



## **PARTICIPATION OF FARMERS IN THE MANAGEMENT OF RAINAGE SYSTEM**

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To combat waterlogging and salinity, initially a number of Salinity Control and Reclamation Projects (SCARPs) were introduced 1960s in Pakistan. And also, surface and subsurface drainage system and biological drain system has been introduced for controlling over twin problem of waterlogging and salinity in the country level. Out of total irrigated area of 16.69 Mha (41.23 Ma), 7.545 Mha (about 45%) has been covered under drainage. Still 9.14 Mha (22.59 Mha) needs to be provided drainage facilities in the irrigation basin system of Pakistan.

Institutional Reforms has been introduced within water sector by act 1997, in the Sindh Province Pakistan. Through these reforms Sindh Irrigation & Drainage Authority (SIDA), Area water Boards (AWBs) and Farmers Organizations (FOs) were formed at barrage, main canal and distributaries/ minor levels. Drainage Beneficiary Groups (DBGs) have been made on branch drainage system levels. These reforms have provided good opportunity to the farmers/stakeholders participations in management of Irrigation as well as Drainage system in Sindh province of Pakistan.

The Left Bank Outfall Drain (LBOD) which consisted on Spinal drain and Link drain such as the DPOD, KPOD and Tidal Link has been constructed in recently which will receive drain water from left side of Indus River for disposing off into Arabian Sea While Right Bank Outfall Drain (RBOD) is under construction on right side of Indus River which will receive water from Upper Sindh and Balochistan for outfalling in the creek of Arabian Sea. The drainage system/ network in the commanded area of Kotri barrage has been introduced in 1960s. This system covers both sides of Indus Rivers and downstream of Kotri barrage which is under jurisdiction of Districts Thatta, Tando Muhammad Khan and Badin on right and left flanks respectively.

There are many constraints/problems for safe removal of drains water, such as, high tide low hydraulic gradient, mismanagement of operation and maintenance of the system, defer of maintenance, not proper collection of revenue and drainage cess, lack of interest of framers/stakeholders towards drainage system, heavy rainfall and cyclone frequently, low crop yield, high value of input, low value of output, shortage of irrigation supply, impact of waterlogging & salinity, fertility of soil, effluent of Sugar mills, polluted of surface canal waters, highly saline groundwater, deteriorating conditions of communication infrastructures, poor living standards, bad environmental

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impacts over ecosystem, frequently earth due to unstable slopes in silty stretches; these all constraints/problems are brought under discussion during meeting with farmers/stakeholders to address for better management of drainage system in the study area.

## **INTRODUCTION:**

Pakistan is a developing country having highest population growth rate of about 3% per annum that requiring the increasing water demand year by year. The demand of water consumption can be coped with modernization of irrigation system through Integrated Resources Management and better management of drainage network and support agricultural modernization for the sustainable development, socially, environmentally and economically.

Pakistan is bestowed with the largest integrated irrigation network in the world. This makes Pakistan essentially an agricultural-based country and therefore, its economy largely depends on the irrigation system. Surveys carried out from time to time indicate that conveyance losses range from 20% to 30%. The colossal wastage of water, not only decreases water for agricultural, industrial and domestic uses but also creates the problem of waterlogging and salinity.

Unlike the integrated irrigation network, Pakistan's drainage network is not interconnected. Much of the drainage effluent is either reused in the Indus basin Irrigation System (IBIS) or disposed into the rivers and canals. The needs to be constructed drainage basin in each canal command area for avoiding environmental degradation through interconnecting the drainage system of the country in order to dispose off all effluent water drainage into the Arabian Sea.

