Working Paper Series no: W-78

Adaptation to Climate Change in the Context of Sustainable Development and Equity: The Case of Pakistan

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01 September 2002

Sustainable Development Policy Institute

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Working Paper Series # 78
2002

A publication of the Sustainable Development Policy Institute (SDPI).

Sustainable Development Policy Institute is an independent, non-profit research institute on sustainable development.

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Adaptation to Climate Change in the Context of Sustainable Development and Equity: The Case of Pakistan

Shaheen Rafi Khan

Abstract

Society's ability or inability to adapt successfully reflects its state of development. While the IPCC, Third Assessment Report (TAR), 2001 accepts this premise, it also appears to contradict itself by alluding to macro and micro strategies for climate change as if the two were disconnected. This paper, which is with reference to Pakistan, argues that the absence of sustainable human development (SHD) creates social and ecological instability and that such instability is likely to be exacerbated by climate change. In fact, we posit that unsustainable development paths tend to block climate specific adaptations. Case studies are used to illustrate the effects of policy neglect and intransigence upon poor communities and complex ecosystems, which are both a source of biodiversity and a means of livelihoods.

1. Introduction

With regard to climate change, the vulnerability of a given system or society is a function of its physical exposure to climate change effects and its ability to adapt to these conditions (Chambers: 1989).[1] Similarly, Ausubel (1991a), Raynor and Malone (1998) and Munasinghe (2000) state that the significance of climate variation or change depends on the change itself and on the characteristics of the society exposed to it. Thus, vulnerability recognizes the role of socioeconomic (and ecological) systems in amplifying or moderating the impacts of climate change. The nature of these systems determine adaptive capacity and its adaptability. Adaptive capacity refers to the ability to prepare for climate change in advance (as in anticipatory adaptation) and adaptability to respond or cope with its effects (as in reactive adaptation).[2]

Society's ability or inability to adapt successfully reflects its state of development. The UNFCCC Article 3.4 enjoins countries to promote sustainable development, so that they are prepared for and can deal effectively with climate change impacts. A more rigorous expression of this theme, articulated in the TAR, is represented by the conjunction of and synergies between development, sustainability and equity (DSE: Munasinghe, 2000). The TAR posits a strong coincidence between the imperatives of sustainable development and the requirements of enhanced adaptive capacity.

In other words, promoting sustainable development is tantamount to improving society's capacity to adapt to climate change. It also links the societal and the ecological aspects of vulnerability. Specifically, the absence of sustainable development can lead to environmental degradation and pollution, adverse health impacts and economic losses directly and through the vehicle of poverty, a condition referred to as the poverty-environment nexus. (Khan and Naqvi, 2000).

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1 The sensitivity of systems is also a factor

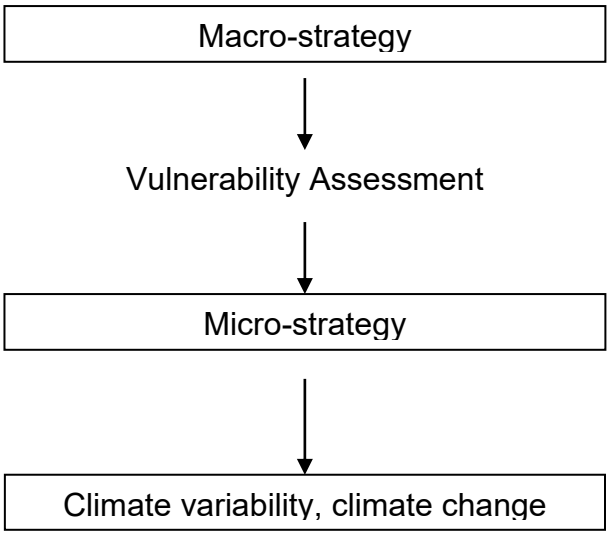
2 Hazards may be a more appropriate term to use here. Secular changes in climate are either likely to evoke spontaneous responses; or they provide sufficient lead time for society to develop strategies to deal with them. This is much less likely to occur in the case of extreme events.

