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Water Resource Management in Sindh: Fundamental Problems and Policy Guideline

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Abstract:

Having greater potential to produce food and fiber for its growing population, the Sindh province of Pakistan is facing dual crises in its water sector such as; declining water resources for irrigation which creates drought situation since 2000-2001 and the super floods in the year 2010 and 2011 in both northern and southern regions. About 89% of cropped area in the province is irrigated through canal system, the infrastructure damage and deprivation of cultivable land with standing water caused by these floods mainly due to institutional mismanagement has resulted in multi billion rupees loss to the agricultural sector with a significant decline in its growth. On the other hand, an inadequacy in the supply of irrigation water and its inefficient use forms a bottleneck on achievement of the desired results from complementary inputs.

The paper aims to sort out fundamental problems in managing the irrigation water in the province, and to formulate a policy guideline for batter use of the natural resources in the agricultural economy of Sindh. The study explores the significance of a largely mismanaged canal irrigation system of the province and suggests modern tools and methods of managing the available resources. It also recommends some alternative water conservation strategies such as; use of under table water through tube wells, storage of rain water through construction of small dames and lining of natural ponds in arid zones of the province. These measures can lead to overcome the supply and demand side issues to some extent, necessary for sustainability of the process of agric-development in the region.

Key words: *Canal irrigation; Tube well, Rain water, Agriculture growth, Drip irrigation, MAF (Million Acre feet).*

1.Back Ground

The importance of irrigation system in the development of agriculture sector and consequently to the whole economy can not be overemphasized and needs urgent and undivided attention of the policy makers. An adequate supply of increased water is instrumental in enhancing crop yields. It has been observed with a great concern that since the green revolution period, much of the increase in agriculture production has been possible due to investment in the irrigation system. "Pakistan's agriculture is mainly dependent on irrigation which accounts for 76 % of the total irrigated land in Pakistan against 25 % in India and 35 % in Indonesia. The area of irrigated land has increased in Pakistan from 12.5 million hectares in early 60s to nearly 17 million hectors in 2002-3" (Dr Syed Manzoor, 2006, pp.7).

In Sindh province, water is among unique natural resources. The conservation and management of water supply is crucial as the demand for water continues to rise with special reference to canal water of the River Indus. The water provided through River Indus plays a key role in the agricultural economy of Sindh but, its supply, distribution and use is inadequate, mismanaged and very inefficient, rather wasteful. In the past history of agriculture sector growth, the shortage of irrigation water has dealt a serious blow to estimate growth of Sindh agriculture sector in particular and economic growth of the country in general." The water shortage scenario in Pakistan is further aggravated with high variability of rainfall. The on set of climate change and global warming is likely to severely affect the availability of water (Economic Survey of Pakistan 2011, pp.13-34).

Analyzing the recent historical trends of water crisis in Sindh, we find that in 2000-2001, an unprecedented severe drought and shortage of irrigation water to the extent of 40% eventually caused a 3 % decline as compared to its impressive 5.1% previous growth. The drought phenomenon (dry year) is said to occur in 4 out of 10 years, instead of 3 out of 10. The effect of the continued low rainfalls in most areas of Sindh for the last ten years and old manual method of water collection form ponds and lakes have resulted in low river flows and drought conditions. The severe/long drought-conditions have affected crops, livestock and humans. The rough estimates show that between July 1999 to July 2000 alone, 143 humans and 2.5 million livestock lost their lives, let alone crop loss and other economic losses i.e. migration of masses and animals towards urban centers. The loss has been more pronounced in the arid area of Sindh. In addition, increased incidence of malnutrition, diarrhea, respiratory infections, measles, malaria,

school drop-outs, and permanent dislocation of families have been observed. The drought has also been responsible for sea water intrusion in deltaic areas, migration of cattle due to worsening state of range and wetlands, and depletion and deterioration of groundwater reservoirs. The effect on agricultural crops has been tremendous; the total loss is estimated to be about Rs.15 billion per year including the total loss of crops in more than 1 million acres of Barani (rain-fed) areas in Sindh province only.

On the other side in 2010 and 2011 supper flood severally affected Country's economy particularly of Sindh province and caused a decline of agricultural growth to 1.4% from previously 4.5%. Supper flood of Indus river in 2010 which destroyed 08 district of upper/northern Sindh and the super rain flood of 2011 which also badly affected 10 districts of lower (southern) Sindh are result of massive mismanagement of available water resources which caused more than RS 300 billions loss per year also needs urgent attention of policy makers to resolve the issue on war footing basis for agricultural and economic development of the region and also for the welfare of the population already facing food insecurity, poverty, hunger and malnutrition. The use of other complementary input will not yield the desirable results if adequate water is not supplied to crops and livestock's.

