



## Impacts of Upstream Irrigation Development on Deltaic Landscape, Resources and Livelihood - A Case of Indus Delta in Sindh Province, Pakistan

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**Abstract** Over the period of last 80 years, massive irrigation development in Pakistan and subsequent disturbance in the natural course of Indus River has led to significant changes in landscape and natural resources of the Indus delta. Thousands of hectares of precious agricultural land have been engulfed by the sea. The pace of these changes has been reported considerably faster during the last two decades. A survey using structured questionnaire, Focus Group Discussions (FGDs) and interviews was carried out during April-July, 2009 to study how the changes in landscape and resources have affected the local livelihoods and social fabric in the delta. The findings of the analysis revealed all three major occupational groups - rice farmers, livestock herders and fishermen - in the delta are experiencing disturbing changes in their livelihoods. Former rice farmers and livestock herders have diverted to fishing, resulting in the overcrowding of marine fishery. Subsequently, various harmful fishing practices are in vogue, thereby exerting severe pressure on resources and making local livelihoods increasingly vulnerable. Increased competition for limited resources has significantly affected the social fabric in the delta as different social groups do not have similar degrees of harmony as enjoyed in the past. The case of Indus Delta is a stark example of environmental and social disturbances arising from a narrow-focused 'development'. The findings of the study have useful policy implications.

**Keywords** irrigation development, fishery resources, local livelihood, Indus delta

### INTRODUCTION

The Trans Himalayan River Indus is the most prominent geographical feature of the South Asian landscape. About 56% of the basin area of River Indus lies in Pakistan, where the world's largest gravity-driven irrigation system has been developed (Fig. 1). This system comprises 3 major dams, 23 barrages, 12 inter-river canals, 48 perennial and non-perennial canals with a running length of about 60,000 kms and about 160,000 watercourses with an estimated running length of more than 1.6 million kms (Kamal, 2008; Hameed, 2007). The irrigation water is spread over about 17.3 million hectares, accounting for 80% of Pakistan's farmland (Rizvi, 2001). The stable irrigation has considerably boosted agricultural production, accounting for 22% of GDP and 45% of employed labor force, thus the sector is considered as the 'backbone' of the economy (MoF, 2009). Resultantly, the government is enthused for more damming on River Indus aimed at irrigating 9.1 million hectares of remaining cultivable land awaiting water (Hameed, 2007).

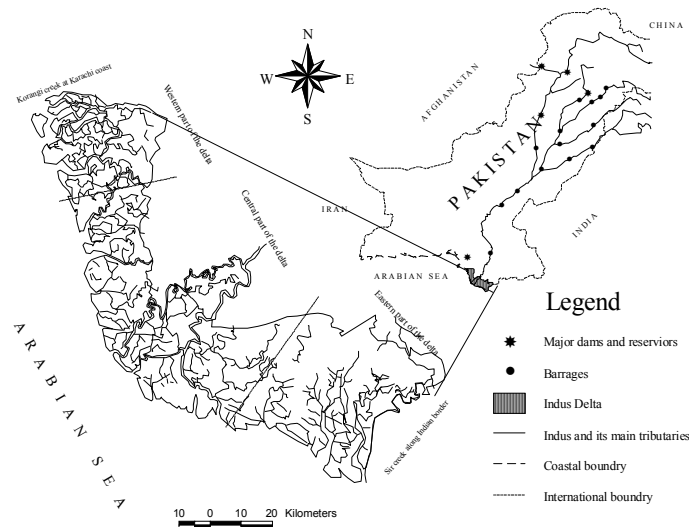
Despite the impressive role in agro-economy, the dam construction in Pakistan is highly controversial mainly due to water-sharing formula and noncompliance of previous water accords among provinces and environmental and social concerns associated with it (TCWR, 2005). In Sindh province, one of the key concerns is the downstream/deltaic ecology that has been significantly altered due to water shortage and subsequent sea intrusion. By drawing on some of the studies reporting changes in coastal landscape, this article attempts to study the way these landscape changes has

affected local livelihoods. The subsequent section provides a brief on methodology and is followed by results and discussions and conclusions sections.

## METHODOLOGY

The study was based on the temporal data obtained from both primary and secondary data sources. Primary data at household level was collected through structured questionnaires, FGDs, interview and observational methods of social research. Prior to detailed data collection, a reconnaissance was carried out for field orientation and survey planning. It consisted of various meetings with concerned officials and locals, followed by visits to coastal villages. Based on insights from reconnaissance, the study area was divided into three parts (Fig. 1). Since majority of population is currently engaged in marine fishery, a sample of 251 randomly selected households was determined and drawn proportionately corresponding to the total number of household in each part of the study area. Accordingly, 60 households in the eastern part, 77 households in the central part and 114 households in the western part were surveyed.