The Potsdam Adaptation Workshop Agenda, October 2001, focussed on two adaptation strategies.[3] The first strategy envisions enhancing "macro" scale adaptive capacity, such as increasing wealth and improving education, income distribution, institutions and health care so as to improve countries' ability to cope with climate change and other stresses. The second strategy is to enhance capacity to adapt at a "micro" or sector specific scale, such as planning for sea-level rise and developing heat or drought resistant crops, so as to enhance the ability to cope with specific impacts on climate-sensitive sectors. In both instances attention will be paid to improving the understanding of the determinants of adaptive capacity and their interactions in defining (*i*) the ability of actors to adopt appropriate adaptation strategies at the micro-level and (*ii*) macro-level vulnerability to climate change, climate variability and abrupt climate change.

This echoes the approach of the TAR, which states:

> "Two general strategies on adaptation can be used. The first is macro strategy that involves rapid development. Sustainable and equitable development will increase income levels, education and technical skills and improve public food distribution, disaster preparedness and management, and health care systems in developing countries of Asia. All these changes could substantially enhance social capital and reduce the vulnerability of these countries to climate change.
>
> The second strategy is a micro strategy that involves modifying the management of sectors that are most sensitive to climate change. This approach entails developing new institutions or modifying existing institutions related to these sectors that promote rather than discourage adaptation to climate change. It also involves modifying climate-sensitive infrastructures that are already planned or implemented or other long-term decisions that are sensitive to climate to incorporate the risks of climate change. (IPCC, 536)"

The point of departure in this paper is that the first strategy is a pre-condition for the second, that there are risks inherent in adopting one without the other already in place. The simple schematic below illustrates the argument.



3 Enhancing the Capacity of Developing Countries to Adapt to Climate Change, Potsdam, Germany, 30 September – 2 October 2001

The links is illustrated with the help of two case studies. The first case study examines adaptive response capabilities (adaptability) to extreme events (droughts and floods). Unsustainable development processes leave vulnerable communities exposed and unable to cope. Poor institutional responses are another aspect of such development. This provides worrisome signals for the future, when both the incidence and severity of such events is expected to increase (see Section 2, Climate Change Scenarios).

Large dams in Pakistan are another illustration of the failure of micro-strategy when macro-strategy is inappropriate. In the present development climate, the planning of such large infrastructure projects has tended to ignore social and environmental norms.Further, the existing policy parameters support building more dams rather than modifying existing structures to accommodate climate change impacts, even though these serve equally well the purpose of water retention. (See Section 5.2, Adaptive Capacity)

Section 2 of this paper presents climate change scenarios for South Asia, as presented in the TAR, focusing on both secular change and extreme events. Section 3 assesses Pakistan's performance in the light of sustainable human development (SHD) criteria. It assesses sector vulnerabilities and how these are likely to be impacted by climate change. Section 4 presents the two case studies, illustrating how the absence of DSE has left institutions unprepared, both in terms of their ability to prepare for climate change, as well as to cope with its effects. The consequences are a prelude to what might happen as extreme events increase in frequency and intensity. Section 5 points to a possible area of research. It provides evidence of shifts in cropping zones over time in response to climate change. The aim is to establish whether and how communities have adapted to such shifts – technically defined as spontaneous adaptation. Section 6 concludes with some observations.

2. Climate Change Scenarios for Arid and Semi-Arid Asia[4]

Recent latest climate change scenarios, generated by general circulation models (GCMs) for Arid and Semi-Arid Asia are presented in Table-1.

Table-1: Mean Annual Temperature and Rainfall for Asia

	Area-averaged annual mean warming		Area-averaged annual mean rainfall	
Decade of	Without sulfate aerosols	With sulfate aerosols	Without sulfate aerosols	With sulfate aerosols
2050	3°·	2.5°	7%	3%
2080	5°	4°	11%	7%