Keeping in view the above situation, the author intends towards a separate study on the potential of Sindh's water resources with a special focus on the major problems concerned with its management and addresses the policy makers to make the irrigation system efficient through adoption of the alternative strategies on account of their pivotal role in agricultural growth and development.

2. Methdology And Data

Descriptive analysis method has been used in the study including findings of specific group of the growers conducted in different cropping zones of the region. The insights from Ph.D thesis "Major Obstacles in Agriculture Development of Sindh and their Remedies" are also widely included in the study. The data of the SZABIST centre, Agriculture Statistics of Pakistan, Ministry of food, agriculture, fisheries and livestock (MINFAL) government of Pakistan is used in the study.

3.Water Resorurces In Sindh

The Sindh province boasts of three sources of water to irrigate its agricultural sector; the canal irrigation system itself irrigates 89%, whereas the under table water utilized

through tube wells and rainy water irrigates only 8% and 3% respectively of the cropped area. It is very important to mention here that the canal system of the Indus is a major source of water for agricultural and economic prosperity of Sindh. Tube well water is applied in many areas during cropping season particularly when access to canal water is not possible, and rainy water is the only source of irrigation in arid regions of Sindh.

The proceeding sub-sections contain an analytical discussion on the three types of irrigation systems with focus on the causes underlying scarcity of water and mismanagement in the systems on the supply as well as on the demand side.

3.1.Canal Irrigation System

The canal network of Sindh consists of three barrages i.e. Sukkur Barrage (1932), Kotri Barrage (1955) and Guddu Barrage (1962). As shown in Figure 1 below, the Sukkur Barrage has seven canals, Kotri Barrage four canals and Guddu Barrage has three canals. The water of these barrages below the canal level is delivered through branch canals and minors, eventually the water flows onwards through 42000 water courses to the farms/fields. The average length of each water course stands at 4 kilometers and the total length of irrigation system in the province stands at 160,000 kilometers. Figure 1 also underscores the importance of Sukkur Barrage which irrigates 26.1 millions acres is more than that of other two barrages. Perennial canals irrigate 77% of the total canal irrigated area of the province as show in Figure 1 the Canal Command Map of Sindh Irrigations System.