There are several principal causes of water logging and salinity, namely irrigation without drainage, over irrigation, low delivery efficiency of the irrigation (35 to 40 percent from canal head to root zone) and inadequate drainage system., Low hydraulic gradient of Sindh Province, obstructions and obstacles developed in natural depressions through construction of railway lines, lanes and roads. The semi-arid climatic conditions prevailing in Pakistan also lead to accumulation of salts in the root zone. In addition, irrigation supplies add salts every year to the root zone. Groundwater pumpage, which is unregulated, further aggravates the situation by mobilizing salts dissolved in the groundwater aquifer

The drainage of Sindh Province covered 2.724 Mha (6.732 Ma) where drainage facilities have been provided through 4190 tubewells in Fresh Ground Water (FGW), 2256 Saline Ground Water (SGW) areas including 361 scavenger wells, 9185 km surface drains and 4046 km of sub drains (Tile drains). The project are; LBOD (Stage-I) constructed to carry the saline effluent from the left bank area of River Indus through a system of spinal drains, main drains and Tidal Link to the Arabian Sea and RBOD (Stage-I), which is under construction and will provide drainage facilities for the Indus Right bank. About twenty four percent of the area is severely waterlogged and out of which 54% is saline and needs to be covered under drainage.

**MAIN OBJECTIVES:**

The main objective of this study is to review & examine the functioning of the drainage system and environmental and socio-economic impacts and also agricultural enhancement in Kotri Drainage circle. Therefore a study exploratory survey has been conducted on the selected systems due to the short span of time.

- ii. To address the problems in surface drainage system.
- iii. To examine performance of the drainage network..
- iv. To assess potential for the re-use of drainage effluent..
- v. To examine Operation & Maintenance of the system.
- vi. To diagnose the causes of the drainage problems/ threats with a special view to prevent water logging & salinity.,
- vii. To assess socio-economic conditions of local people
- viii. To assess environmental impact in the study area

**STUDY AREA**

The area of the drainage circle commonly is located in deltaic areas low-elevation above MSL flat but slightly sloping from the apex to the sea, land underlain at shallow depth by un-ripened soils & marine saline ground water drainage outfall to the sea constrained by the tidal regimes, at the sea side the cultivated land of the command transits into extension flat type of coasted fore lands, flooding by the sea is only the incidental problems and there are no distinct coastal embankments. Natural drainage conditions vary with the higher lying lands in the upper command.

**MEETINGS FARMERS/STAKEHOLDERS**

The meetings were held with Farmers Organizations (FOs), namely Pandhi Wah, Shah Bukhari minor, Dandhi Mubark wah, Jarki minor, Pthan hassan Ali minor, Dodo minor and etc and also the field visits have been conducted and the data about studies have been collected. Poor performance of drainage system Loss of lives and damages due to flooding caused by cyclone, heavy rain fall, capacity of drainage system, breaches of embankments, Water logging and salinity problem, Backwater flow of certain main and branch drains, the high tidal effects, severe pollution of irrigation and drainage water, Over-use of irrigation water in the upstream area and severe shortage in tail-end areas, certain loss of fisheries recourses in Dhandh and reused of drains water.

**IDENTIFICATION OF PROBLEMS AND CONSTRAINTS**

In this regard, physical status of drainage infrastructure has been visited and examined, as well as the meetings were held with local people of different walk of life and interviews were conducted & recorded in order to identify the problems related to irrigation system, drainage network, socio-economic & environmental issues. This

collected information and data has provided much more views to address the problems and the issues, described as under.

### **DRAINAGE NETWORK**

The construction of the Kotri barrage which happens cause over application of irrigation water for higher crop intensity within its command area. Therefore, it was realized for prerequisite of Drainage System in the command area of barrage. There are about 8.0 million cusecs per day canal water is being delivered for irrigation of 2.0 million acres of agriculture land. The application of increased quantity of water and cutting of natural drainage lines by network of irrigation canals, railway lines and roads have resulted in waterlogging and salinity in the canal command area. In 1959, the waterlogging problem became very acute in certain areas that it became necessary to undertake a drainage scheme in the Kotri Command area.

### **DRAINAGE CESS**

During the meetings, farmers apprised to that the surface drainage network suffers from weed growth and banks sloughing, as well as degradation of structures and insufficiency of outfall. The major cost of the improper maintenance and operation of the system are the shortfall in revenue generation i.e. Abiana and drainage-cess as well as paucity of development funds for the modernization of the system. In order to understand these complicated problems of system and improve the operational efficiency of Kotri Surface Drainage System. The stakeholders brought under discussion both the physical status and improvement needs of the system as well as O&M requirements, given the present and future Socio-Economic, and environmental requirement of the catchments area of the drainage system.