Source: TAR-WG II, 2001

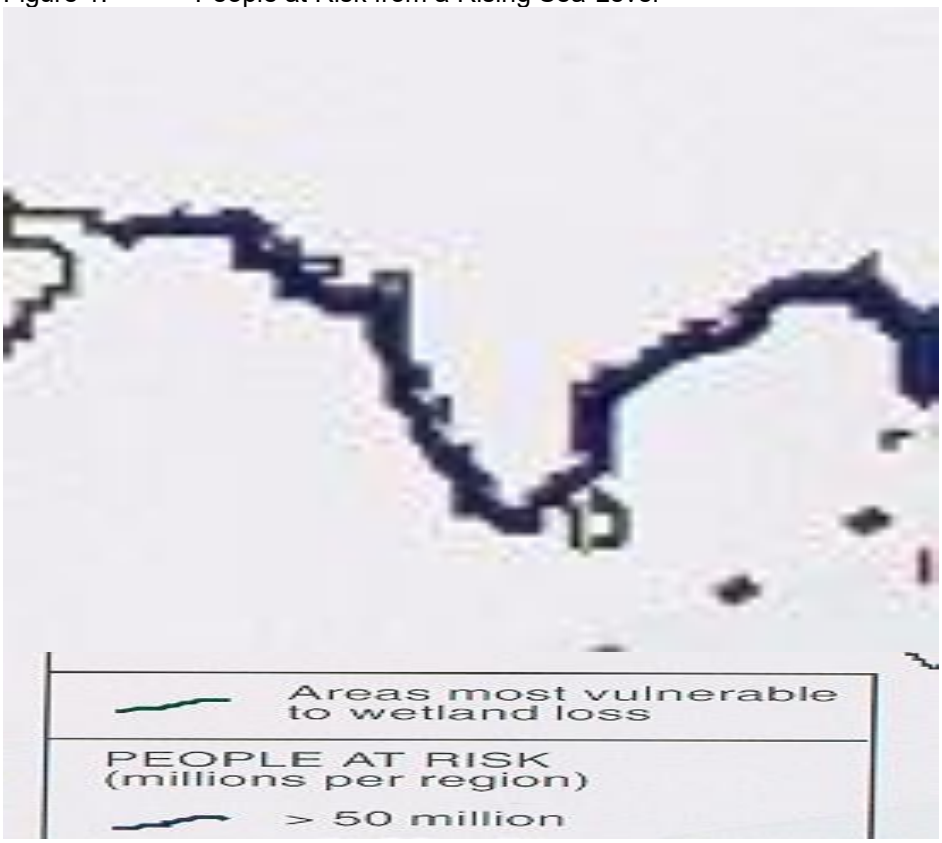
Although area-averaged annual mean precipitation is projected to increase, this average alone can be misleading because it conceals an expected decline in summer precipitation over the central parts of arid and semi-arid Asia. This includes the Indo-Pakistan subcontinent almost entirely. Because the rainfall over this region is already low, severe water-stress conditions - leading to expansion of deserts - are quite possible, with rises in surface air temperature and depletion of soil moisture. The largest reductions (precipitation reduced to <1 mm day^{-1}, 60% decline in soil moisture) are simulated in the arid regions of northwest India and Pakistan. (See Annex-I for the sub-continental projections for temperature and precipitation).

Drought disasters are more frequent during years following ENSO events. At least half of the severe failures of the Indian summer monsoon since 1871 have occurred during El Nino years. In the event of advanced anomalous warming of the western equatorial Pacific Ocean, such as that observed during the 1998 El Nino, a higher frequency of intense extreme events (both droughts and floods) across all Asia is possible.

4 This section recaps Asia-specific (arid and semi-arid Asia) portions of the IPCC, TAR 2001 (Chapter 11)

In fact, an increasing frequency and intensity of floods are likely to be the result of an interaction of diverse climatic factors: rising temperatures, the more frequent onset of El Nino and glacial melt. Some mountains in Asia have permanent glaciers that have vacated large areas during the past few decades, resulting in increases in glacial runoff. As mountain glaciers continue to disappear, the volume of summer runoff will eventually be reduced, as a result of loss of ice resources. Because the melting season of snow coincides with the summer monsoon season, any intensification of the monsoon is likely to increase the risk of flood disasters in Himalayan catchments, especially in the western Himalayas, where the snowmelt runoff is higher.

Figure 1: People at Risk from a Rising Sea-Level



Source: R. Nicholls, Middlesex University in the U.K. Meteorological Office, 1997. Climate Change and its Impacts: A Global Perspective

Recapitulating, a worst-case scenario for the sub-continent, in general, and Pakistan, in particular, is characterized by rising temperature, reduced precipitation, increased water stress, a growing frequency and intensity of droughts and sea level rise. The prognosis on floods is more uncertain. While glacial melt could contribute to more intense floods in the upper Himalayan regions in the relatively near future, over a longer period they are likely to taper off as glacier size is reduced.

3. The Absence of Sustainable Human Development (SHD)

This section assesses the consequences of neglecting sustainable human development (SHD).[5] This inclusive term means development, which is efficient, equitable and sustainable in terms, respectively, of resource use, resource access and resource resilience. 'Resources' is used in its generic sense and refers to capital, human and environmental resources.

