Research article

Preliminary Social and Environmental Assessment of Zulfikarabad: a New Coastal Mega City Project in Pakistan

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Abstract This article presents the preliminary social and environmental assessment of Zulfikarabad Mega City Project that is underway in the coastal region of Sindh Province in Pakistan. Four parameters comprising the existing land use, hazard profile at the site, occupational structure of the local communities and existing land property rights are examined. Data sources included remote sensing imagery, questionnaire survey, rapid appraisals, literature survey and official records. Findings of the land use analysis reveal that most parts of the City would be built by clearing the mangrove areas which have been declared protected forests since 1950s. Besides, the location is prone to the modest frequency of earthquakes and cyclones which in some cases were not only devastating for the lives and properties of local people but also had brought significant economic losses to the regional economy. Numerous villages of varying sizes are located on the proposed site where the majority of the population ekes out their living from agricultural and fishing activities. There is a clear indication that the Government's prime attraction towards this location is the 'availability' of so-called 'wastelands'. This standpoint is contested in the light of land use analysis. Considering that the City is still in its planning stage, the finding of this study will serve as a useful guide for more in-depth studies on some of the emerging concerns over the megacity project.

Keywords coastal mega cities, city and regional planning, Indus delta, mangroves clearance, Zulfikarabad

INTRODUCTION

Megacities, on one hand are recognized as global junctions, engines of economic growth, agglomerations for cost-effective provision of facilities to civilians, and markets of surplus rural labor; while on the other hand, these geographies are portrayed as unmanageable, subjects of poverty and disparities, and polluted environs impressing heavy footprint on local environments (Haiqing, 2003; Juha I, 1998). Over the last few decades, rapid urbanization has resulted in the proliferation of megacities in hazardous regions of the developing countries and has left billions of people exposed to natural disasters (Juha I, 1998; Wenzel, Bendimerad and Sinha, 2007). A natural disaster can be conceptualized as a function of natural hazard, exposure or propinquity of humans or their properties to a hazard, and vulnerability or propensity to suffer a loss (Juha I, 1998). Occurrence of a natural hazard is almost always beyond the control of humankind and little can be done in this regard at least in the short run. Ideally, however, exposure to a hazard can be minimized for existing megacities but various practicalities limit the prospect to relocate these huge masses in safer zones. The only front where humans can intervene is the vulnerability; where entities exposed to hazards can be made resilient and prepared through improved construction techniques, early warning systems and specific disaster preparedness measures. Although various practicalities limit the prospect of reducing the exposure of existing coastal megacities to natural hazards, any new urban development should be allowed only in safer zones so as to preempt future disasters. Nevertheless, in some regions such as the Arabian Gulf, countries like UAE, Qatar, Saudi

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Arabia, Dubai and Bahrain has developed various new townships without considering their exposure to natural hazards (Kumar, 2009).

Pakistan is busy with its second planned city after independence following the conventional justification of reducing pressure from the unmanageable Karachi megalopolis (Government of Sindh, 2011). After considering the 'availability' of one million ha of land, the location of Zulfikarabad is finalized at four coastal sub-districts of Thatta district in Sindh Province (District Government Thatta, 2010). This paper presents the preliminary social and environmental assessment of Zulfikarabad Mega City site based on four parameters comprising the existing land use, hazard profile, the occupational structure of local communities and existing land property rights. The next section describes the methodology and is followed by a section on the results of four analyses as mentioned above. The last section makes discussion and draws important policy implications and recommendations. The study highlights some of the emerging concerns about the safety of future inhabitants of the new coastal city and livelihoods of the communities currently living in the area.