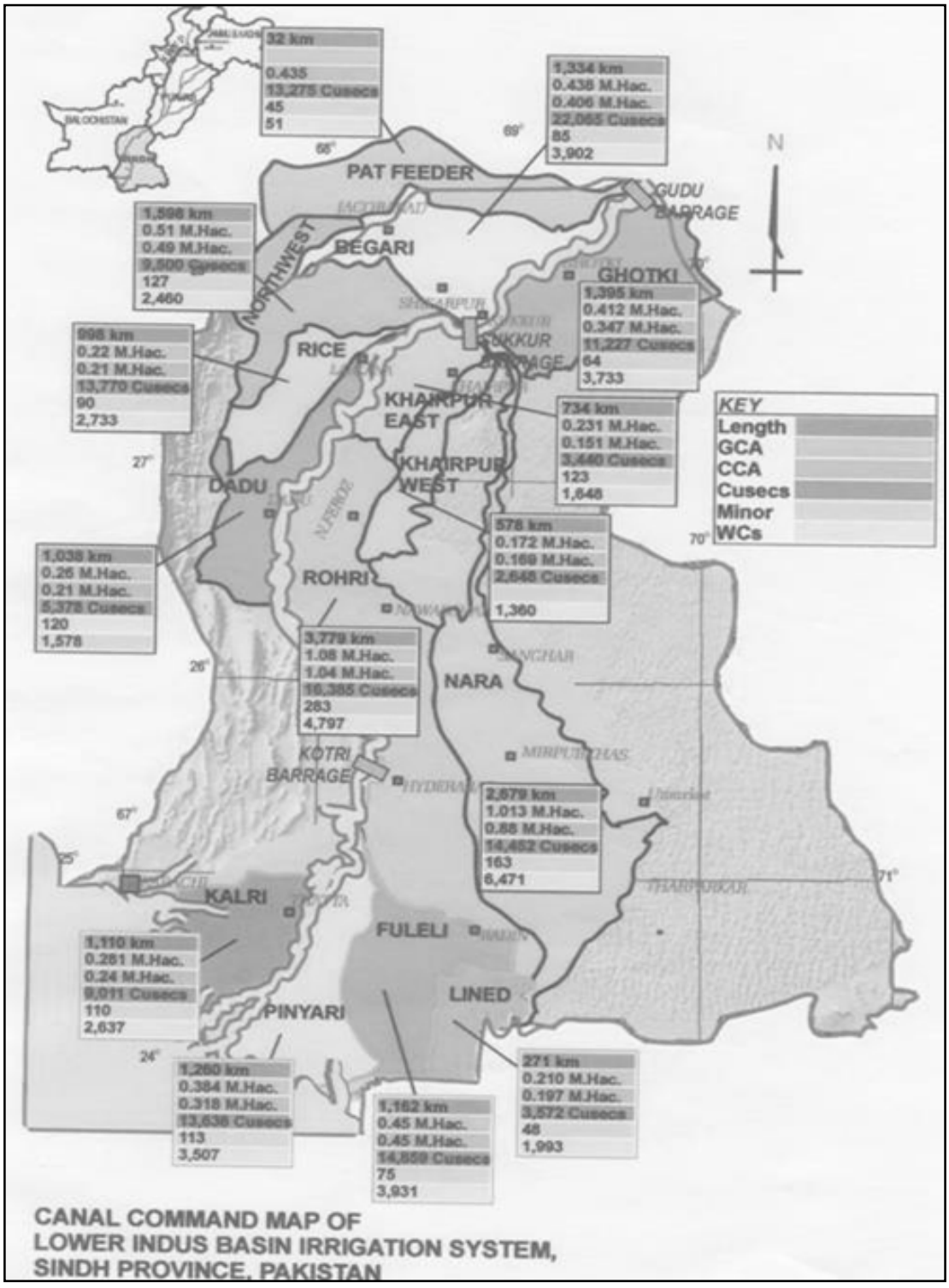


Figure 1: Canal Command Map Of Lower Indus Basinirrigation System Sindh Province Of Pakistan
(Source: irrigation Department Government of Sindh, Karachi).

In the system, the scarcity of water is a major obstacle eventually leads to high level fluctuations in agricultural growth and affects development process of the sector as well. The malfunctioning of canal irrigation system in the region has following features.

3.1.1.Design Flaws

The makeup of Indus basin irrigation system has been so designed that the water can carry silt along from river to the canal, distributaries and eventually to the land growers. At that time, there was very a little possibility of silt staying in the canals and distributaries. The most important idea was that the silt particles would make the land more fertile .But the silting problem intensified soon afterwards due to water shortages and ill-planned water distribution. Due to silting of channels, the two problems cropped up. Firstly, the capacity of water for channels was reduced. Secondly, the outlets at heads started drawing more water than at tails. Hence we find it hard to meet ever increasing water requirement/demand, greater intensities and higher/bumper yields.

3.1.2.Seepage And Salinity

Since the soil of Sindh is alluvial, a considerable amount of fresh water is lost due to seepage and filtration. The irrigation water seeps from the canals, water courses, and fields. The water is continuously gathering underground leads to raise water table which renders the fertile land infertile in the shape of water logging and salinity.

3.1.3.Wastage Of Water

A huge amount of water 70% i.e. 30.82 MAF (Million Acers Feet) is wasted during water distribution from Indus River to canals and from canals to water courses. From canals to water courses, 25% of water is lost, amounting to about 8.8 MAF or 1.088 million hectare meters. 35% of water is wasted in water courses, amounting to about 15.41 MAF or 1.9 million hectare meters. Similarly, 15% of water is lost for improper application of irrigation department and unleveled land i.e. 6.6 MAF or 0.814 million hectare meter as shown in table 1 below. The table clearly shows that a considerable amount of water wastage amounting to 35% from water courses to farm (15.41 MAF), and total available canal water is 44 MAF for the Sindh province. It is because of old system of water courses that the Sindh province suffers this loss. Out of 42000 water courses in Sindh; only 10500 courses have so far been lined. Major losses of water also occur in the tertiary conveyance system consisting of old, badly constructed and poorly

maintained water courses in Sindh. The main reasons include seepage, spillage and side leakage from water courses and mismanagement at farm level.

3.1.4.Mismanagement At Farm Level

The majority of growers naively assume that the over irrigation is likely to benefit their crops. Whereas, the excessive use of water causes water logging and salinity. The land owners at the heads use water in excess by bribing the irrigation department officials; and the growers at tail suffer water shortages. Hence, the growers at the head suffer salinity and water logging and the growers at tail suffer due to the degradation of land by water shortages. Due to poverty, lack of resources, illiteracy and lack of knowledge, small and medium scale growers and tenants of absentee landlords can not use modern laser technology for land leveling.