The imperatives of SHD are inter-generational justice, a concern with protecting the environment for future generations and intra-generational equity – ensured through social and economic empowerment which, among other things, is a prerequisite for sustainable livelihoods. This refers to the ability of communities to extract a living from the environment in a manner which does not degrade it, as well as to cope with the environmental excesses engendered by unsustainable development. Essentially a people-centered theme, it requires policy interventions to strengthen community coping and management capabilities.

The table sheds some light on Pakistan's performance with respect to SHD criteria. It illustrates how policy neglect, low financial allocations for conservation and non-consultative and extractive management practices have weakened the coping capacity of communities and led to increasing environmental losses.

Table-1: The Absence of Sustainable Human Development (SHD)

	The Three Development Strands		
Common Elements	Economic	Social	Environmental
Development/Efficiency	Macroeconomic instability (fiscal deficits, current account imbalance, exchange rate overvaluation) Sector price distortions (industrial protection via tariffs and licenses, input and output price subsidies, varying degrees of state intervention in industrial production, utilities service delivery, internal and external trade)	Low social sector allocations (education, health, water supply and sanitation, income generation and employment) Poor outreach of poverty reduction schemes, politically influenced entitlements and misappropriation of funds	Policy neglect and low allocations for natural resource conservation and the use of environment-friendly technologies Failure to internalize environmental effects (perverse incentives encouraging extraction rather than conservation, unable to enforce/comply with environmental quality standards governing emissions and pollution)
Equity	Tax policies favoring the affluent (regressive indirect taxes, agriculture income tax exemptions)	Minimum provision for grassroots participation and empowerment of disadvantaged groups in the formulation and implementation of policies and development programs Centralized decision-making and governance provides little space for social capital to develop or articulate itself	Degradation and pollution impact disadvantaged groups adversely (ecological marginalization, urban industrial and vehicular pollution, household fuel consumption, sanitation and waste disposal)

Continued…..

5 For a more detailed discussion of the requirements and attributes of SHD, see Munasinghe (1998) and Khan (1998)

	The Three Development Strands		
Common Elements	Economic	Social	Environmental
Sustainability	Degradation of physical infrastructure (industrial, municipal, transport and utilities)	Lack of resilience in political systems (military coups frequently replacing elected governments) Withering of informal legal and social systems thanks to modernization ('panchayats', 'jirgas', traditional support networks and resource management practices)	Degradation – irreversible in many cases -- and increased vulnerability (deforestation, rangeland degradation, biodiversity loss, coastal zone erosion, air, soil and water quality deterioration)

Source: Developed in-house at SDPI, 1998

3.1 Impact on the Environment

Lapses from SHD, leading to the secular deterioration in Pakistan's environmental health, are evident from several key indicators. Roughly 38 percent of Pakistan's irrigated land is waterlogged and 14 percent saline (Agricultural Statistics of Pakistan, 2000). The annual rate of deforestation ranges from 4-6 percent. (Biodiversity Action Plan, Pakistan, 1999). Carbon dioxide emissions are increasing annually at the rate of 8-10 percent (National Conservation Strategy, 1992). And an estimated 250 million gallons of untreated water out of Karachi is dumped into the Arabian Sea every day, causing great harm to both humans and the ecology. Water toxicity, triggered by the rural-urban interface, has begun to reach alarming proportions. While not fully documented, its debilitating health effects have begun to manifest themselves with increasing frequency, especially in the proximity of large cities and towns. Recent data indicates that over one million acres of fertile, arable land in the Indus delta has become saline and unusable, largely due to the retention of freshwater flows by large dams across the Indus River (IUCN: 2000).

Two attempts to quantify environmental losses raise serious concerns about the sustainability of economic growth. Using extremely conservative assumptions, World Bank economists Brandon and Hammond (1995) estimate that environmental degradation results in the loss of about 4 percent of GDP every year, thus offsetting considerably the conventionally measured GDP gains. The breakdown of the GDP loss includes annual health impacts of water pollution (US$759 million) and air pollution (US$301 million), and the loss of agricultural production due to land degradation (US$300 million). Another way of interpreting the same data is in terms of the net savings rate of the country—after accounting not only for the depreciation of physical capital, but also the degradation and depreciation of "natural capital", accounting for energy and mineral resource depletion, net deforestation and emission impacts. A low savings rate means the lack of adequate resources for investment and growth. The World Bank estimated the 'genuine savings rate' for Pakistan in 1997 to be only 2.5% of GDP.

