

Ecosystem Approach and Hydrological Potential Study of Coastal area of Thatta Sindh, Pakistan

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Introduction

Thatta district is spread over an area 17,355 km² (1.735 million acre). The location of the district is between 23°43' to 25°26' North and 67°05' to 68°45' East in Sindh Province of Pakistan (Fig. 1). The district is surrounded by Dadu district, Hyderabad and Badin districts, Rann of Kutch area and the Arabian Sea, and Karachi district on north, east, south and west respectively. Moreover, it had a population of 1.113 million people in which 11.21% were living in urban areas as per 1998 census of Pakistan. The projected residents of Thatta district in 2008 was 1.469 million comprising of 0.778 million males and 0.691 million females (ERWRMSW, 2010; IUCN, 2009).

There are seven administratively divided tehsils of the district (talukas or sub-districts): Ghora Bari, Jati, Mirpur Bathoro, Mirpur Sakro, Shah Bunder, Sajawal, Thatta, Kharo Chan, and Keti Bunder (Table 1). These tehsils include 53 Union Councils, 1107 villages and more than 41,408 households considering the average size of 6.5 people per home.



Fig 1. Satellite map of Thatta district in the Sindh Province.

Environmental profile of district Thatta

According to the 1998 census, it was stated that inadequacy in getting the advantage of developmental progressions to the basic level is consistently replicated in the level of expansion of the relevant area.

Table 1. Tehsils and union councils of Thatta district.

Tehsil	Union Council	Total Ucs
Ghorabari	Garho, Khan., Kotri Allah Rakhio, Mahar, Uddasi	5
Jati	Begna, Gul Muhammad Baraa, Jati, Karamalik, Kothi, Murid Khoso	6
Mirpur Bathoro	Bachal Gugo, Banno, Darro, Darya Khan Suho, Jhoke Sharif, Laikpur, M. Bathoro, Mehar Shah	8
Mirpur Sakro	Bohara, Choubandi, Dhabeji, Gharo., Ghulamullah, Gujjo, Haji Ghirano, Karampur, Mirpur Sakro, Sukhpur	10
Sajawal	Ali Bahar, Bello, Bijora, Jar, Kinjhar, Sujawal	6
Shah Bander	Chuhar Jamali, Doulatpur, Goongani, Jungo Jalbani, Ladiun Chatto Chand, Doomani,	5
Kharo Chan Keti Bunder	Jherruck, Jhampir, Jungshahi, Kalakot, Kalri., Makli, Onger, Sonda, Tando Hafiz Shah,	13
Total Number of Tehsils = 7, Total Number of Union Councils = 53		

In fact, 30% and over 45% shares of urban population in total suggest a verge stage and take-off stage of development respectively. However, the urban population share for district Thatta (11.21%) show that it is currently in the under-development stage (ERWRMSW, 2010).

The pattern of use of land, types of dwelling units and the presence of infrastructure amenities including the supply of water, sanitation, transportation and roads, found during the survey, reflect the under-development situation in Thatta district. In fact, the necessary facilities required for the upgradation of the quality of life of the people of the relevant areas are highly scarce. The situation of degraded land and a rural character are implicated by the villages, union council, tehsils and districts (ERWRMSW, 2010; IUCN, 2000).

Land Resources

The area of the Sindh province is 14.09 Mha with cultivated, cultivable waste, forest and uncultivated lands of 14.09 Mha, 5.69 Mha, 1.43 Mha, 0.685 Mha and 6.27 Mha respectively. There are total 801,983 Mha farms including 801,967 farms in the province with 4.25 hectares of average size of farm. The typical size of farms in Thatta district is 4.5 ha while the average cultivated area per farm is 3.1 ha. The cultivated area in Thatta is

ha of the district farm area is waterlogged and/or salinized, while 1.35% of the district farm area is under forest cover. This shows that irreversible alterations have occurred in the ecology of the district as a result of irrigation (Table 2). Thatta is facing a severe risk of water logging and salinity on the one hand and widespread deforestation due to withdrawal of excavation of groundwater and silt, sand, gravel from the river bed in study area (ERWRMSW, 2010; WASRI, 1998).

Table 2. Irrigation facilities in Thatta district.

Total Cultivated area with Irrigation Facility	375,448 (Mha)
Canal	319,484
Canal with Tubewell	32,598
Tubewell	14,104
Tank / Bandat	422
Spring / Rodkahi	14
Unspecified	578
Not Irrigated	7,015
With No Irrigation Facility	
Sailaba /rainfed	1,113
Barani	120

the lowest in the whole Sindh province. The proportion of cultivated area per farm declines because the area of farm rises from the typical holding area of 3 to 5 ha to huge holding area of more than 60 ha (ERWRMSW, 2010; IUCN, 2000).