TOTAL AVAILABLE CANAL WATER (44 MAF)	**100%**
Wastage from canals to watercourse (8 MAF)	20%
Wastage from watercourse to farm (15.41 MAF)	35%
Wastage due to improper application by irrigation department and unleveled land (6.6 MAF)	15%
Total Wastage (30.82 MAF)	**70%**
UTILIZED CANAL WATER (14.18 MAF)	**30%**

Table 1: Wastage of Canal Water Resources in Sindh

Source: SZABIST (2001) pp.74.

3.1.5.Mismanagement By Irrigation Department

This mismanagement and poor maintenance on the part of irrigation department/ officials speak volumes if one happens to visit canals and distributaries in person. The absence of effective control/check and in-efficiency of irrigation staff/officials result in cuts and tempering of outlets by landlords and growers as they grease the palm of the concerned. Such illegal practices reduce the down stream flows which deteriorate the situation and create problems for the people. According to growers' perception, corruption is the main obstacle to the development schemes of the public sector. There is strong evidence of corruption and mismanagement of funds in the irrigation department. Every year, the government announces a number of projects and other schemes for the improvement in irrigation sector and hundreds of millions of rupees are allocated for said purpose but the majority of these projects are undertaken only on paper. The financial allocation in particular for de-silting of canals, minors and water courses is brazenly misappropriated /mismanaged by irrigation department/officials. The lining of water courses is also inadequate and of poor quality as the contracts of construction/lining of water courses and minors are given on political basis or on the basis of 10-25 % illegal commission.

3.1.6.High Percentage Of Evaporation

Evaporation is also the most common cause of water shortage. A great loss of water estimated as much as 30 MAF occurs as water from shallow water tangle moves up, causing evaporation of water from surface of rivers, canals and irrigated fields. About 65 MAF of water is also lost from village ponds, lakes and dams. Compared with other provinces, the Sindh province loses a considerable amount of water due to evaporation. There are two major causes of evaporation in Sindh i.e. 1) environmental changes across the world (global warming and industrial pollution), and 2) deforestation. In this study, it has been analyzed that the reduction in Indus water flows reduces the area of forests in Sindh. There is another important point that due to law and order situation since movement for restoration of democracy in early eighties, forests have served as safe havens for the gangs of dacoits. The above situation is cashed in by the forest and other officials. The illegal cutting of trees continues unabated under the aegis and with the connivance of irrigation and other officials. The trees on both sides of minors and canals and other irrigation distributaries are illegally cut by the irrigation officials due to absence of any proper higher authority check and the mismanagement plaguing the

irrigation department and the same practice is repeated by the people due to poverty in rural area.

Dr.Ghulam Rasool Chaudhry and Nazir Hussain measured percentage of evaporation with modern equipments and assistance of Dr. M. A. Qazi Advisor for science and technology to the President of Pakistan. They concluded that "high percentage of evaporation was measured in Sindh at Sehwan 134.7%. It is among the highest compared with the rest of provinces in Pakistan. Balouchistan ranks second with 128.9% of evaporation at Goth Haji Karim Bukhsh, NWFP third with 75.9% of evaporation at Tarbela Dam, and Punjab fourth with lowest 70.8% of evaporation at Leiah District".[Ghulam Rasool & Nazir Hussain 1988, pp 2.15 & 2.16.]

3.1.7.Sindh-Punjab Water Conflict

Sindh and Punjab provinces have harboured difference of opinion on water share of Indus since British rule but matter was resolved in 1991. According to the Indus water accord, 1991, signed on 16th of March 1991, by all the four provincial governments of Pakistan. Sindh including the requirements of Karachi has been assured the water supply of 48 MAF (Million Acre feet) during the summer and winter seasons. Punjab has to get 56 MAF; NWFP has got 8.78 MAF and Balouchistan 3.87 MAF. Thus the supply of water balances for Sindh 37%, Punjab 37%, and NWFP 14% and Balouchistan 12%.The supply of 10 MAF of water was earmarked for the flow beyond Kotri for the existence of local people and the survival of mangroves. The actual demand of the release water at the further side of Kotri was 27MAF according to the irrigation experts to save the mangroves forests, interests of costal communities and reduction in environmental hazards.

The people of Sindh province have harboured two genuine complaints against Punjab for ages that it does not comply with accord religiously and when Sindh needs water during crop seasons, Punjab does not release enough water down stream and interestingly, when Sindh does not need water during floods, the Punjab rushes out all extra water down stream.

