies held the world's most extensive irrigation system, and they swiftly became India's primary granaries because canal irrigation improved production reliability and increased average output dramatically. Furthermore, it allows farmers to plant more valuable crops that would otherwise be difficult to grow on unirrigated land. During the post-independence period, the state steadily extended canal irrigation. The Bhakra Canal System was built between 1948 and 1963, and by 1966, the net-sown area irrigated in Punjab had increased to 54%, compared to the national average of 19.5%. Out of this, 57.8% was canal-irrigated, 41% by wells/tubewells, and 2.7% by ponds, rivers, and Persian wells. The state has a vast and completely constructed network of planned irrigation system comprising of approximately 14,500 kms of canal / distributaries / minors and approximately 1,00,000 kms of water courses, which provides guaranteed irrigation to approximately 16 lac Ha. However, the area watered by government canals has decreased over time, from 12,860 sq km in 1970-71 to 11100 sq km in 2008-09. Thus, presently the surface water resources cover only 29% of the total irrigated area of the State. Most of the canals were constructed/upgraded after independence and/or reorganization of the State (figure 1.4).

Fig: 1.4



The primary canals originating from the Satluj River are the Anandpur Hydel Channel and the Bhakhra Main Line (BML). BML is further divided into the Narwana branch and the Bhakhra main branch. At Ropar, two major canals, Sirhind canal and Bist Doab canal, emerge. Satluj provides water to the Rajasthan feeder canal and the Ferozepur feeder canal near Harike. The Bikaner canal (Gang Canal) begins in Hussainiwala, while the Shah Nehar or MukerianHydel Channel begins at the Shah Nehar Barrage. Upper Bari Doab Canal is the main irrigation canal that runs from Ravi to Madhopur (UBDC). The overall length of canals and distributaries (including minor distributaries) is around 14,500 kilometers. The maximum capacity of the Rajasthan feeder canal is 18,500 Cusecs. . Detailed capacity of various canals is given in the fig. 1.5. Sirhind canal system has the maximum Culturable Command Area of 1.36 million ha.

Table 1.5 Main Canals In Punjab

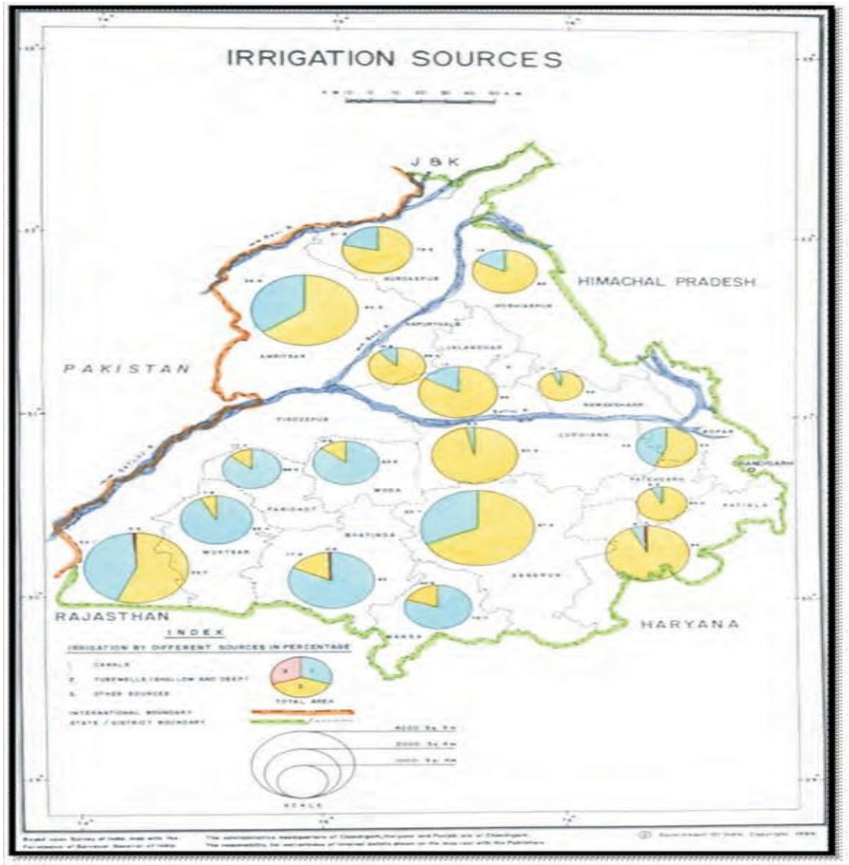
S.No	Name of Canal	Discharge in Cusecs	Length in Km
1	Sirhind Canal	12622	59.44
2	Nangal Hydel Channels	14500	20.12
3	Combind Branch	7635	3.22
4	Sidhwan Branch	1751	88.01
5	Abohar Branch	3029	109.75
6	Bathinda Branch	2890	152.40
7	Ferozepur Feeder	10192	51.42
8	Sirhind Feeder	5264	136.53
9	Rajasthan Feeder	18500	149.43
10	Abohar Branch Lower	1692.50	46.37
10	Bikaner Canal	*2720/3027*	102.01
12	Eastern Canal	3929	8.02