The drainage system is facing problem of operation and maintenance since its construction. This system is directly not source of earning for farmers and other stakeholders but indirectly provides good opportunity for sustaining of land fertility and safe disposal of heavy rain water and pancho water. Owing to deferred maintenance of drains which provides space to thorny bushes and reeds to develop in the prism of drain. Therefore, recently Government has taken initiative steps for levying cess for revenue collection as proper operation and maintenance can be carried out.

### **HEAVY RAINFALL AND CYCLONE**

The average annual rainfall in the study area varies from 6 inches to 9 inches. Most of it occurs in the months of (July and September) monsoon season. The hottest months are May and June and coldest is January. Light rain showers occur occasionally in January & February. Although the annual rainfall is low, yet the project area is subject to severe storms. This area receives the heavy rainfall and the cyclone within frequency of four or five year. In 1992, 1994, 1999 and 2003 there was heavy rainfall and the drain which was already silted up could not accommodate the storm water. This caused heavy losses to standing crops and property and damage to drain sections. The prism sections of the drains have almost been lost due to flow well beyond their capacities.

## SEA INTRUSION

Farmer told that the drainage system is under close to coastal area, therefore, drainage effluent is being disposed off into Arabian Sea. The Surface drainage system of Sindh province has been diverted for out-falling directly into the Arabian Sea via tidal creeks.. The tides cause reverse flow in the systems especially during high tides. Land slope along the lower reaches of the open drain are practically flat and ground water tables are high with heavy salt contents. Hence these areas are badly flooded especially during the monsoon season. This problem is more aggravated due to deferred maintenance of the drainage system.

There is large Kotri Drainage Circle network so that there was not possible to conduct study of over all Drainage Circle. Keeping in view, six (6) main drainage system have been selected out of eighteen (18) of Kotri Drainage circle. There are following selected six drainage system whereof study was carried out with participations.

- I. Ghora Bari Outfall Drainage System
- II. Jamsakro Outfall Drainage System.
- III. Nagan Dhorro Outfall Drainage System
- IV. Karo Ghungro Outfall Drainage System
- V. Fuleli Guni Outfall Drainage System.
- VI. Lowari Branch Drains System

## THE SELECTED OUTFALL DRAINAGE SYSTEMS:

Surface Drainage Systems above mentioned which are located in Badin and Thatta district of coastal area of Sindh Province of Pakistan. The drainage system was constructed in 1960s. The area lies in the Canal Command area of the Kotri Barrage. The drains water of the system outfalls into different creeks of Arabian Sea by gated and ungated structures. The network presently comprises a main outfall drain, branch drains and field drains and also catchment area of drain. Due to improper operation and maintenance, the drains have been silted up badly, resulting growth of weeds and reeds. banks sloughing has also occurred.

The drainage system has been damaged due to not proper maintenance and repair of infrastructure. Therefore, embankments of main drain and branch drains are in poor condition. The breaches and erosion have been developed in the drainage berms and flanks of banks due heavy rain. The weeds and reeds have been grown in the prisms of the main drain and sub surface drain system which cause of obstacle of smoothly flow and take place shape of afflux.

Outlet structure, Left bank outfall wing has partially collapsed, which affects main outfall structure and starts to endanger asphalt road. Depending on drainage water discharge, saline water enters more or less far from the tidal creek into the lower reach drains, thus negatively affecting neighboring lands, groundwater and crops was observed.

The study of this system is required to investigate the feasibility of structures and including drainage system, which integrates i.e. hydrologic, hydraulic/flood protection, tidal, agricultural, irrigation and drainage water quantity and quality management, environmental and O&M costs aspects. This study may serve as a pilot for similar situations (but on a larger scale) of low-laying lands crossed by major open outfall drains discharging into dhands in the tidal fringes of the Left Bank of the Indus.

## **ENVIRONMENTAL & SOCIAL IMPACT**

Kotri circle of drainage system is considered in the coastal region, This region has been come under impact of heavy rainfall and cyclone frequently average between 4 and 6 year. The cyclones and heavy rainfall have destroyed the ecosystem and socio-economic standards of the local people. Therefore, this region has to face environmental physical, biological, socio-economic issues frequently. The network of drainage system of Korti circle has brought some extent good opportunity for improving negative environmental impacts but due to construction of this network created obstacles in the natural ways of run off rainwater or inundated flow on one hand, while lack of operation and maintenance of system happened more cause of environmental adverse impacts in its jurisdiction.