METHODOLOGY

Required information was collected using primary and secondary sources. For land use analysis, five classes namely: Mangrove vegetation, Agriculture and non-mangrove vegetation, Deltaic land/wet mudflats, Inland residential and uncultivated agricultural areas, and Water, were determined. Classification was performed on satellite image LT51520432011058KHC00 from LANDSAT TM dated: 27th February, 2011 using a hybrid classification approach that combined unsupervised and supervised classification techniques. At first, the selected image was classified into 100 classes using Iterative Self-Organizing Data Analysis Technique Algorithm (ISODATA) of unsupervised classification method. Signatures obtained through ISODATA classifier were identified and labeled based on the maps given in Memon (2011) and high resolution satellite imagery of Google Earth. Merging of signatures was conducted in accordance with the predetermined classes. Since the histograms of all bands were normally distributed, the final classification was performed through Maximum Likelihood method. The classification accuracy was assessed based on 256 randomly selected Ground Control Points which indicated the overall accuracy of 85.16 percent and Kappa Coefficient of 0.80 suggesting the acceptability of classification results.

Information on the occurrence of two kinds of hazards, earthquakes and tsunamis, was gathered from various secondary sources as indicated in Table 3 and elsewhere in the text. Records on different categories of land rights were obtained from the District Revenue Office, Thatta. Information on the occupations of the local communities was obtained from two sources. Out of total 343 households (Table 4), the occupational affiliation of 107 households representing the communities which live on the fringes of the active delta was extracted from the raw dataset compiled for a study on mangroves conducted by Memon (2011) in 2009. The occupational affiliation of the remaining 236 households was obtained through rapid appraisals in four randomly selected inland villages where the village heads, in consultation with their advisers, reported the occupations of each household in their village registers. Since, only one parameter, namely the occupational engagement of local communities was to be assessed, this method was deemed appropriate all in terms of time, human and financial resources.

RESULTS

Existing land cover of Zulfikarabad site

Zulfikarabad is planned in the Indus Delta located along the southeastern coast of Pakistan (Fig. 1). The site is under the administrative jurisdiction of District Thatta. A little more than two-thirds of the site area falls in the intertidal zone (Fig. 1), which comprises mangroves on 7.2 percent, wet mudflats on 40.2 percent and water in major and minor creeks on about 20 percent (Table 2).

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Mangrove vegetation is dominated by *Avicennia marina* species (locally called *Timir*) while small stands of planted *Rhizophora mucronata* species could also be found. The deltaic mudflats remain empty for most part of the year, until monsoon and subsequent freshwater regimes in the Indus River facilitate the natural growth of *Porterasia coarctata* species (locally called *Sohan*) in the northern part of the site (Fig. 1). The remaining one third of the site is located further inland and is a part of abandoned delta that comprises agriculture and inland vegetation on about 09 percent and uncultivated agricultural and residential areas on 24 percent (Table 2). The major crops cultivated in the area include sugarcane, vegetables, banana and sunflower while the wild vegetation comprises shrubby stands of *Prosopis juliflora* (locally called *Devi* or *Kekar*).

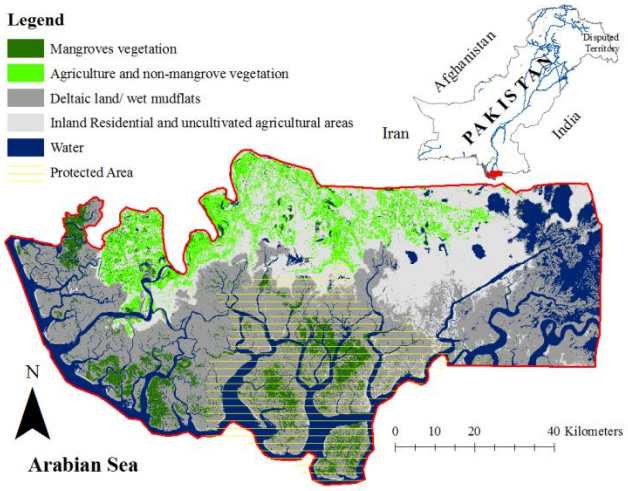

Fig. 1 Location of Zulfikarabad, its existing land use and the demarcation of protected areas

Almost half of the mangroves cover, significantly higher than one third of wet mudflats and about one third of the water bodies constituting Zulfikarabad site are declared protected areas since 1956 (Table 2) and are managed by Shah-Bandar Subdivision of Sindh Forest Department (Memon, 2011).