3.2 Impact on Adaptive Capacity and Adaptability

Failure to achieve SHD has left society vulnerable to the effects of climate change in terms of reducing its adaptive capacity and adaptability. This is also referred to as pre-adaptation vulnerability. The TAR's definition is "socially constructed or endogenous risks," which weaken the ability of society to deal with climate change or variability. Such vulnerability can be segregated by direct and indirect source and by sector. Efforts to address pre-adaptation vulnerability tend to strengthen society's ability to deal with climate change.

3.2.1 The Direct Source of Vulnerability: Institutional Failure

The existing state of degradation and pollution is a result of the failure to mainstream environmental activities within the development process (Jalal, 1993).[6] At some risk of generalization, one might define this process as highly resource, capital and technology intensive. Relatively little weight is given to economic and financial incentives as a means of conserving land, forest, air and water resources, or using them in a sustainable manner. Modernization, in and of itself, contains impulses for degradation: for instance, when economic opportunity and mobility depreciates the value of the resource base for communities drawing their sustenance from it, or when national legal and regulatory systems over-ride traditional, community-based resource management—in fact, are misused to exploit such resources unsustainably.

When such development takes place in the absence of democratic and decentralized governance, environmental problems are compounded. Centralized state institutions tend, at best, to be insensitive to the importance of community property rights and empowerment and, in general, to the need for public space to facilitate the growth of social capital. At worst, they are hostile to decentralized initiatives, viewing them as a threat to their sovereignty. This is unfortunate as, backed by the right incentives, traditional community practices offer considerable hope for sustainable environmental management (Jodha, 1998). Similarly, an aware and motivated civil society can play an active role in environmental conservation.

3.2.2 The Indirect Source: Poverty

While Pakistan has achieved impressive aggregate economic growth—with GDP averaging in excess of 5 percent over the past three decades and a steady increase in per capita income (currently assessed at US$480 in real terms and at approximately US$2,000 in purchasing power parity terms)—its impact in terms of poverty reduction is more ambiguous.[7] The proportion of the population below the poverty line fell from 46 percent in 1984-85 to 34 percent in 1990-91 (World Bank, 1995), and has increased to 40 percent in recent years. Less clear is whether the improvement in consumption poverty was accompanied by a reduction in the absolute number of people falling below the poverty line. Pakistan did not perform well by another measure of poverty, namely, income inequality—as represented by the income share ratio and the Gini coefficient.[8] Both have worsened over time. Finally, Pakistan's performance is even less creditable with regard to human development. Its social indicators are far below those of low-income countries, with comparable or lower levels of per capita income. Furthermore, disparities across provinces as well as across the rural-urban divide are pronounced (Human Development Report, 2000).

The socially constructed or endogenous risks identified by various sources fall into these two zones of pre-adaptation vulnerability.

Table 2: Endogenous Risks Identified in the TAR

Indirect – Poverty
Improved access to resources (Ribot et al., 1996; Kelly and Adger, 1999; Kates, 2000)
Reduction of poverty (Berke, 1995; Eele, 1996; Karim, 1996; Kates, 2000)

Continued…..

6 Specifically, this refers, not to the management of the environment per se but to the management of development activities within the assimilative capacity of the environment.

7 Poverty is a multidimensional term. Consumption poverty refers to the extent to which the private consumption of individuals or households falls below the 'poverty line', the minimum acceptable standard of private consumption. Another important dimension focussing on human development, a term which captures improvements in education, health, water and sanitation and the provision of sustainable livelihoods.