The shortage of water is natural all over the world due to global warming and climate changes and the construction of dams and barrages at the upper areas i.e. Punjab & NWFP. With the opening of new canals, the flow of water down stream has shrunk. For example as we have mentioned above that the total share of Sindh is 48 MAF of total Indus water resource but unfortunately, Sindh received less than 50% of its total share in

the last decade. Lowest share amounting to 22.63 MAF was provided in 1994–95 and highest share amounting to 34.84 MAF in 1996-97. This reduction in Sindh's due share leads to several problems in rural economy.

The growers of Sindh also complain that the Punjab while occupying the head of Indus River gets full supply of water during the shortage of water in Sindh and releases a meager amount of water for Sindh. As for as the implementation of Indus water accord 1991 is concerned, facts and figures prove that the Punjab has brazenly violated the basic principles of accord time and again. The aforementioned problems in Sindh pose serious problems at times leading to famine and starvation. Negative agricultural growth has also been registered several times for the last two decades. The uncertainty of water supply for irrigation also creates terrible fears among the growers of Sindh and hugely affects largely their long-term investment in agricultural sector. It not only affects crop sector but also fruit farms; forest resources and fisheries sub sectors.

3.2.Under Table Water Utilized Through Tube Wells

Despite having the largest canal irrigation water, the surface water can not ever meet increasing need of the population for bringing more land under cultivation for food requirement and further development of agric–sector. This situation causes shortage of water for human consumption, live stock and cultivation. There is dire need of underground water utilization with best possible methods and technologies. The ground water is a second largest source of water for agricultural needs exploited by tube-wells. Hence the ground water for irrigation has no future in Sindh. The areas where the fresh ground water can be obtained are the ones located in Indus river vicinity. But this is only 20% in contrast with the saline ground water in the province. It is a great tragedy that sodiac, saline water affects about half of Sindh's fertile land. The result is reduction or stagnant yields of crops and slow growth in the sector.

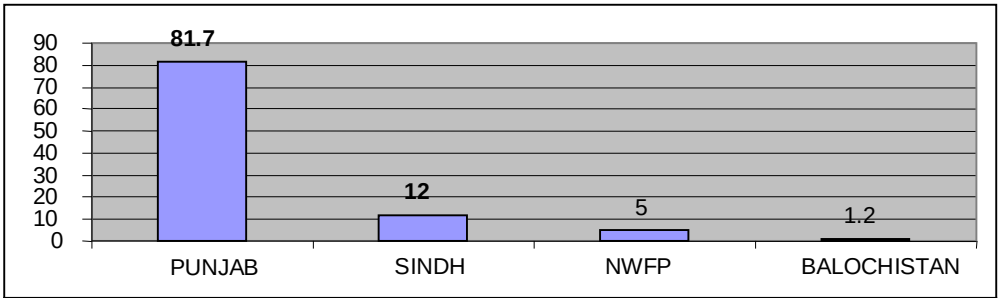
3.2.1.Natural scarcity of Under Table Water

The Sindh province has a very little amount of ground water in comparison with Punjab. The potential of ground table in Pakistan has been explained further with province wise percentage in figure 2. This figure shows that Punjab has 81.7% of ground water whereas Sindh has only 12% of under table water resources, 80% of which is sodiac leading eventually to the spread of salinity and water logging in the region. Wells lends credence to water and power development authority officials' bad behavior towards small

growers. The hapless growers interested in tube well installation face great difficulties in seeking electric connection and skyrocketing electricity costs. During the survey, the cost of installing an electric powered tube-well was reported as above Rs.0.5 million whereas the installation cost of a diesel engine tube-well was reported as up to one hundred thousand rupees. The data of table 2 further indicates year wise lowest ratio of installation of electric tube-wells in Sindh. In the year of 2000-01, about 1439 electric tube wells were installed. The number reduced to 525 in year 2004-05. On the other hand the number of diesel engine tube wells rose from 2089 to12547 during the same period due to its low cost and easy installations. It is evident from the above mentioned facts that, natural scarcity of under table water resources in Sindh is of very poor quality and is managed improperly with lack of adoption of suitable technologies. Due to in-efficiencies in the public sector tube-wells installations program, a very high cost of electric tube-wells and corruption practices of water and power development authority and the irrigation department constitute major obstacles in the utilization of under table water in Sindh province for agricultural sector prosperity. As a result a huge quantity of saline and sodiac water destroys the precious natural land resources.