Table 2 Existing land use of Zulfikarabad site and land under 'Protected Area' category

Major Land Cover/Land Use	Entire Site		Protected	
	Area (ha)	% [a]	Area (ha)	% [b]
Mangroves vegetation	54,708	7.20	26,726	48.85
Agriculture and non-mangrove vegetation	66,688	8.77	1,088	1.63
Deltaic land/ wet mudflats	305,870	40.25	114,987	37.59
Inland Residential and uncultivated agricultural areas	182,675	24.04	14,355	7.86
Water	150,053	19.74	47,426	31.61
Total	759,995	100	204,581	26.92 [a]

a. Percentage of the total
b. Percentage of relavant land cover class

Hazard profile of the region

Zulfikarabad site is exposed to extreme geological and atmospheric disturbances and has witnessed various cyclones, tsunamis and earthquakes in the Past. Although the locations and magnitudes of some ancient earthquakes are doubtful (Ambraseys, 2004; Bilham et al., 2007), various others are well documented. For example, in 1819, Allah Bund Fault (ABF) generated an earthquake of 7.7 Mw that formed a 90 km long dam across Kori Creek (Jordan, 2008; Khan, Abbasi, Hadi, Laghari and Bilham, 2002) – flowing 10 km south of Zulfikarabad site. Furthermore, the ABF earthquake caused a crustal displacement of 7-9 meters that generated a large tsunami submerging Sindri town in India (Jordan, 2008). The ABF created another earthquake in 1896, causing extensive damage in Shah Bandar town (Pararas-Carayannis, 2006) that is the headquarters of one of the constituting sub-districts of Zulfikarabad. In the northwest of Zulfikarabad, the Makran Subduction Zone

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(MSZ) is also seismically very active. On 28 November 1945, MSZ generated an earthquake of 8.1 Mw with its epicenter at the distance of about 450 km from Zulfikarabad. The quake and Tsunami killed more than 4,000 people along the Makran Coast and a few in Kachchh and Mumbai (Jordan, 2008; Pararas-Carayannis, 2006). The Tsunami generated by the MSZ earthquake swept 12 fishermen (Pararas-Carayannis, 2006) and destroyed various fishing villages near Dabo Creek of Keti Bandar that is another sub-district constituting Zulfikarabad (Jordan, 2008; Pararas-Carayannis, 2006). Some recent disasters, for which statistics are considerably reliable, are more indicative of the nature and magnitude of natural hazard exposure and vulnerability of the site (Table 3). The Tropical Cyclone 02A of 1999 and the Bhuj earthquake of 2001 created disasters which went unparallel in the 20th Century (Table 3).

Table 3 Some recent natural hazards and disasters in the coastal region

Hazard	Disaster
Cyclone TC – 02A, May 19, 1999 Category 3 hurricane	– The cyclone had landfall near Keti Bandar and caused widespread and destruction in 160 km coastline of Sindh Province. It caused 56 breaches in the tidal link, wiped away 73 settlements[1], collapsed 75,000 houses and partially damaged 59,000 houses[2]. At least 168 people and 10,000 livestock died[1, 2]. It inundated 0.16 million ha of farmlands[2], destroyed 1,800 boats and partially damaged 642 boats[1]. The loss to infrastructure and fishing assets of the local communities exceeded PKR 1,000 million[1]
Bhuj Earthquake, January 26, 2001 (7.9 Mw on the Richter scale) in India	– Negligible human loss along Sindh Coast but the quake devastated almost everything within 300 km radius of the epicenter[3] in India. The aerial distance between epicenter[4] and Zulfikarabad was less than 150 km. Reportedly[5] 20,000 persons died, about 166,000 injured of whom 20,700 sustained serious injuries and 247 persons were missing. Livestock deaths also exceed 20,000[5]. In India, it affected 21 districts, destroyed about 187,000 houses and partially damaged 500,000 houses[5] in 800 villages. Together with these losses, severe damages to thousands of schools, about 750 km of the Indian National Highway and telecommunication networks suffered an estimated loss of INR 214,620 million[5].
Cyclone Yemyin, June 21-26, 2007 causing severe flood	– The cyclone caused 460 deaths in Baluchistan, 89 deaths in Karachi and 38 deaths in Thatta and Badin[6]. Reportedly in Keti Bandar[7], it killed three persons, injured a dozen more, collapsed 750 houses totally and 1,050 houses partially. Besides, it destroyed 26 boats completely and 174 boats partially[7]. An estimated population of 22,424 living in 2,822 households[7] in the northern part of Zulfikarabad site was affected.