Total C.C.A 30.88 lacs Hectare Source: Department of Irrigation, Punjab

V. GROUND WATER RESOURCES FOR IRRIGATION IN PUNJAB

Tubewell irrigation is a relatively new method in Punjab, and, unlike canal irrigation, its growth was driven by individual farmers' initiative and vision. Prior to 1960, nearly one-third of all irrigation was provided by open wells and tubewells. Ground water irrigation is generally performed in the state using shallow and deep tube wells. Farmers own small tube wells with depths ranging from 50 to 100 metres, but the State Government constructs deep tube wells with depths ranging from 50 to 300 metres for direct irrigation and drinking. There are presently 12.32 million tubewells (MI Census, 2001), up from 1.92 million in 1970-71, and around 75% of total tubewells are driven by electric motors, with the remaining powered by diesel engines. As a result, from 1970-71 to 2006-09, the proportion of net area irrigated to net area planted grew considerably, from 71 to 97.4%. During this time, groundwater irrigation using tubewells increased from 55% to 73% of total irrigated area.

Fig: 2.1



Fig; 2.1 depicts several irrigation sources in Punjab.

There is a substantial increase in number of tube wells in the State since 1970 as presented inTable 2.2.

Table: 2.2 Status of Tube Wells in Punjab (1970-2009)

Year	Diesel Operated	Electric Operated	Total (Lakhs)
1970-1971	1.01	0.91	1.92
1980-1981	3.20	2.80	6.00
1990-1991	2.00	6.00	8.00
1997-1998	1.75	7.35	9.10
1998-1999	1.70	7.45	9.15
1999-2000	1.70	7.55	9.25
2001-2002	2.85	7.88	10.73
2003-2004	2.88	8.56	11.44
2004-2005	2.88	8.80	11.68
2005-2006	2.88	9.05	11.93
2006-2007(P)	2.80	9.52	12.32
2007-08	2.75	9.71	12.46
2008-09 (P)	2.80	9.96	12.76

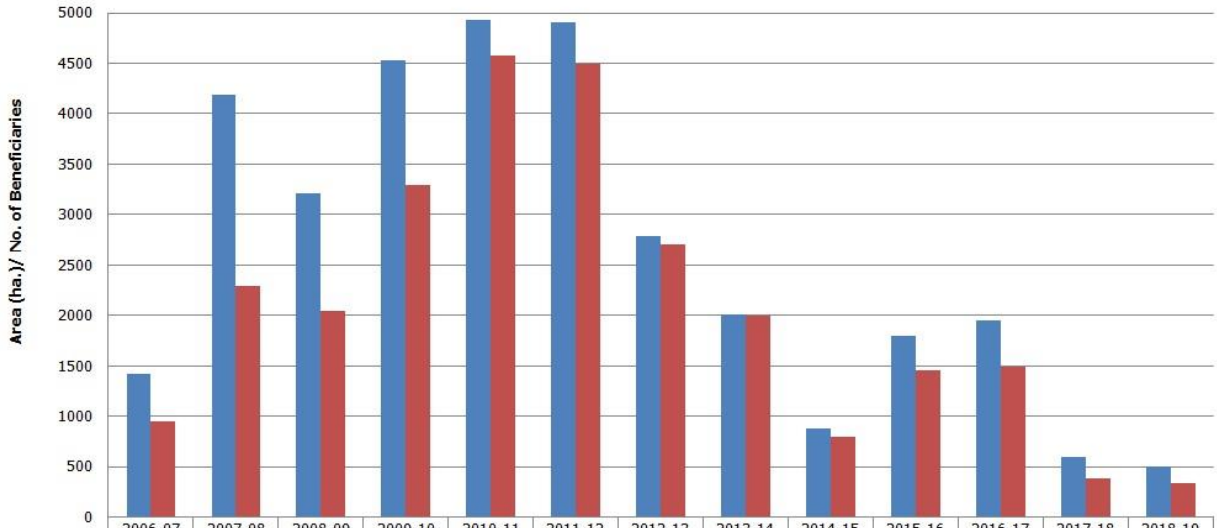
Source: Director of Land Records, Punjab as cited in Statistical Abstract of Punjab, 2009.

In Punjab, it is critical to advance Miniature Water system frameworks which give water system proficiency as high as 80%-90% if there should arise an occurrence of Trickle water system and 60%-70% in the event of Sprinkler water system in correlation of typical

water system effectiveness of 30%-40%.Punjab Government has been giving all out help @ 80% of real market cost of Miniature Water system to ranchers. Extra top-up sponsorship far beyond PMKSY has been given out of 'Task to Advancement of Miniature Water system (NABARD-RIDF-20)'. Extra 10% endowment is likewise given to Ladies, Little/Minor and SC ranchers. There is no most extreme roof of region and extra appropriation trouble is met out of RIDF-20 task. MI frameworks incorporate Dribble and Sprinklers. Sprinklers Water system Frameworks cover Miniature Sprinklers, Smaller than usual Sprinkler, Compact Sprinklers, Semi-super durable Sprinklers and Huge Volume Sprinklers (Downpour Weapons) on a wide range of Cultivation and Horticulture crops. Extraordinary accentuation is being given on advancement of Downpour Firearms for development of DSR Paddy in regions following Rice-Wheat Cycle.