There are 298,544 out of 801,967 farms or 37.2% in Sindh which are split into an average of 2.7 fragments. 15.5% farms are fragmented in Thatta with a low average of 2.4 fragments. Higher average number of fragments of 4.8 to 5.6 are found only for farm size of 60 ha and more (ERWRMSW, 2010). The share of owner and tenant operated farms in Thatta district is almost the same as the provincial average of 51% and 42% respectively. The share of owner-cum-tenant operated farms is as low as 4% in Thatta compared with the provincial average of 8% (ERWRMSW, 2010).

The 92% of total 18% uncultivated farm area in Sindh are culturable waste with rest of farm area (8%) consisted of uncultivated land which contains 27,277 ha of forest area. The culturable waste includes 302,398 ha or 87% of the water-logged provincial farm area with salinized soil, while the unculturable farm area includes 0.8% of the provincial forest covered area (WASRI, 1998). The land is degraded at the plain with slope of less than the overall gentle slope of more than one foot to a mile to less than one foot to a mile (Hussain, 1988).

Water Resources

Thatta district has the cultivable and uncultivable farm area in the 69.2:30.8 proportions. 56,620

The leading cause of water in the province of Sindh is surface run-off, river flow through the River Indus, its network of canals and groundwater. Surface run-off is kept in tanks or *bandats* after diversion, which irrigate 7680 ha or 0.27% of the total cultivated area of 2.84 Mha. Springs and *rodkahi* system irrigate 1.05% of cultivated land. *Sailaba* or flood plain irrigation is practiced over 0.43% of the cultivated land while 0.456 Mha or 16% of the cultivated farm area constitutes the barani or rainfed area (ERWRMSW, 2010; Naeem, 2008). About 1.5% of the cultivated land is irrigated by tubewells. 0.23 Mha land was being irrigated by over 5000 tubewells in Sindh in 2006-07 (ERWRMSW, 2010; Sundquist, 2007). Availability of sweet groundwater in the area southwest of the study site is quite limited. The thin layer of sweet water that exists over the brackish aquifer is under serious stress. This water is being supplied to communities in and around Nooriabad, Jhimpir and much of Sindh Kohistan. Hence the usage of groundwater for the irrigation purposes is quite limited. In fact, there is only 62% availability of perennial in the province, Thatta restricts it to only 19% (Sundquist, 2007).

- i. An inefficient delivery system leading to evaporation losses since the rainfall is about 110 mm /annual while evapotranspiration is 2400 mm/annum which accounts for evaporation losses to the extent of 7 to 10 MAF. Seepage losses on the other hand, account for another 10 to 12 MAF, (PMD, 2009).

- ii. Water logging and salinity, the imminent hazards due to excessive use of water by the landlords at the canal head or upper reaches of the distribution command area. Inequitable sharing of water resources, thus depriving the landowners at the tail end of the canals by 50 to

cover. For Thatta district, the use is from 1 to 3% of the farm area (WASRI, 1998).

Livestock

Livestock is one of the key components of livelihood in the rural population of the area. The

Table 3. Ownership of livestock in rural households (1996-97) in Thatta district.

Category	No.	Percent
Cattle	55.0	27.1
Buffaloes	48.6	24.0
Sheep	10.1	5.0
Goats	26.4	13.1
Poultry	52.6	25.9

80% of their legitimate share; (WASRI, 1998).

- iii. Lack of soil and water conservation practices which have caused deforestation and erosion of sediments due to indiscriminate removal of tree cover.
- iv. Salinity owing to the amount of salt in water for each hectare foot of water ponding over the fields ranges from 0.4 to 0.45 ton salt; the 47 MAF (Million Actre Feet) and water side tracked into the watered meadows of Sindh while adding about 18 tons of salts each year (Sundquist, 2007).
- v. According to the National Drainage Programme, the Left Bank Outfall Drainage (LBOD) and Right Bank Outfall Drainage (RBOD) have been adding 3.2 MT (Million Ton) and 7.8 MT salts respectively.

farmers in Thatta area keep a few heads of livestock, ranging from bullocks and cows, buffalos for milk, and poultry for eggs and meat. The communities in study area do not depend exclusively on livestock for their livelihood, since the prevailing impoverishment of resources; particularly those of water have dried up the range land which has compelled the farmers to look for other sources of income (ERWRMSI, 2010).

The total population of cattle and buffaloes together is much higher than the number of sheep and goats and thus is the principal livestock in

Thatta district. The numbers of small ruminants in the arid areas of Kohistan and also in the coastal areas is much larger and there are many more goats than sheep in all districts (Table 3).

