THE NEGLECTED RIVERINE AREA OF SINDH: THE PRESENT SITUATION, AND SUGGESTIONS FOR ITS DEVELOPMENT.

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Abstract

The Riverine Area in Sindh consists of approximately 2,112,000 acres or 855,100 hectares. Lying on both the sides of the main stream of the river Indus, within the two floor protective embankments. These embankments or levees had been constructed over a century from 1860, to 1960 and the river was virtually trapped within these embankments approximately ten miles apart, protecting roads, railways, towns, villages and above all the agricultural crops out-side them, from annual floods of the river. The pre-barrage inundation to levels in the river. The river having westerly tendency is in general now closer to the right (west) bank, rather than to left (east) bank. The levees or embankments are 6-8 kilometers from the main river channel, which is 1-3 kilometers, wide at most places.

Introduction

The Riverine Area.

The Riverine Area in Sindh consists of approximately 2,112,000 acres or 855.100 hectares, lying on both the sides of the main stream of the river Indus, within the two flood protective embankments. These embankments or levees had been constructed over a century from 1860 to 1960. and the river was virtually trapped within these embankments approximately ten miles apart, protecting roads, railways, towns, villages and above all the agricultural crops out-side them, from annual floods of the river. The pre-barrage inundation canals could also be given permanent mouths to ensure water supply according to levels in the river. The river having westerly tendency is in general now closer to the right (west) bank, rather than to left (east) bank. The levees or embankments are 6-8 kilometers from the main river channel, which I 1-3 kilometers, wide at most places.

The main active channel of the river, Dhoros (its abandoned channels) and sand and mud flats in general occupy about 29% of the riverine area or approximately 612,000 acres as per aerial photographs. Some of the Dhoros get silted up year after year, opening up fresh arable plots for agriculture. The rest of the area of 1.5 million acres is slightly undulating with generally the higher levels along the embankments and slopping towards the Wahurs, Dhoros and the main channels in the center. Wahur is abandoned channel usually connected to main channel at some point, but Dhoros are not, though they too are abandoned channels. However this is not a hard and fast rule, as wind and water erosions and depositions have caused good many mounds between embankments and the abandoned river channels. Of the 1.5 million acres, approximately 1 million acres are agricultural land; 450,000 acres are forest land and the rest 50,000 acres over villages, graveyards and uncultivable waste lands. These figures can vary by 5% due to recurrent changes and more or less annual flooding of riverine areas yearly, but total area within embankments naturally remains the same.

This land was flooded annually during the inundation season to various degrees and depths and the whole land profile got over-tipped or inundated, under going a process of erosion and accretion of new banks, until the river receded to its active-bed. Water absorbed in the ground during floods. Gradually seeps back into the main channel and Dhoros after inundation. This alternating charging and re-charging of ground with water and its seeping-out has created highly permeable and fertile alluvium soils, Before commissioning of Tarbella dam in 1973, floods visited every year and inundated almost the whole agriculture and forest area. More than 300,000 cusecs (cubic feet per second) discharge was common in almost 100% years. Heavy floods over 800.000 cusecs arrived in 1914, 1929, 1942, 1948, 1956, 1957, 1969, 1973, 1975, 1995, i.e., 11 times in 90 years. This overall trend is to continue and the planning of riverain area has to take into consideration this fact. A flood of 500,000 cusecs occuring three times in four years caused no damage Floods of 300,000 cusecs accurred almost each or the rest years and were beneficial, but did not flood total agricultural and forest land. Heavy floods of 500,000 to 600,000 cusecs caused some damage. But heavy floods to 700,000 cusecs and above caused 75-100% damage to housing, Kharif (summer) crops, government buildings, river port facilities, the stored grain and animals and caused some human casualties. However people were happy for ensuing better prospects, i.e., Rabi (Bosi). In recent years if flood water exceeded 500,000 cusecs, there also was damage to tube-wells an housing chocking of dug wells, damaging government buildings like schools and hospitals and above all causing dislocation of population and animals.

Frequency of peak floods at down stream of Sukkur barrage for the years 1907-1976.
This is given in the table below.

Table 1, 1 frequency of peak flood 1907-1976

Flood exceeding (cusecs)	Frequency or recurrence times in 100 years.
300,000	98%
400,000	86%
500,000	77%
600,000	55%
700,000	28%
800,000	13.3%

(Source: WAPDA, 1976. development of Riverine Area Part-I)

These are the figures prior to dams constructed in India, as well as Mangla, Tarbela, and Chashma in Pakistan. Presently even the usual; 300,000 cusecs discharge is not possible in most of the years. Figures for year 1977-2000 are not available to he author. The major advantages accruing from annual flooding are:

The soils in the area are generally highly permeable; they have higher horizontal permeability than the vertical one, a factor advantageous for recharging from the river, when in flood. Thus, helpfully, the soils in the area remain salt free.