The jurisdiction of Kotri Drainage circles comes under canal command of Kotri barrage. In this area water is being supplied through perennial and non-perennial canals. Therefore, during dry season local people and livestock consume drainage water for domestic and livestock. On the one canal water is being polluted by wastewater municipal and industrial and also effluent water of established of sugar mills in the command area of Kotri Barrage which also have been dumping their effluent into the drainage system on the other hand. It is really fact that the local people and ecosystem is only source of consuming canal water and drainage water because ground water is heavily saline. The recently, they could not receive potable water for drinking purpose and other purpose. The application of such type polluted water will not cause of demise fertile lands, animals and ecosystem but also of humans gradually.

Environmental issues were also discussed with the stakeholders, and outlined no significant negative environmental impact; however the stakeholder complaint about the effluent of sugar mills and stagnant water due to which smell and other environmental issue occurs.

In view point of the stakeholders and from our team view point the following suggestions are made; Sugar mills owners in the area may be asked for the in house treatment of the their mills effluent before discharging it into drain, domestic sewage of the towns and cities should be treated before discharging into near by drain. A monitoring plan is proposed and implemented under O&M component Stagnant water may be drained by making natural flow arrangements.

The data regarding the social and economic aspect were collected on the questionnaires by questioning the different categories of the stakeholders i.e Landlords, Farmers, Fishermen, NOGs, Agricultural Departments Labourers, and Servicemen etc. General Socio – Economic query is consisted on the following points, yearly income by all sources, expenditure during the year, technical persons as an additional source of

income, health care facilities including the maternity facilities, Social problem faced by then and any assistance from government organization, environmental aspects affecting their living and agriculture productivity, Source of domestic use of water, Irrigation water and its distribution, Merits and demerits of drainage networks, usage of drainage water for domestic use and agriculture purpose, Participations in the drainage system

## RESULT AND DISCUSSION

During the meetings were held and field visits have been carried out for better management of drainage system through participation of farmers/stakeholders. The farmers are real stakeholders of operating and maintenance of irrigation and drainage system. During discussion it was realized that farmers were more interest in the management of irrigation system than management of drainage system. It was observed that farmers/stakeholders were not familiar with the importance of drainage management.

During the meeting with farmers/stakeholders, NGOs, FOs, about management of drainage system following aspects was covered during study such as:

- Drainage / Canal systems performance
- Socio-Economic Conditions
- Environmental aspects

Keeping all objectives of study in view, the following points and facts have been observed and documented:

- Non awareness regarding the drainage system of the stakeholders were noted.
- Mostly the stakeholders were interested in the canal system rather than Drainage system.
- Natural drainage conditions vary with the higher lying lands in the upper command, being some what better drained than the lower lying lands in the lower commanded and in depressions.
- Drainage condition in the lower command area and in the depression adversely affected by the discharge and collection of excess surface water in the area.
- Water logging and salinity problems were visible in the catchment area.
- Though the record regarding alignments dimensions and design criteria are available of the irrigation and drainage system in the concerned office, but at the site there was found much variation in design parameter of the systems.
- Drainage systems have not been designed for multifunction use (e.g. cattle drainage, re-use) and also according to heavy rainfall.
- No plan was made regarding the development of the drainage system for consultation with local Community.

- Blockage and obstacle in certain main, branch and sub drains were observed due to closure of drains by the local people for their crossing purpose or otherwise due to reeds, weed and sloughing of site slopes.
- The drain sections at some places have widened whereas the infrastructure are almost the poor condition, hence the cost of maintenance of drain prism may increase.
- The outfall structures available were not functioning properly.
- Where there were no outfall structures at the outfall points, therefore, sea intrusion has damaged the drainage network up to about 10 Km in upstream.
- Farmers and other stakeholders showed less interest to own this system for operation and maintenance because they are considering this huge network so that it not possible for them to manage and operate on one hand while they have been referencing about low crop yield due to salinity and waterlogging and frequently impact of cyclones. Therefore, there is need of establishing Drainage Beneficiary Group (DBG) and conveying positive benefits from this system.
- The drainage water has been used for crop without considering negative impact over fertile lands.
- Dhands are located in the coastal area which have been supplied pancho water from irrigation system so that they have been maintaining their sanctity but due construction of Drainage system and huge network LBOD system have put serious impact on this dhands. Therefore, these have been converted from fresh water saline.