Data collection was carried out during April-July 2009. As the structured questionnaire comprised of the data on status of livelihood and resources for past and present time, it was made sure that either the respondent is household head or a member aging above 35 years. In FGDs, the young participants were encouraged to comment on statements of the mid- and old-age participants about the present state of affairs in the study area. Interviews with lower-tier revenue and local government officials, grassroot and mid-level NGO workers, social activists, politicians, civil society members and locally knowledgeable persons were also useful in understanding and validating findings and observations. Descriptive statistical tools were used for making inferences from household data.



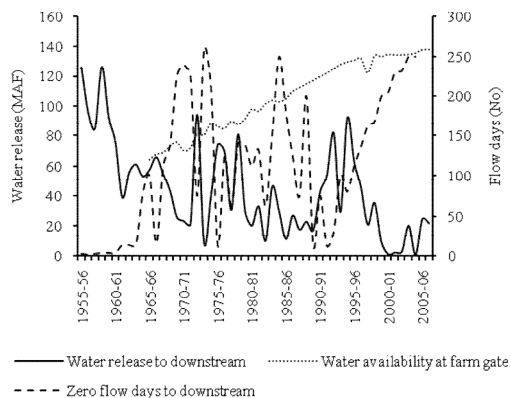
**Fig 1 Location of the study area in Pakistan including important reservoirs and barrages on River Indus and its tributaries**

## RESULTS AND DISCUSSIONS

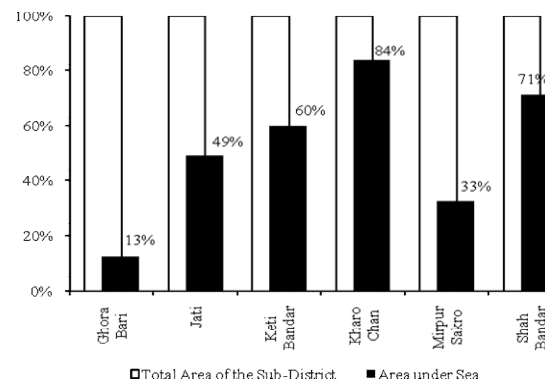
### Regulated hydrological regimes of River Indus and ecological changes in deltaic landscape

The recent history of flow regulation/diversion on River Indus dates back to 1858 with the construction of the Upper Bari Doab Canal. However, changes in hydraulic regimes to the delta were not observed until commissioning of Sukkar Barrage in 1932. It was the first time that coastal people realized the power of human artifact that could divert mighty river originating from the mouth of the lion (local myth based on the Rig-Veda –an ancient scripture of Hinduism). The situation further

aggravated with the inception of Kotri barrage in 1955, Guddu barrage in 1962, Chashma barrage in 1971. Meanwhile, two major dams, namely, Mangla Dam on Jehlam River – a tributary of Indus – in 1967 and Tarbella Dam on Indus in 1974 were also constructed to maintain the perennial flow of barrage network in the country. This list continues to grow with various completed, under-construction and proposed irrigation expansion projects on Indus River System. The half century time-series information indicates a highly fluctuating but downward trend in freshwater release to the Indus delta (Fig 2). This trend is further reinforced by steady upward trends in farm-gate water availability for irrigation and the number of zero flow days to the downstream. Changing hydraulic behavior has also reduced the sediment budget to the delta by 80% since 1950 (Giosan et al., 2006; Kravtsova et al., 2009).



**Fig. 2 Changes in water regimes on Indus River** (Source: WAPDA, 1969, 1970, 1971, 1972, 1973, 1974; WAPDA cited in Hameed, 2007; Giosan et al., 2006 and MINFAL cited in MoF, 2009)



**Fig. 2 Loss of agricultural land in six coastal sub-districts of Thatta district in Sindh Province, Pakistan** (Source: DO-R, 2008)

The change in Indus River's natural course has had a detrimental effect on the deltaic ecology. This has transformed Indus delta from riverine dominated to a marine dominated ecosystem (Kravtsova et al., 2009). The most serious effect has been sea water intrusion in the deltaic region which is rapidly encroaching inland and has caused a loss of more than 525,000 ha of agricultural land in six coastal sub-districts of Thatta (Fig. 3). The mangroves - once a prominent feature of deltaic landscape - are no more inundated by freshwater and are gradually vanishing together with other elements of biodiversity (IUCN, 2005; Shah et al., 2007). Many port towns, including Sokhi Bandar and Nindo Bandar, Dhando Bandar which were once renowned for their red rice and butter exports (Hughes, 1876) are abandoned due to the devastating changes in regional economy. The ruins of various such port towns are scattered throughout the delta and indicate the splendid past of the deltaic region (Interview/observations). The Keti Bandar town -one the sub-districts of Thatta- has been displaced three times during last century, mainly due to sea intrusion. At its current location too, the town has survived only because of an artificial embankment around it. All these changes have impinged severely upon local people's livelihood and social fabric of the delta (Interview/observations).