Ecological zones of Thatta

- a) Rivers and stream beds as well as their catchment zones with respect to the revelation of their rock extremity, which may have caused the decrease of capacity of captivation of the apprehensive stream and river beds (Fig. 2).
- b) The variations in the municipal areas due to the use of land which may cause sealing of the surface of soil and thus, decreasing its penetrability.
- c) Withdrawal of groundwater as compared to reduction of prospective and escalation of salinity of the groundwater.
- d) Salinization of the soil in facility areas of canal and infiltration of freshwater to decreased levels as well as replacement prospective of the groundwater.

The interface of physical environment components viz. geography, weather, geology,

Cultivation

Cultivation is one of the main livelihood activities of the people of Thatta District. Almost all the households around irrigated areas possess some piece of land which is used for cultivation. Rice, wheat, sugarcane and tomato are main crops of the area. Wheat and vegetables are grown during *rabi* (winter) season, while rice, sugarcane, and vegetables are grown during *kharif* (summer) season, and by the end of this season tomato is extensively cultivated (Sundquist, 2007).

Cultivation methods are traditional in most of the area. Water logging and salinity problems have further reduced the already poor crop yields.

Farms using fertilizers are only 73% of the total in Sindh. For Thatta it is 55% where 20% of the farm area is fertilized with manure. Similar is the case with the use of pesticides. Only 23% of the provincial farm area is provided with pesticide

and plant life with ecological factors such as land use, water use, wastewater and brackish over flow releases caused by the amendments of human, will be depicted by use of the ecology approach and determination of enactment of water-related improvement projects in western side of Sindh (ERWRMSW, 2010).

Environmental Assessment include: (i) Calculated previous damages to the environment covering the watershed (ii) The streams escalating from Kirthar Range and flowing into the Indus during floods, and the contribution of Right Bank Outfall Drainage (RBOD) in terms of briny discharge into the arid wade along the Kirthar Range, and establish the baseline on the following parameters:

- Input, quantity and production of the environmental regions of eastern Sindh.
- Receiving of rainwater and river or stream entry.
- Condition of the stream and river beds such as exterior water eminence, groundwater and wastewater quality, and characteristics of soil of diverse levels of dissimilar wells and river beds.
- Condition of existing sources which cause contamination of water and soil in many environmental regions of eastern Sindh.

During survey it has been identified that the ecosystems and subsystems in Thatta district are

- a) Kotri-Jhimpir Section
- b) Jherruk-Sonda Section
- c) Super Highway-Darsano Chano-Malir Valley-National Highway Section
- d) National Highway-Ghaggar Nala-Dhabeji-Gharo Section
- e) Gharo-Boharo-Keti Bunder Coastal Zone
- f) Irrigated area along Indus River Right Bank.
- g) Area irrigated by Kalri Baghar Feeder of Kotri Barrage Canal Command area in Thatta district

Conclusion

The irrigation system is that in the absence of drainage system and inadequate discharge downstream Kotri has led to its failure and

irreversible damage has been done along the west of Indus River and the entire coastal belt from Gharo to Keti Bunder.

It has been drawn from analysis of surface water, groundwater, seawater, and wastewater and it has been noted that the fresh water being used marginally meets the drinking water quality standards, while treatment of wastewater remains unattended.

Extensive mining of ground water has dried up the aquifer and it is barely recharged once in three years and extensive excavation of sand and gravel from the riverine areas has dried up the aquifer and the flash floods are taking their toll, while excavation of sand from the coastal area has destabilized the coastline at several places and during the past decades disturbed the water balance.

Over-exploited without confirming the hydrological potential of the region by municipalities the groundwater sources have been depleted and increased the risk of seawater intrusion and of seismic events in the coastal areas.

References

- ERWRMSW, (2010). Ecosystem Research on Water Resources in Sindh West. HEC Project: (1196).
- Hussain, M. (1988). Environmental degradation, Realities and remedies. Ferozsons Pvt. Ltd., Pakistan.
- IUCN, (2000). Status Paper on Situation of Arid Zones in Sindh, Pakistan.
- IUCN, (2009). Executive Summary, IUCN, Pakistan. [http://www.iucn.pk/pdf/sssd/.../Executive%20S Summary. pdf](http://www.iucn.pk/pdf/sssd/.../Executive%20S%20Summary.pdf). Accessed on 10th March (2016)
- Pakistan Meteorological Department (PMD), (2009). The rainfall in July-September monsoon.
- Sundquist, B. (2007). Irrigated Lands Degradation: A Global Perspective. <http://home.windstream.net/bsundquist1/ir0.html>, Accessed on 10th March (2016).
- WASRI, (1998). Report on water table in October (1998). International Water logging and Research Institute (WASRI), Pakistan.