8 Khan and Aftab, 1997

Indirect – Poverty
Lowering of inequities in resources and wealth among groups (Berke, 1995; Torvanger, 1998)
Improved education and information (Zhao, 1996)
Diminished inter-generational inequities (Berke, 1995; Munasinghe, 2000)
Improved infrastructure (Magalhaes and Glantz, 1992; Ribot et al., 1996)
Moderate long-standing structural inequities (Magadza, 2000)
Direct – Institutional
Respect for accumulated local experience (Primo, 1996)
Assurance that responses are comprehensive and integrative, not just technical (Ribot et al., 1996; Cohen et al, 1998; Rayner and Malone, 1998; Munasinghe and Swart, 2000)
Active participation by concerned parties, especially to ensure that actions match local needs and resources (Berke, 1995; Ribot et al., 1996; Rayner and Malone, 1998; Ramakrishnan, 1999)
Improved institutional capacity and efficiency (Handmer et al,., 1999; Magadza, 2000)

Source: Working Group II, Climate Change 2001: Impacts, Adaptation and Vulnerability, IPCC third Assessment Report, 2001

3.2.3 Vulnerability to Climate Change: A Sector Review

Table 3 presents areas/sectors most likely to be affected by climate change, as indicated in the TAR. This is followed by an assessment of sector vulnerability. Clearly the existence of such vulnerability is likely to exacerbate climate change impacts. By the same token, caution is advised in attributing impacts to climate change which may, a priori, have been the result of unsustainable development processes.

Table 3: TAR Projected Impacts of Climate Change in Arid and Semi-Arid Asia

Expected Impacts					
Agriculture and Livestock	Ecosystems and Biodiversity	Desertification	Severe Droughts and Floods	Sea Level Rise	Human Settlements and Human Health
○ Declining agricultural (food and fibre) productivity. Food insecurity. ○ Large northwards shifts of sub-tropical crop areas. ○ Livestock: Rangeland degradation reduces carrying capacity	○ Ecosystem degradation Changes in the composition and distribution of vegetation types (grasslands, rangelands and woodlands) ○ Exacerbating biodiversity loss	○ Desertification ○ Because of the current marginality of soil-water and nutrient reserves, some ecosystems in semi-arid regions may be among the first to show the effects of climate change.	○ Erosion and soil degradation	○ Sea-level rise. ○ Would cause large-scale inundation along the vast Asian coastline and recession of flat sandy beaches. ○ The ecological security of mangroves and coral reefs around Asia would be put at risk.	○ Heat stress-related mortality and morbidity, principally in older age groups. ○ Expansion of vector-borne diseases (malaria) ○ Heightened vulnerability to skin cancers, cataracts and other ocular diseases. ○ -- Increased vulnerability to waterborne diseases (cholera, diarrheal diseases)

Source: Working Group II, Climate Change 2001: Impacts, Adaptation and Vulnerability, IPCC third Assessment Report, 2001

Drawing upon the regional level impacts we focus on three sectors/areas for the vulnerability assessment:

- human settlements and human health;
- ecosystems and biodiversity and;
- agriculture.

Each area/sector assessment assesses the consequences of institutional failure and low social sector priorities. It illustrates how the response capabilities of poor communities to climate change and variability are weakened thereby. In turn, by becoming environmental predators, the poor also become the instruments of destruction of their resource base, leaving it vulnerable to climate change impacts, and ultimately weakening its ability to sustain them. It accelerates further the vicious cycle referred to commonly as the poverty-environment trap.

Human Settlements and Human Health: The key sources of human health problems in intermediate to large urban settlements are water pollution, air pollution and solid waste disposal.

While the water pollution caused by organic and chemical discharges is widespread, its impacts are predominantly on the poor, as a result of the skewed distribution of sewage, sanitation and piped water facilities in poor urban slums.[9] Also, the poor are often forced to settle in the low-lying urban areas which, although relatively more affordable, are more prone to flooding, water pollution and disease. Air pollution ranks as high as water pollution in terms of its health effects and its incidence on the poor. Low-income neighborhoods mushroom around industrial areas and power plants, where exposure to air pollution is high. Traffic congestion and the resulting vehicular emissions are becoming an increasingly serious problem in the big cities. Poor communities are the most exposed to auto-emission and other toxic fumes, as they tend to live close to the main trunk roads (NCS, 1992). Developing countries, in particular, are ill prepared to deal with the problem of solid waste. Once again, the burden of the problem falls disproportionately upon the poor, a consequence of distorted municipal budget and planning priorities. In Pakistan, an average 50,000 metric tons of waste is generated every day. Municipalities collect only 60 percent of this waste. In general, the poorer city areas are the worst served by garbage collection services, or not served at all. In fact, the solid waste collected in upper or middle class areas of cities is often dumped in the slums and city peripheries, either in landfills or thrown directly into watercourses. The resulting problems are smell; disease vectors and pests attracted by garbage and overflowing and clogged drainage channels.