Sources: (NDMA, 2007b)[1], (Khan and Nomani, 2002)[2], (Khan, M.A. et al., 2002)[3], (Indian Metrological Department in Malik, Nakata and Sato, 2001)[4], (Ministry of Agriculture, Government of India in CESNED, 2001)[5], (NDMA, 2007a)[6] (WWF-Pakistan, undated)[7]

Occupational structure of the local communities

Zulfikarabad site is sparsely inhabited with a population density of not exceeding 40 persons per km^2. Nevertheless, about 275,888 persons are living in 277 villages in four sub-districts identified as the site of Zulfikarabad (District Government Thatta, 2011). Furthermore, various small settlements may also exist on the site as the village list prepared for Sindh Rural Development Project (SRDP) in 2005 indicates 709 settlements in the four sub-districts ranging between two and four hundred households. The majority of the local people earn their livings from surrounding natural resources comprising sea, mangroves and land. Marine fishery is a major primary and secondary occupation followed by crop cultivation and livestock herding as the second and third important occupations, respectively (Table 4). Besides these major occupations, some people were also formally employed as non-fishing laborers or were engaged in other occupations such as venders and village artisans (Table 4). It was gathered that almost half of them had a secondary occupation that was almost always the marine fishery, crop cultivation or livestock herding (Table 4). The majority of marine fishers and livestock herders (specialized in camel herding) were settled on the fringes of the delta while those engaged in agriculture were settled further inland.

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Table 4 Occupations of the local communities residing on Zulfikarabad site

Occupation	Dependent households (N=343)	
	Primary	Secondary
Marine fishery	54.23	26.53
Livestock herding	12.24	7.87
Boat driving	4.08	–
Crop cultivation	16.91	12.24
Formal jobs (Govt, NGO and Private sectors)	6.12	–
Daily wage labor (other than marine fishing)	3.21	–
Other occupations	3.21	2.62
No Occupation	–	50.73
Total	100	100

Land property right on the proposed site

The State is the major landholder owning more than three-fourths of the land in the four coastal sub districts constituting Zulfikarabad (Table 5). Two other categories of land which can have significant influence of the state are Running Grants and the land for Public Purposes. Running grants are the lands which the government has allotted to any individual but the actual transfer of rights to the allotted party remains pending till they complete installments payable against the allotment. Meanwhile, the allotted party can take the possession of land and cultivate it. The land for 'Public Purpose' is the one that is utilized for villages, schools, hospitals, roads and similar purposes and was reserve for the welfare of local inhabitants. Thus the remaining one fourth of the land which comprises the land for Public Purpose (3.02 percent), Private Land (7.44 percent), Private land for which Transfer Orders (TO) has been issued (6.94 percent) and Running Grants (5.38 percent), is the land where local communities has a direct stake (Table 5). Besides, it is also noteworthy that 204,581 ha or roughly 35 percent of the state owned land that is considered as 'available' for Zulfikarabad City is the area declared as 'Protected' mangrove areas since 1950s (Fig. 1 and Table 2).