#### **SUGGESTION / RECOMMENDATION:**

The Researcher observed number of adverse issues in the study area, on the basis some suggestions and recommendations are given below:

- There is stern need of creating awareness among farmers/stallholders about importance and self operation and maintenance of drainage system.
- There should be given top priority for establishing Drainage beneficiary Group (DBG) for operation, maintaining and self sustaining of drainage system.
- The capacity of drainage system in the Kotri Drainage circle should be enhanced according to heavy rainwater, as rain water can be safely dispose off into creeks of Arabian Sea.
- Awareness should be created among Farmers and stakeholders for not making breaches and cuts in the drainage system during heavy rainfall.
- The gated structure should be constructed at all outfalling points for averting sea intrusion and controlling high tides of sea, otherwise, sea intrusion may cause degrading fertile lands, negative environmental and socio-economic impact.

- There is hard need to construction small ponds at upstream of each outfall structure, as drainage water may be store in the ponds during high tides.
- During field visit it was observed that drainage water is being utilized for cropping through lift machine without knowing quality of water. Therefore, this water has put negative impact over fertile lands.
- There is very important to monitoring water quality of drainage system after that can be applied for cultivating of crops. Otherwise, the saline water may cause of devastation of fertile lands and which leads low crop yield.
- The Protective Embank may be constructed along with coastal area for controlling sea intrusion, flooding during cyclone. This bank will provide facilities to local people to save their lives and their livestock through shifting on it.
- It is clear fact that due to defer of maintenance of drainage system which has badly affected on the operation, Therefore, Government should pay serious consideration for improving this system with the consultations of local people and stakeholders.
- It is important to mention that out these lagoons some are in RAMSAR commission. Accordingly, ecosystem of the lagoons has in dangerous conditions and also cause of deteriorating socio-economic conditions of local people and fishermen.
- The subsidiary should be paid to the farmers in seeds and fertilizers as they can improve crop yields.
- The irrigation system supply may be made perennial basis that may increase crop productivity. This is tail area of irrigation system of our country so it has always been facing shortage of water.
- The groundwater is saline that can not be used for application of land for cultivation of crop and for utilization of domestic purpose so that entirely ecosystem in the command are of Kotri barrage depends upon the fresh surface water of canal.
- During conducting interviews from local people in the catchment area that they have been crying about not only shortage of water but told that they have receiving polluted water from canal system and drainage system for drinking purpose. They told that urban and industrial effluent was disposed off into both side of canals of Indus River. Therefore, it should be not dumped into canals as they can save waterborne diseases.
- Social and economical conditions of local people was poor due lack of awareness, low crop yield, low literacy rate, victimization of heavy rain fall and cyclone frequently.
- The house building structure of local people was constructed of raw material and that constantly remains in danger due to heavy rainfall and cyclone.

- The life standards of the local people was realized poor due to lack of facilities of communication system and education system.
- Ideas / opinion of stakeholders regarding the benefits of the drainage system and their interesting coordinator and responsibility to take own the O&M of the system of on farm drainage system.
- To developed and improve the use of both natural as well as human re-source are environmental sustainable economically feasible and socially equitable way, through improved drainage and related water management in the individual drainage problem.
- Identification objectives i.e. protection of Irrigation and drainage water quality against pollution, reduction of the saline surface effluent quality through technical measurement, protection against storm water management to prevent solution for drainage problems and disposal of drainage water with the random of selected system, to have sufficient social support for the implementation of the system effectively.
- The need of organizational development which can enhance capacity with several factors in the new approach to drainage development. Multifunctional designs for structures, which have several purposes to be improved as people are not familiar with multifunctional of operation & Maintenance drainage system.

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