Horizontal permeability of the soils is disadvantageous too, in as much as the soils lose water to the river much faster. This disadvantage comes in the way of Sailabi cultivation. If the river recedes in August or early September soils lose moisture before sowing of crops in late October. Before commissioning of Tarbella, floods receded at the end of September and moisture was available for sowing crops in October.

Except in rare cases, soil pH is 7.6 and higher at points, which are not flooded for years. Some of these high points are also having saline ground water underneath. Soils at these places have pH between 7.6 to 8.5 and usually over 8.0.

After recession of floods, water seeps out towards the Dhoros and the river bed gradually, over many months. Until onset of next floods therefore, with a little soil working crops are raised regularly on the preserved moisture on this soil. This type of cultivation on preserved moisture is called “Sailabi” or “Bosi” and had been traditionally practiced in Sindh for over 5,500 years or since the archaeologically called “Amrian Times”. It consisted of complex water management from Wahur to Dhoro and to the diminutive Dhori; these are from-big-to-small size and originate from abandoned channels or the river Indus. Water enters Wahur from the main channel in the inundation season or even when water recedes. Dhoros or Dhori are not connected to the main course or Wahur. Water is led from Wahur to Dhoro by cutting a small channel, which fills Dhoro to the level of Wahur at the point of cut. From Dhoro water is led to Dhori to fill it up. From Dhori water is led to small fields each 4 to 8 acres area having dish shape and below the level or water in the Dhori. At point of water entry Wahur has same level of water as in main river Channel. But at various points along its length it has higher level than adjoining point of the river as bed has slope of about 12.2 CMS per kilometer and level of water in the Wahur will remain the same as at the point of entry.

Though crop yields of Katcha lands. Raised only on preserved moisture, are half of those in the irrigated Indus plains. But even without fertilizers, herbicides and pesticides, the yields double up if two irrigation doses are applied to Rabi crop from Wahur-Dhoro-Dhori, to meet deficiency of water during flowering and ripening of crops. Farmers knowing it have adopted the system for higher yields, wherever possible.

Water which seeps towards the river bed also has low salinity; for example the Indus waters have total soluble salts (TSS) contents of about 150 ppm (parts per million) during the inundation season in the months of July and august, but seepage water from the ground, as received at Kotri barrage in the month of May, prior to the on-coming inundation, has TSS of 250 to 500 ppm. This regenerated water in the river is utilized in the down-stream of barrages, namely Sukkur and Kotri, and adds greatly to the economy. The Kotri barrage depends solely on seepage or regenerated water of the river after the inundation season. The Sukkur and Kotri, and adds greatly to the economy. The Kotri barrage depends solely on seepage or regenerated water of the river after the inundation season. The Sukkur barrage has historical rights on water of the Indus, including seepage between Kashmore to Sukkur by this process. The Kotri barrage does not have allocated rights under 1945 Sindh Punjab Water Agreement, but seepage water from embankments thus supplied for the past 40 years has created its own historical rights too and this quantity has to be supplied without fail each year.

Dhoros remain filled with water to varying degrees and water is lifted from them for raising summer and winter crops Wahurs or recently abandoned channels are a few miles long connected with the river at top end and not along its whole length will have water six feet (1.8 meters) higher than the nearby main channel at its tail end. If it has well developed natural embankments, due to slope of river bed, as well as the land, as discussed above. Thus Wahurs can be used for gravity irrigation at suitable points, and have been used as such through out in the past.

Dhoros serve as fish stock breeding and farming ponds on natural phytoplankton and zooplankton created by solar energy as the only source of fish feed in the riverine areas of Sindh. Before creation of "One Unit" in 1955, Sindh produced 80% fresh water fisheries of Pakistan due to fishing from river channels and lakes filled by canals, and fish was sold at one third price of mutton. The fishing industry in the river has historical rights and the dwindled industry had to be re-activated.

The main channel of the river is also able to support variety of fisheries and aquatic life and adds to economy of Sindh. The whole area of 2.112 million acres was highly productive supporting large population of fishermen, farmers, livestock grazers and boats-men. The availability of 40,000 boats on the Indus had provided before commissioning of railways between 1860 to 1900. There were live ports at every 6 to 10 miles and they buzzed with population and business activities.

When railways were built, no provision was made for settlement of boats-men and their supporting service men in irrigated areas. They were forced to accept life to tenant farmers and this hit them socially in Sindh's hierarchy of caste system, putting them into unpleasant situation. The business community at the ports was shifted to newly built railway stations by establishment of Notified Area committees and allotment of land to them Sukkur barrage did not have ship lock and this stopped direct boat traffic from the Punjab and NWFP to Sindh.