Table 5 Land property rights in four coastal sub districts of Thatta district

Name of sub district	Total area of sub district in hectares[1]	Major categories in Land Register – area in hectares (%)					
		Public purpose	Private land	Private land T.O issued	Running grants	State Land	Other Land
Keti Bandar	61,885	2,969 (4.80)	14,952 (24.16)	2,340 (3.78)	4,967 (8.03)	37,253 (60.20)	162 (0.26)
Kharo Chan	92,366	2,834 (3.07)	5,766 (6.24)	1,643 (1.78)	3,876 (4.20)	79,154 (85.70)	–
Shah Bandar	295,453	3,583 (1.21)	20,205 (6.84)	17,208 (5.82)	11,987 (4.06)	239,605 (81.10)	5,547 (1.88)
Jati	266,880	12,268 (4.60)	12,457 (4.67)	28,571 (10.71)	17,749 (6.65)	190,325 (71.31)	–
Total[2]	716,584	21,654 (3.02)	53,380 (7.44)	49,762 (6.94)	38,579 (5.38)	546,337 (76.24)	5,709 (0.80)

Source: (ZDA, 2011)

1. *Area as per the land register which is different from the total geographical area of the sub district*
2. *A small difference of 1,165 ha bringing about a difference of 0.16% is due to typographical errors in the official records*

DISCUSSIONS AND POLICY IMPLICATIONS

In the wake of climate change, hazard exposure and disaster vulnerabilities of existing coastal megacities are already a major concern for researchers and policy makers. Nevertheless, some countries such as those located in the Arabian Gulf and the Indian Ocean are establishing new coastal townships and cities in the regions which had experienced a number of severe atmospheric

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and geological hazards in the recent past (Kumar, 2009). Surprisingly, the location of Zulfikarabad Mega City Project in Pakistan is also guided by the 'availability' of the land. Government's tendency to build new cities in hazardous zones seems unabated and ignorant of the past experiences. For example, Islamabad – the first planned city and capital of Pakistan – was also built in a high seismic zone that experienced an unprecedented earthquake in 2005 causing 87,000 deaths and destroyed about 32,335 buildings in various towns and cities including the collapse of Margalla Towers in Islamabad (USGS, 2011). Even the argument that "the land required for Zulfikarabad City is available in the Indus Delta" also cannot be justified since the major proportion of the said government land is 'Protected Mangrove Areas' while the remaining land is under some form of private or communal property (Table 2). Drawing on the mangrove cover statistics provided by Memon (2011), this study gathers that Zulfikarabad will cost the clearance of about 50 percent of the mangrove cover of Pakistan, half of which are already declared as protected forests by the government (Table 2). Furthermore, the City is going to be constructed in a region that is more exposed to the oceanic disturbances and seismic activities of Kachchh than the coastlines of the Arabian Gulf.

Loss of mangroves coupled with the large scale 'development' on account of Zulfikarabad City may further aggravate the ferocity of meteorological and geological hazards and pose a threat to the lives and properties of future inhabitants of the proposed city. These findings of the site's exposure to meteorological and geological hazards are consistent with Bilham et al. (2007) and Pararas-Carayannis (2006) who suspected that the seismic disturbances originated in Kachchh region of India could endanger Karachi megalopolis (located 300 km Northwest of Kachchh) and thus are valid threats for Zulfikarabad site that is juxtaposed to the source of various past quakes.

Regardless of the disaster vulnerability of Zulfikarabad site, the local livelihoods primarily are linked with the surrounding natural resources including mangroves, marine fishery and agriculture. Memon (2011) reported that upstream diversion of the Indus River has already resulted in loss of livelihoods of erstwhile paddy farmers and camel herder who coped with the situation by shifting their occupation to marine fishery. Certainly Zulfikarabad will make it impossible for them to continue their fishing activities and thus push back them in a similar position where they were left few decades ago following the construction of dams and barrages. Considering that the development work of the city is still in its planning stage, it is recommended that more in-depth studies on the above mentioned aspects need to be carried out before starting the onsite development of Zulfikarabad Mega City.

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