S.NO	Year	Electric	Diesel	Total
1.	2000-01	1439	2089	3528
2.	2001-02	4424	12247	16671
3.	2002-03	2020	11630	13650
4.	2003-04	245	5199	5444
5.	2004-05	525	12547	13072

Table 2: No of Tube wells Installed in Sindh
Source: Development statistics of Sindh 2006, pp. 75



*Figures are percentages (%)
Source: Muhammad Akram Kahloon and Abdul Majeed (2001), pp.19

Figure 2: Ground Water Abstract

3.3.Rain Feed Irrigation System

Rain water is a third source of agricultural prosperity in Sindh region but it is scare and inadequate and is only received when high-intensity winds and rainfall occur during monsoon and its intensity continues to decrease from coastal areas towards central and northern parts of the Sindh. The system is life and soul of agricultural activities in arid zone .The people of the region, livestock and crops completely rely on the rain fed water. These areas do not have access to canal irrigation water nor is the existing under table water suitable for crop due to a very minimal quantity and saltiness. The present contribution of rain to crops in the area is estimated at about 3 MAF. A large quantity of water is wasted where this type of water is the only source of survival of the people of Thar and Kohistan. In these areas, if the rain intensity is high, it brings more prosperity to the people. The rainfall water is collected in the ponds, lakes and wells by the age old traditional methods. People and animals drink water from the same ponds.

The data on different locations of Sindh has further indicated that it is situated in isolated geographic location from rainfall point of view. It receives less and irregular rains throughout the year. Generally, the province receives 5 inches rainfall in summer season and 2 inches rainfall in winter season. The average annual rainfall does not exceed 10 inches. This rainfall percentage even varies by large extent across different areas and years by season. As show in Figure 3 below, the southern part of the province receives more amounting to 10-11 inches as compared to 6-7 inches and 3-4 inches received in the central and northern parts respectively.

According to data of agricultural statistics of Pakistan (1998-99 pp.137-38), crop water requirement is greatly as high as six times the mean seasoned rainfall in Sindh. The mean

seasoned rainfall in lower Sindh Hyderabad received 222 mm (millimeters), whereas the crop water requirement is 1372 mm and Badin, a part of lower Sindh, received 290 mm against the required 1371 mm. Similarly, MirpurKhas received 217 mm and required 1398 mm .Thatta received 252 and required 1404 mm; Karachi received 257 mm, whereas it required 1219 mm for sowing of crop in Kharif and Rabi season. The Nawabshah area of mid of Sindh province received 198 mm and required 1047 mm. The Sukkur upper Sindh region received 150 mm and required 1457mm. The Jacobabad area of upper Sindh 137 mm seasonal rainfall received; both seasons Kharif and Rabi, but crop water required in area is 1487 mm. The low rainfall and neglect in the collection of rain water usually lead to severe drought particularly in this arid zone. It has been analyzed that the rainfalls have generally shown downward trend since 1997 as mentioned in table 3.The which was the peak-year.

The data of received rain (1723 mm) and required rain water (10755mm) for crop shows great difference of (9032mm) in natural rain water supply and crop demand, so it is very necessary to conserve this little source of rain water with immense care. It is a major obstacle at institutional level that, there is no any institutional arrangement for better utilization of above discussed little source of rainy water for the prosperity of agriculture, forestry, live stock and human in the region. It flows down in the far flung areas of Run of Kutch without proper utilizations that can be helpful for further development in the region if collected with modern methods.