Some fishermen had some centuries old historical rights of fishing. Those at Rohri had rights to catch hilsa (palla) around Khawaja Khizir Tomb. Sukkur barrage did not allow hilsa to cross it to Khawaja Khizir tomb on its upstream. The fishermen asked for rights below the barrage head – works near Sukkur. It took 30 years to settle the case and when it was settled. The faulty fish Ladder at Kotri barrage did not function and they asked for fishing rights below Kotri barrage. Before it was settled, water started flowing below Kotri barrage for less than 50 days a year and flows now only for a week or two.

The main channel of the river between Guddu and Sukkur remained navigable for small boats almost throughout the year, and for nine months between Sukkur and Kotri until 1970s. In post Tarbella period, this industry has dwindled forcing fishermen and boatmen to become tenant farmers, as no allocation of land was made for these to categories of workers in Kotri and Guddu barrage land distribution. This results from wrong planning, and responsibility whereof lies on the governments of the day controlling railways; canals and barrages.

With construction of barrages human resources, capital investment and government attention moved away to barrage areas and development in riverine areas became suboptimal.

The Indus river behaves as influent stream during the summer or the flood season. When water form its streams seeps into ground towards the flood protective embankments. During winter it behaves as effluent stream and water seeps out from the fields outside and within embankments to the river stream. Dhoros, Wahurs and Dhoris.

Soils of the riverine area are fertile and free of salinity and of excellent quality. Sediments brought by river Indus form year to year have also enriched soils with macro and micro-nutrients, but these soils lack organic matter as compared to irrigated soils. This is specially so after the failure of flood occuring year after year, causing almost desert like conditions due to lack of vegetative cover. Now it is an area in "low input-low output trap".

The entire riverine area was the most prosperous area in pre-barrages period but has been ruined economically in recent decades.

Indications by aerial photographs

Aerial photographs were taken in 1953, 1967 and 1973. Comparison of land forms in the riverine area during the three periods show continuous changes in land forms on the surface. Satellite photographs can give recent pictures of land forms. These photographs show that in absence of water, salinity problems have increases heavily in the riverine area.

In the riverine area permanent roads may never be constructed even by Cooperatives or sugar mills or local authorities, as the total area is bound to be flooded twelve to thirteen times a century, destroying these roads.

Constraints to agriculture in riverain area.

Factors like a high water loss in watercourses and fields due to high permeability is also much higher than in the Indus plains,) have caused low irrigation efficiency and extra water allowance has to be made for it. Other constraints are: lack of infrastructures, no roads, no telephones, no telegraphs and no markets.

This present position of inundation water.

Ever since the construction of the flood protective embankments, the whole of riverine tract used to get flooded, year after year, during each inundation season, from June to October. The people were conditioned to temporarily move away from the area during the period. But afte ind-Pakistan Water Treaty of 1959. India's diverting waters for the irrigation purpose, and within Pakistan construction of link-canals in the Punjab and Mangla and Tarbella dams, the situation changed. Inundation water was reduced and riverain areas in Sindh no longer were flooded fully as before. Originally annual peak discharge of more than 300,000 cusecs of water in almost 98% years and more than 400,000 cusecs in 86% years, had ensured that the riverain area got nearly full flooded, and on preserved moisture good winter (Rabi) crops were raised annually, and luxurious pasture developed in rest of the area as grasses tapped shallow ground water, but now it is reduced to probability of once in every ten years or so, resulting into poverty, migration, unemployment, famine conditions, diseases and deaths. Poverty has led to infestation of area with dacoits, and poor riverine people are neither interested nor in a position to assist in eradicating them at their cost. Even if they want to, the government protection to them against criminals and dacoits is lacking.

Population

The total population of the riverine area according to 1972 census was 750,000 people. Now, however, it is twice this figure. Inspite of desertification caused by lack of food and the resultant migration. The concentration of population is in areas having tube-wells and forests. **Recent Banana Bunchy top** Viral disease has resumed into abandoning of banana plantation in riverine areas below Moro to Keti bunder, and this has changed the population patterns in the whole area. The people have migrated. The riverine areas if fully irrigated can support a population of three million people in various trades, namely farming, fishing, transport and marketing, animal husbandry, forestry, etc. The constraints to development of the area are:

- Poverty of the people.
- Lack of capital to install tube-wells.
- Poor infrastructures.
- Brackish ground water in 50% of the riverine areas.
- Desire to keep area backward and un-surveyed so that it does not come under preview of Land Reforms and big land owners occupying the area are made to surrender the land and pay agriculture income tax.
- Uncertainty of the periodic low, medium and super floods, which disturbs and dislocates the regime and living patterns of the populace.

