CASE STUDIES IN WETLAND VALUATION #5: May 2003

INDUS DELTA, PAKISTAN: economic costs of reduction in freshwater flows

Water-based developments in Pakistan

Pakistan's vast irrigation network comprises three major storage reservoirs, 19 barrages or head works, 43 main canals with a conveyance length of 57,000 km, and 89,000 watercourses with a running length of more than 1.65 million km (IRIN 2001). The system feeds more than 15 million hectares of farmland, affording Pakistan the highest irrigated to rain-fed land ratio in the world. This impressive irrigation system is, however, exacting a heavy toll on the environment. In particular there is concern that the abstraction of large volumes of water from rivers has, in many cases, left insufficient flow to meet the needs of downstream ecosystems. Coastal and marine regions, because they lie at the end of rivers, have been impacted most heavily by upstream water abstraction.

Failure to recognise downstream ecosystem needs has often led to water allocation decisions being made that are neither economically nor ecologically optimal. Contrary to the dominant development imperative that favours the allocation of water to large-scale, commercial uses such as dams, reservoirs, irrigation and hydropower schemes, Pakistan's ecosystems, too, are economic users of water. Yet the economic benefits of water-based ecosystems are rarely factored into river basin planning, or into water allocation decisions.

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The economic costs and losses arising from such omissions can be immense, and often irreversible, impacting on some of the most fragile ecosystems and the poorest and most vulnerable human groups. This case study describes the economic costs that have occurred as a result of inadequate freshwater allocation to the Indus Delta in Pakistan. Especially, it focuses on the crippling environmental economic costs that upstream water allocation decisions have incurred to poor local populations, manifested through declining agricultural yields and fisheries production.

Managing freshwater flows in the Indus River

The Indus River has a total length of more than 3,000 km and a drainage area of some 950,000 km². Almost 90% of the water in the upper portion of the river basin comes from glaciers located in the Himalaya and Karakoram mountain ranges, which border China, Pakistan and India, and the Hindu Kush, which borders Pakistan and Afghanistan. The Indus travels southwards across Punjab and Sindh Provinces in Pakistan before entering the Arabian Sea through a delta close to the border with India.

Figure 1: The Indus Delta

The Indus Delta is a typical fan-shaped delta, built up by the discharge of large quantities of silt washed down from upland and mountain areas. The present Delta covers an area of about 600,000 hectares and is characterised by 17 major creeks and innumerable minor creeks, mud flats and fringing mangroves (Meynell and Qureshi 1993). The mangrove ecosystem of the Indus Delta is perhaps unique in being the largest area of arid climate mangroves in the world. As annual rainfall is so low in the region, mangroves are almost wholly dependent upon freshwater discharges from the river, supplemented by a small quantity of run-off and effluents from Karachi.

The total available freshwater flow in the Indus is about 180 billion m^3, carrying with it some 400 million tonnes of silt (Meynell and Qureshi 1993). Over the last 60 years a series of dams, barrages and irrigation schemes have been built in upstream parts of the River Indus. Today, it is estimated that up to 60% of the Indus water is used to feed Pakistan's irrigation networks, and that the Indus watershed irrigates up to 80% of Pakistan's farmland (Iftikhar 2002). There has for some time been a high level of controversy surrounding the allocation of the waters of the Indus River, in particular between competing uses in different Provinces. Recurrent disputes over water usage led the government to set in place the Indus Water Accord in 1991, which apportioned the use of the river's water between the four provinces of Pakistan. It also recognised – for the first time – the need to allow some freshwater discharge into the delta to safeguard the ecosystem, specifying a minimum flow of 12 billion m^3. In 1994, because of drought and water shortages, Punjab Province however demanded and got a break from the 1991 Water Accord and a subsequent higher reallocation based on historical use.

As a result of upstream water abstraction, mainly for irrigation, by the time the Indus reaches the Kotri Barrage (some two thirds of the way into Sindh Province, or 200 km from the Arabian Sea), there is inadequate flow to maintain the natural ecosystems of the Indus Delta. The annual flow reaching the Delta before the 1994 break from the Water Accord was less than 43 billion m^3, and quantities of silt discharged estimated to be 100 million tonnes/year (Meynell and Qureshi 1993). Even at this level the amount of freshwater reaching the Delta was argued to be insufficient to maintain healthy natural ecosystems, and had resulted in severe saltwater intrusion and salinisation. With the existing reduction in flow, downstream Sindh Province already claims it is short of the minimum 12 billion m^3 of water needed to maintain the Delta.

The economic significance of the Indus Delta

Loss of freshwater flow, and consequent saltwater intrusion, has had devastating effects on the ecology and human economy of the Indus Delta. Land in the area has become unsuitable for agriculture, and potable water sources have become very scarce or have disappeared altogether. In Thatta, a predominantly agricultural District in Sindh Province which is situated where the Indus river flows into the Arabian Sea, almost a third of land has been affected by saltwater intrusion. It is estimated that up to 0.5 million hectares of fertile land in Thatta and adjoining areas (IRIN 2001), or about 12% of total cultivated area in the entire Province (Government of Pakistan 2001), is now affected by sea water intrusion. As well as crop losses, this has resulted in severe damage to livestock through rangeland depletion, shortage of fodder, pasture and watering areas, and a resulting mass migration of both livestock and human populations out of the area.

The human population in and around mangrove forests on the coast of Pakistan is estimated to total 1.2 million people, nearly 900,000 of whom reside in the Indus Delta (Salman 2002). Of these, a predominantly rural population of more than 135,000 depend on mangrove resources for their livelihoods (Shah 1998). Reductions in freshwater inflows have had tangible impacts on mangrove ecology, and on the fish populations that rely on them for breeding and habitat. At least three quarters of the Delta's rural population depend, directly or indirectly, on fishing as their main source of income, and most of Pakistan's commercial marine fishery operates in and around the mangrove creeks on the coast of Sindh Province. A large proportion of fish and crustaceans spend at least part of their life cycle in the mangroves, or depend on food webs originating there (Meynell and Qureshi 1993).