### Occupational changes

Interviews, FGDs and household data reveal that historically, the delta had three occupational groups namely rice cultivators cum general herders, fishermen and herders who were specialized in camel rearing. Since time immemorial, different occupational groups were living in harmony and their occupations were complementary. A discrimination based on socio-economic status of each occupational group, however, existed. Rice cultivation, camel herding and fishing were considered as

high, medium and low profile occupations, respectively. Such discrimination was more like a social guarantee against occupational intrusion among different groups. With a few exceptions, communities in the central area of the delta (Fig. 1) were primarily engaged in red rice cultivation mostly done on river inundation on the deltaic mudflats. These communities also raised livestock consisting of buffalo, cow, goat, sheep and occasionally camels as their secondary occupation. The central region was the main producer of red rice and *ghee* - a derivative of butter - which eventually were being exported to neighboring countries (Hughes, 1876). On other hand, communities of the eastern and western parts were mostly specialized in camel herding and fishing, respectively.

Over last few decades, the occupational configuration of the delta has significantly been reshuffled (Table 1). Information collected through household survey indicates an overwhelming shift of coastal population from livestock herding and field rice cultivation to fishing as their primary occupation. Before such a change took place, only a negligible proportion of the population was engaged in fishing as their secondary occupation. This clearly indicates that these communities were compelled for an overnight shift towards an occupation for which they were totally naïve and inexperienced. Household data and FGDs unfold that the agricultural economy of the central delta collapsed due to prolonged dry periods and subsequent sea intrusion (Figs. 2 and 3). In such a situation, the fishermen communities voluntarily welcomed rice cultivators of central part of the delta to the fishing occupation. The rice cultivators initially joined the occupation as laborers but with gradual knowhow and experience in fishing, they started their own operations.

**Table 1 Occupational changes among coastal communities**

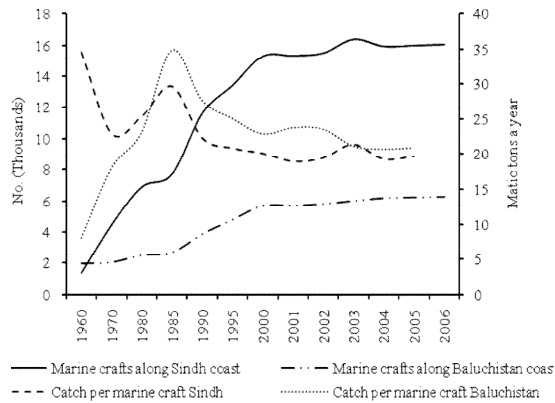
Occupation	Primary occupation (n =251)			Secondary occupation (n =251)		
	Current (%)	10 years ago (%)	20 years ago (%)	Current (%)	10 years ago (%)	20 years ago (%)
Fishermen	86.9	86.5	42.6	3.6	0.8	0.4
Livestock herding -includes general and camel herders	0.8	4.8	38.6	19.5	6.0	11.2
Rice cultivation	0.4	0.8	16.7	4.0	4.4	4.4
Employed in GO & Pvt. sector	4.0	1.2	0.0	0.4	0.4	0.0
Other occupations	8.0	6.8	2.0	2.0	1.6	1.6
Without any occupation	0.0	0.0	0.0	70.5	86.9	82.5
Total	100	100	100	100	100	100

However for camel herders, the occupational shift took a slightly different trajectory. Before the felt scarcity of freshwater, camel rearing was almost a cost-free (at least in monetary terms) activity. Camels used to be kept inside mangroves of the delta where they fed on *Avicenna marina* leaves and drank sweet water from nearby creeks. Once the river started running dry, these communities were compelled to bear unexpected cost of water transportation for their camels. This cost was unaffordable for these communities as they were poor. The new imposed cost not only compelled them to seek for alternative occupation but also pinged on the long drawn desire of daily income for their livelihoods. Meanwhile, occupational transformation ongoing in the central delta served both as a source of inspiration and imitation for an alternate source of livelihood available at door step. The camel herders too joined fishing as laborers and later started their own operations.