Tube-wells in the riverine area.

Prior to 1960 not a single tube well existed in the riverine area, primarily on account of fear of losing it to the floods. After 1960s, however there has been continuous demand for the installation of new tub-wells.

The Dhoros are also exploited by way of pumping water from them for agriculture. Dhoros show virtually inexhaustible supplies of water if pumped in cautious and reasonable amounts. The Dhoros created recently by the river are 15-20 feet below the surrounding land and pumping from them induces seepage from adjoining lands towards them. They have proved to be much more economical than tube-wells, not only on account of low capital cost, due to elimination of under ground tube-well elements, but also due to less draw-down (drop in water level) at the pumping point or less suction or pumping head and thus creating economy on power for pumping. For the purpose of ground water development, Dhoros are a source of water, as they capture seepage water from adjoining area.

Presently there is no alternative, but to install tube-wells in this area to rehabilitate agriculture pasture and forest lands. The operation, maintenance and economy of tube-wells, is totally different from what it is in the irrigated areas, where tube-wells, is totally different from what it is in the irrigated areas, where tube-wells supplements the canal irrigation for the purpose of raising and promoting value added crops specially fruits, nuts or pomology and floriculture, which need more water than allocated quota during certain periods of the year, for optimum yields. Thus they play a special role in boosting the economy of already existing crops in irrigated areas. In the riverine areas, the tube-well installation and operation would immediately raise the question of most economical application of water to the crops. This factor alone would lead to new thinking. New analysis and new institutions for the support of the success of this

experiment of raising crops on tube-well water alone. Due to the highest cost of irrigation water, the cropping pattern in the riverain area has to be totally different form that in the irrigated area. Farmers, extension workers, researchers and planners have to work to that end. If in every ten years, there is going to be flood of more than 500,000 cusecs in August, crops which tolerate flooding have to be investigated and introduced as summer crop, and there are not many such crops.

Agriculture Land.

Of the 1 million acres of agriculture land approximately 0.45 million acres is privately owned called Kabuli and the balance 0.55 million acres is privately owned called Kabuli or state land. This land if disposed in pieces has to go to the people having Muhag or border rights of first refusal, if their holdings are less than 16 acres, although Land Reforms do not apply to riverain areas and these have now been declared illegal by Shariat Court

Existing agriculture.

Traditional agriculture in the riverine area is based on Sailabi cultivation i.e., cultivation on preserved moisture for crops like wheat, oil seeds, winter vegetables, and melons, which all are winter crops. Kharif (summer) cultivated is carried out only on tube-well water is led from the main stream or Dhoros to low lying flat lands. Tube-well irrigation is limited mostly to sugarcane but some time cotton, sorghum, fodder, summer vegetables and summer oils are also raised. Use of tube-well water for raising mainly sugar cane shows the general trend in use of pumped water for value added crops. It is encouraging that the future trend would mainly be to grow value-added crops, rather than conventional cereal culture or fodders which are un-economical to grow on tube-wells or lift pumps from Dhoros and are marginal on canal water even in irrigated areas. At present winter crops grown in the riverine area are winter vegetables, fodder, wheat, oil seeds, pulses and root crops specially onions, carrots and sweet potatoes. Melons and water-melons also form important non-tree fruit crops. Sugar cane where ever grown is the annual crop.

Forest land.

There are about 450,000 acres of government forestland in the riverine tract. These were supported by annual floods of the river Indus. The forest species establish themselves by natural selection, adopting them selves by natural selection. Adopting themselves to the annual flooding for three to four months and depending on under-surface preserved moisture within the root zone for another three to four months due to their shallow tap-root-system and for survival during the next four to five months, on the deep tap-root-system. In case of horticultural plants it is well known that taproots keep trees alive during the drought, but the fruit yields are either reduced considerably or fruit crop failure is common occurrence. It is probably the same phenomenon that the forest trees growth in Sindh dwindles during the “off flood” years with poor yields. Some forests or Sindh are known to have died or reduced to a mere xerophytes type growth, especially where flood water has not reached for some years. A good example is the lush green “Hilaya forest” near Keenjhar Lake, which perished due to lack or water. The common belief is that the forests need no regular irrigation water. But under the present circumstances without pumpage from ground water sources, it is doubtful if they can survive or become economical. But whether such application of ground water to the present forest species would be economical, needs a thorough study and a further research. Whether any new forest species suiting to the

present ecological conditions, need to be introduced for economic advantage or the species be continued to meet the running demand for supply of timber for mining, furniture, buildings and fuel.