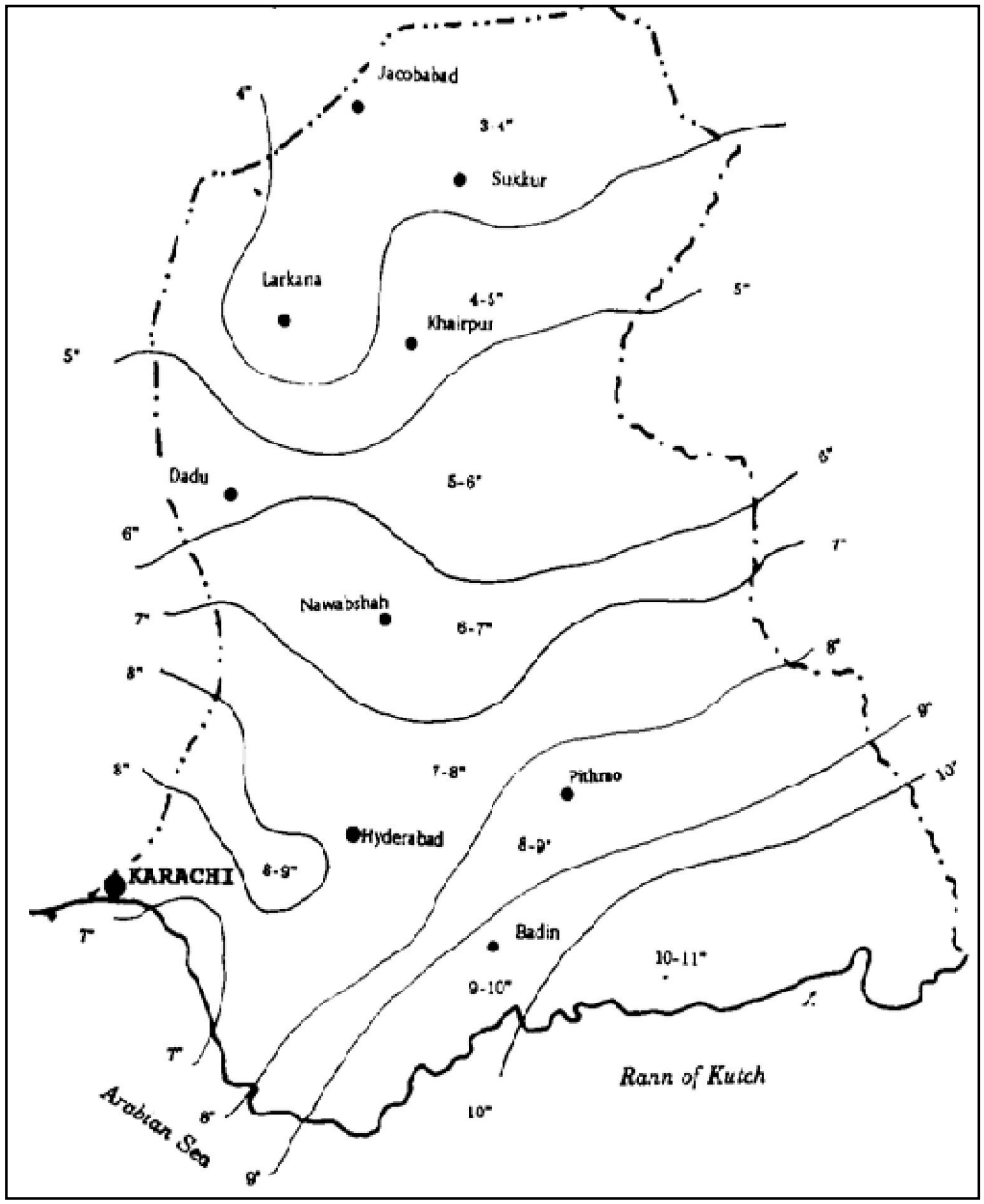


FIGURE 3: Annual Rainfalls in Sindh (Average in Inches)
Source: Mushtaque Rahman (1993) pp.46.

STATIONS	MeanSeasoned Rainfall(InMillimeters)			CropWater Requirements (In Millimeters)		
	Summer	Winter	Total	Summer	Winter	Total
HYDERABAD	152	70	222	697	675	1372
JACOBABAD	67	70	137	837	650	1487
BADIN	220	70	290	685	686	1371
MIRPURKHAS	147	70	217	715	683	1398
NAWABSHAH	128	70	198	511	536	1047
SUKKUR	80	70	150	797	660	1457
THATTA	182	70	252	715	689	1404
KARACHI	183	74	257	611	608	1219
TOTAL	**1159**	**564**	**1723**	**5568**	**5187**	**10557**

Table 3: Mean Seasoned Rainfall and Crop Water Requirements in Sindh
Source: Agricultural Statistics of Pakistan 1998-99, pp.137-38

4.Findings Of The Study

- The agricultural land in Sindh is largely dependent of canal irrigation (89%) followed by tube well irrigation (8%) and rain feed (3%). While the canal system carries silt which reduces its capacity and it also causes water logging and salinity through seepage of water destroying 38.5% of the fertile land of Sindh.About 70% of the canal water is lost from river to the end user. The larger portion of canal water (35%) is wasted at field level which needs proper attention of the policy makers.
- The irrigation department is responsible for mismanagement of the canal irrigation system and the distribution of its water at all levels. Moreover farmers also due to lack of education and awareness improperly apply water at field level.
- The tussle between Sindh and Punjab province on the share of Indus water and construction of dams in northern areas lead to fears and uncertainty among the growers of Sindh and this fear and uncertainty constitute one of the greatest obstacles in long term investment in the agricultural sector that seriously affects the development process.
- The Ground Table Water has very little potential in the province only 20% water can be used for irrigation. That is why, 80% of water is sodic and saline; this little

source could not be utilized still properly due to inefficient policies, high cost and difficult process of electric connection for tube wells.