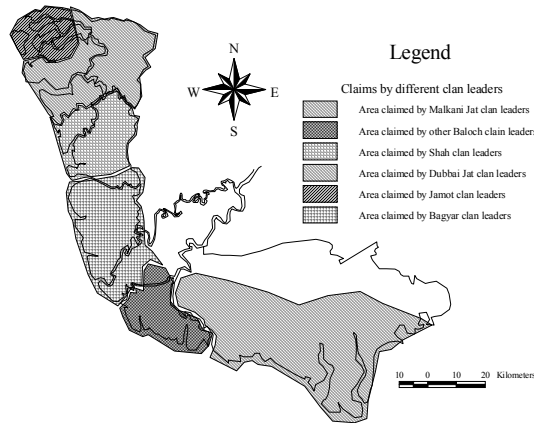
### Impact of occupational change on marine fishery resources

The massive occupational shift has exerted heavy toll on marine fishery resources of the delta. Over few decades, the number of marine fish-crafts along the Sindh coast has exponentially increased resulting in a sharp decline in fish catch per craft (Fig. 4). However, similar trends in the adjoining coast of Baluchistan province are not as severe as in Sindh province. Declining fish catch has boosted a fierce competition for limited resources, resulting in new claims and destructive fishing practices in

the region. It was frequently reported that none of the creek in the delta is free from the claims of clan lords most of whom were either camel herders or rice cultivators originally (Fig 5). These clan lords are either directly involved in the usage of harmful fishing nets – locally named *Bhoolo Gujjo* and *Qatro*, with thin mesh size capable of catching even juvenile fish – or collect a lot of illegal royalty from fishermen. These harmful nets were introduced in the delta around 15 years ago by *Bengali* origin fishermen who had illegally migrated there and were sheltered by the clan lords in order to fulfill their vested interest. Currently, even many locals are also engaged in such illegal fishing activity. The subsistence fishermen condemn these practices privately, but cannot speak out publicly because of the apprehension of prosecution and torture at the hands of clan lords.



**Fig. 4 Marine-crafts and fish catch per craft in Sindh and Baluchistan**  
(Source: Marine Fisheries Department cited in WWF-P, 2007; MINFAL, 2006 and Shirkat Gah, 2000)



**Fig. 5 Territorial claims by different clan lords for collection of fishing royalty from different parts of the Indus delta** (Source: prepared with the help of communities during the field survey, 2009)

### Social drawbacks of occupational change

The FGDs unfolded that rice cultivators and camel herders who had initially joined fishing as laborers, soon emerged as key actors and surpassed traditional fishermen communities. As a result, fishermen communities started losing the charm of their intimacy. The traditional fishermen communities neither expected nor could afford such an encroachment upon their traditional fishing grounds. Being at lower strata in local economy, they found themselves ineffective to protect their historical occupational rights. This led them towards an extreme frustration and hopelessness. As a result, throughout the 1980s and late 1990s, the majority of the traditional fishermen indulged in drug addiction regardless of gender and age division (personal communication with local communities). Though recently such practice is gradually dwindling, the long drawn frustration has led these communities to abject poverty and social exclusion. Even a naïve eye can observe a relative difference between the social status and dwellings - in terms of facilities, educational attainment, health, hygiene and overall living conditions - of the traditional and newly converted fishermen in different subsections of Rehri Goth and Ibrahim Hydri along Karachi coast (observations). At present, extreme sense of mutual abhorrence is prevalent among different groups, resulting in frequent conflicts in everyday interaction among them (FGDs and interviews).

The emerging social problem in the delta is smuggling and illegal trafficking activities (FGDs and interviews). The youngsters remain prone to join smugglers due to quick money that can be obtained through these illegal operations. Regardless of the traditional occupational affiliation, deltaic communities living along the coast are facing this as a common problem. It was mostly narrated as an effect of the decreasing quality of the fishing occupation and unavailability of alternative employment opportunities in the area (FGDs and Interviews). Furthermore, these smugglers also use adjacent ports for the landing illegal stuff and thereby creating problems for nearby villages. For example, in 2005

one of the study villages faced an army action as the adjacent ports were being used for smuggling of the imported liquor. The villagers shared that some of their neighbors were involved in the activity. When asked why not they halt such activities in their vicinities, the villagers clearly told that though often they resist but rarely can they succeed to stop these activities. The main reason for such a failure was the rebellion attitude of youngsters that is emerging out from long drawn hardship in earning livelihoods.

## **CONCLUSIONS**

The study analyzed the occupational change in Indus delta and its social impacts in the post irrigation development scenario. In study area, the rice cultivators followed by camel herders were the ones who first experienced the adverse impacts of ecological imbalance. Subsequent occupational transformation of both rice cultivators and camel herders proved havoc for traditional fishing communities. However, in the long run, all three groups are confronted with various occupational and social problems. The findings reveal that the massive influx of occupational change resulted from human induced disasters cannot be absorbed by regional subsistence economies. If such a massive absorption is even attempted, it can destroy the social harmony and intimacy among different elements of the society. Since all grievances of deltaic communities are the outcomes of narrowly focused water policy in Pakistan, it is therefore the duty of the government to assume the responsibility for mending it. The broad policy intervention might include but should not be limited to the institutional reforms in marine fisheries, the provision of alternative livelihoods for deltaic communities and careful handling of the further water sector development in the country.

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