The annual value of catch from mangrove-dependent fish species in the Indus Delta is estimated at around $20 million. Shrimps are also particularly important, with a domestic value of $70 million and an export value of about one and a half times this figure, and the export of mud crabs contributes an additional $3 million to the regional economy (Mahmood and Ali undated).

Over 60 percent of the rural population also use the Delta's mangroves as their major source of domestic fuel, estimated to account for around 18,000 tonnes of firewood (Khalil 1999) which is worth up to $460,000 a year (Mahmood and Ali undated). Mangroves are also used by coastal villagers as fodder for domestic animals. In addition to cattle, sheep and goats kept permanently in the Delta, it has been estimated that at certain times of the year about 16,000 camels are herded into the mangroves (Khalil 1999, Meynell and Qureshi 1993). In total, the Indus Delta's natural ecosystems are thought to contribute about 67,000 tonnes of leaves and 20,000 tonnes of grasses as livestock pasture and fodder each year, together worth up to $1.35 million (Mahmood and Ali undated).

Valuing the economic costs of saltwater intrusion

The loss of freshwater to the Indus Delta, and consequent saltwater intrusion and natural habitat degradation, is manifest in a wide range of economic benefits foregone, including economic costs related to mangrove loss and reduction in agricultural land use opportunities. This valuation study aimed to generate information about economic costs that could be factored into upstream water allocation decisions, and especially used to support demands for the maintenance of freshwater flows to the Delta. As the economic benefits associated with mangrove and brackish water ecosystems had already been extensively studied before (Khalil 1999, Mahmood and Ali undated), the valuation exercise focused on the inland impacts of saltwater intrusion on crop agriculture and freshwater fisheries.

The study covered three Talukas (the administrative sub-unit below a District) in Thatta District of Sindh Province: Keti Bandar, Ghora Bari and Kharo Chan, with a combined population of some 155,000 people. This area has been most heavily impacted by seawater intrusion in the Indus Delta. Valuation relied primarily on data collected at the Village, Taluka and District levels. Primary data collection, through field visits, involved surveys of farming and fishing communities, interviews with government line departments, and consultations with other public sector and non-governmental organisations. Where data already existed in the form of statistics from Federal and Provincial Government publications, these comprised the bulk of secondary sources. The study entailed collecting data on the ecological impact of sea intrusion and economic data on agricultural and fisheries products, and establishing a link between reduced freshwater flows, saltwater intrusion, and loss of household production.

Using valuation to show the economic benefits of allocating water to ecosystems

Analysis of the data collected during the study showed that reduced freshwater flows, and consequent ecosystem degradation, had impacted heavily on local livelihoods and economic production in the Indus Delta area. Both aggregate crop production and fish catch had declined steadily as salinity had increased. The three Talukas or 30,000 households considered in the study had incurred average annual losses of $70,000 in crop damage and $45,000 from reduction in fish catches as a result of saltwater intrusion. On a broader level, other studies had shown that rapidly escalating mangrove loss has seriously jeopardised the livelihoods of more than 135,000 people who rely on mangrove products to a total economic value of some $1.8 million a year for fuelwood and fodder, and a coastal and marine fisheries sector that generates domestic and export earnings of almost $125 million (Khalil 1999, Mahmood and Ali undated).

The study presented a number of strong policy recommendations. Most importantly, it underlined the economic necessity of proposed freshwater releases downstream of the Kotri Barrage, in order to curtail the spread of saltwater into the Indus Delta. It showed that this was essential not just to safeguard the flora and fauna of the region, but also to sustain the

livelihoods of the Delta population. The study findings also had wider implications. Upstream water demands from the Indus, already intense, will grow still further in the future. Pakistan's socio-economic development plans depend heavily on expanding land under irrigated crops (Government of Pakistan 2001), and a large number of new developments are planned which indicate that freshwater available to the Indus will continue to reduce (IUCN 1991). The status of the Delta's natural ecosystems has already become critical, and the rural economy of the region faces an emergency situation as a result.

The phenomenon of sea intrusion into the Indus River Delta has become one of the most politically-charged environmental issues in Pakistan today. Competition over water allocation within river basins, especially between upstream and downstream areas, between large-scale and subsistence-level uses, and between commercial and ecosystem uses, is becoming a source of severe economic and political conflict. In many ways the Indus Delta case study epitomises a national situation which has already reached crisis point, and is likely to deteriorate still further in the future. For now, national policies have opted to allocate scarce water so as to maximise financial and commercial returns to agriculture – often at the cost of natural ecosystems, and of some of the country's poorest communities. Yet there is growing concern that the failure to factor ecological economic values, or economic losses, into river basin planning is resulting in decisions being made about water allocation that are neither ecologically nor economically optimum. As long as the economic value of ecosystem needs for freshwater flows is marginalised in national decision-making, these conflicts are likely to escalate.

This case study is adapted from Iftikhar, U., 2002, ' Valuing the economic costs of environmental degradation due to sea intrusion in the Indus Delta', in IUCN, Sea Intrusion in the Coastal and Riverine Tracts of the Indus Delta - A Case Study. IUCN – The World Conservation Union Pakistan Country Office, Karachi

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This project aims to develop, apply and demonstrate environmental economics techniques and measures for wetland, water resources and river basin management which will contribute to a more equitable, efficient and sustainable distribution of their economic benefits at the global level and in Africa, Asia and Latin America, especially for poorer and more vulnerable groups.

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