- Generally, the province receives 5 inches rainfall in summer and 2 inches in winter season. The received rainfall in Sindh region is 1723 mm, whereas required is 10752 mm; but above single source could not be managed properly and huge quantity of water is wasted in drains and can easily be collected with simple effort of the state if taken seriously.

5. CONCLUSION & POLICY RECOMMENDATION

- It has been concluded that unfeasible and amateur policies were continued to be made to solve the issue in the past without seeking consultation of genuine stake holders of the area. This is an important obstacle in agricultural / livestock sector development in the region. This dismal picture painted here needs an urgent but sustainable and comprehensive planning and formulation of feasible policies and their implementation in letter and spirit in due course of time.
- Better organized irrigation system through new irrigation development schemes and proper maintenance of old irrigation systems of the British era is the need of hour for the sustainable agricultural development in the region. The lining of water courses, minors and canals can reduce 67% of land degradation caused by water logging and salinity and may also save more than 50 % of water for irrigation.
- The laser technology will bring about a great change in leveling of land and in wastage of water resources. Growers should also be involved in operation and maintenance of irrigation channels and other irrigation and drainage projects. Unfair distribution of water by mutual understanding of influential landlords and irrigation officials should be controlled.
- The plantation of tress on the banks of canals, minors and water courses, conservation of forest resources will reduce evaporation. The National Drainage Program and other irrigational development projects should be revised with consultation of growers.
- The Government tube wells should be maintained properly and made operational. Difficulties in installation of electric tube well can be reduced by decentralization of Water & Power Development Authority. The easy installation methods, power

subsidy for farmers on tube wells, technologies for the better utilization of sodiac and saline water may bring about positive changes.

- In the wake of Sindh Arid Zone Development Authority closure, there is not a single separate autonomous institution for the development of arid zone in Sindh so that separate body may be formed for the development of arid region immediately. There is an urgent need for providing canal water from Nara canal to Thar Desert and from proposed Sewn barrage to Kohistan areas for the prosperity of both of these backward areas of Sindh. It is worth mentioning here that both of these areas boast of great potential in livestock/dairy production.
- In hilly areas of Kohistan, Gorakh hill station and location of Thano Boola Khan Areas are suitable for the construction of small storage dams. There are many seasonal rills flowing down the Kirthar Mountains and to Western Nara and Manchar Lake. The rainy water of above rills can easily be collected and stored for agriculture by lining of natural ponds and construction of small dams in the areas.

5.1.Need to Adopt Alternative Water Conservation Strategies for Sustainable Future

- This study lays water crisis at the door of dismal performance of agriculture sector in Sindh / Pakistan. The farmers of Sindh ought to learn to adopt new methods of irrigating their crops particularly in view of current and urgent water crisis across the country.
- The drip irrigation system is one of the innovative methods of irrigating crops using far less quantity of water than our conventional method. Not only does it helps to save water but increase the crop yield also. It is interesting to note here that there is a great yield disparity in drip irrigation method and conventional method.
- The drip irrigation method works wonders in terms of water saving and yield increase. It reduces water use at farm level and saves about 40% to 70 % of water. It also reduces the rate of land degradation, water logging and salinity.
- In yield increase, its highest impact has been estimated in sugarcane pomegranate, tomato and chilies up to 50% and in case of banana and other fruit farms up to 100% or twofold. other vantages include; Saline water can be used; no fertilizer nutrient is lost due to localized applications; high water distribution

efficiency is achieved; leveling of the field is not necessary; the distribution of water is uniform and controlled; and low labour cost

- Drip irrigation system also minimizes the evaporation and runoff losses , applicable at each level, and unique in a way to be applied at hilly area of Kohistan and desert area of Thar, the arid zones of Sindh, where water is hard to get for irrigation, live stock and human population.
- With adoption of modern methods /alternate strategies, we may fight age-long problems of water-logging and salinity. Weed infestation reduces crop yield considerably with our conventional method. This method helps save fertilizer intake, reduce sky-rocketing expenditure and fight soil erosion.
- The public sector policies should be made in accordance with the modern methods of irrigations i.e. construction of small rainy dams, drip irrigation, sprinkle irrigation and several other methods currently in vogue in developed countries /world.
- The policy makers need to educate different farming communities about the benefits of drip irrigation, tunnel farming and sprinkle agriculture through offering incentives and wide publicity in print / electronic media.

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