Department of Soil and Water Conservation, Punjab

Year-Wise Physical Progress of Micro Irrigation in Punjab State



	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Area (in hectares)	1423	4187	3209	4528	4925	4909	2790	2008	874	1799	1951	600	507
No. of Beneficiaries	954	2296	2041	3289	4577	4495	2707	2000	791	1452	1486	379	337

VI. PUNJAB CANAL IRRIGATION: INSTITUTIONAL REFORM

While trying to foster Punjab as a storehouse of the country, gigantic trench water system network came in to presence exclusively with the public authority exertion. This elaborate different offices connecting with water system, power and others. At first, this multitude of divisions arose as large open area divisions that aided in effective creation, activity and the board of the framework. There was an adequate independence in the activity and the executives of these divisions. This gave the water system offices as well as bountiful power and aided in controlling floods in the district. Throughout some undefined time frame, water system related institutional arrangement weakened precisely in consonance with other public area associations. In the institutional developmental course of State of Punjab, two occasions have been liable for going about as an impetus in making this crumbling to be quick and gigantic. First has been the between state water sharing debate and different has been the free water and free power for water system. Highway water sharing (the SYL line), turned into a political and strict issue as opposed to a financial issue. It wrecked the State in the 10 years of eighties and nineties. A prosperous State, with most noteworthy per capita pay, got changed over into a landmark of fundamentalism and psychological warfare. This affected both speculation and cost recuperation in every one of the frameworks. Second has been the nearsighted political vision and fast buck political methodology that brought about financed diesel, free water and power for water system. This prompted all out disregard of the channel framework and savage mining of the groundwater. Ongoing presentation of water charges in 2018 for channel water system is trivial within the sight of sponsored diesel and free power for tube-well activity. In this progress, the framework has supported a class of water clients who are absolutely ignorant about the shortage of water asset. The condition has been additionally disintegrated by the State upheld cost instrument for weighty water polishing off crops: rice and wheat. Presently, more than monetary, it has turned into a policy driven issue for progressive states; it is challenging to pull out the freebees and present enhancement by breaking the wheat-rice revolution. Water clients in farming have no inspiration and backing component to think for water saving yields. The advancement is demonstrative of the way that water system institutional component fostered the agribusiness in the district and gave the food security to the country. Yet, political contemplations with silly vision have parallelized the institutional set up. State is far beneath the most elite that anyone could hope to find in India, what to discuss worldwide examinations. Taking everything into account, these have been controlled, kept up with and worked by the public authority.

Disregarding monstrous interest in waterway water system arrangement of the express, the result has not been empowering. In the Indian viewpoint, accentuation has been on development of new ventures as opposed to effective administration, activity and upkeep of existing water system frameworks (Mitra, 1992). The horrible showing of trench water system of Punjab might be ascribed to low efficiency of flooded, low profit from venture due to free/low cost of water system water, unfortunate water appropriation particularly to last part clients and underutilization of water system potential. Keeping in view above issues it is of foremost significance and need

of the time that channel water system changes should be started in Punjab as soon as could be expected. Changes might be in line with worldwide viewpoint in which the trench water system framework changes has been headed to destroy state imposing business model and control; as open area associations wretchedly neglected to keep up with and productively work water system activities and move these to water clients, water client affiliations, pachanyati raj foundations and different partners.

VII. CONCLUTION

Agriculture is a main source of income in Punjab, it has also play a major role in providing employment in the villages. High yielding cash crops and expansion of economic activities has led to increasing demand of water for diverse purposes, causing a great stress on available water resources in the State. Punjab is depend mainly on two water resources for irrigation purposes such as surface water and ground water. For surface water irrigation it depends on his canals system including Sirhind canal, Bist Doab canal, makhu canal, Bakhara canal, kasmir canali, shanehar canal, and kandi canal. In order to ground water it depends on tubewells, there are near about 12.75 lakhs tubewells in the State. Paddy crops have consumed much water for irrigation and a major cause for groundwater depilation in Punjab. Depth to water level has been increasing day by day in the state. CGWB has warned, if the current trend continues; Punjab will become a desert in the next 25 years. The state's irrigation projects are completely neglected. Poor recovery of operational expenditures leaves few resources for system repair and maintenance. The main factor is a lack of resource mobilisation and the state's incapacity to produce matching funding for central aid. At the surface level, supply, demand, and financial analyses demonstrate that significant capital and running expenditures have been made on the State's irrigation infrastructure, and providing free energy and water for irrigation has been a poor economics.

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