Compounding the problem is the fact that there is a chronic lack of health facilities to deal with the effects of water and air pollution and unchecked waste disposal (both burning and dumping). The absence of adequate nutrition and lack of education and overcrowded housing increase vulnerability to disease. A telling statistic is that infant mortality continues to remain high, even though most demographic indicators have improved, a result of infants' high rate of exposure to waterborne diseases. The incidence of respiratory diseases and lead poisoning (predominantly among children) from mobile and stationary source emissions is escalating rapidly. Trapped in a vicious cycle, those who are the most disadvantaged are ultimately made more so.

Ecosystems and Biodiversity: This sub-section looks at the issue of forestry, especially in relation to developments in the northern temperate zones where most of the country's primary forest stands are situated.

Between 4-5 percent of Pakistan's land mass is presently under forest cover. Despite its low coverage, deforestation is well underway. In particular, primary forest cover is declining, with associated losses in genetic diversity and resilience. Estimates, show woody biomass disappearing at a rate between 4-6 percent per annum, which is feared to be the second highest in the world (Biodiversity Action Plan (BAP), 1998).

9 The World Bank, A Review of Environmental Health Impacts in Developing Countries' Cities. Urban Management Program Discussion Paper Number 6, Nd.

Indeed, Pakistan is one of the developing countries with no remaining biologically undisturbed forests (World Resources Institute, 1997). Both the quality and composition of forest stands is deteriorating. A recent study shows that good quality, tall tree forests (with more than 50 percent cover) occupy less than 400,000 hectares, (BAP, 1998). Data collected through satellite imagery presents an even a gloomier picture; it shows that only 308,000 hectares are under dense forest cover (Provincial Forest Resource Inventory, 2000).

The root cause of degradation lies in forest management practices, which have focused more on economic than on environmental utility. Such practices are also to the detriment of community subsistence needs. The British colonial government had originally weakened community rights to the use of forest resources. Usufruct rights continued to remain but were heavily proscribed. Community management traditions, already fragile, have eroded further with new opportunities for employment and out-migration. Also, demographic and development pressures have forced communities out of their ancestral lands into marginal areas, where competition for resources is severe, resulting in further violations of indigenous property rights. The situation contains the seeds of conflict, with communities forced to act as predators, rather than as guardians of the commons.

Weak property rights and increased fears of expropriation by powerful groups fuel insecurity about future earning streams, especially in an inflationary environment and, in general, give rise to concerns about the free rider problem, namely, that forests will disappear no matter what the community might do (Inayatullah, 1996). Even in privately owned forests (guzaras) right holders may see in regeneration a reintroduction of state property rights, which may stifle even natural regeneration" (Azhar, 1993).

While there is little doubt that under the presently hostile management and tenure regimes, communities are showing a propensity to raid forest resources, their activities pale in comparison with the activities of the so-called 'timber mafia'; commercial loggers willing to undertake illegal logging driven by rising timber prices. The timber trade also demonstrates a distinct anti-community bias; while communities are entitled to a substantial share of revenues (royalties) from the logging in guzara forests, active collusion between the "mafia" and the forest department results in appropriation of the bulk of these royalties.

The case of deforestation drives home the point that if the root causes of degradation (deforestation in this case) are not addressed, even the beneficial effects of climate change can provide only a temporary reprieve. Thus, for instance, first-order impacts of increased atmospheric concentration, temperature and precipitation were evaluated with the help of BIOME 3 model simulations.[10] Of the 9 biomes, 3 (alpine tundra, grassland/arid woodlands and deserts) showed reduction in their area; 5 biomes (cold conifer/mixed woodland, cold conifer/mixed forests, temperate conifer/mixed forests, and steppe/arid shrublands) showed increase in their area as a result of climate change. There was no change in the area of xerophrytic wood/scrubs in the simulations. Enhanced CO2 concentration in the atmosphere appeared to have a pronounced effect on a biome's area increase, even in the case of high temperature and low precipitation scenarios. However, when climate related gains are juxtaposed with socioeconomic pressures and resource mismanagement, such gains are likely to be undermined.

Agriculture: Around 80% of the arable lands and 90% of agricultural output (which accounts for more than a quarter of GDP) in Pakistan depend entirely on the Indus Basin Irrigation System (IBIS), which is the largest integrated irrigation network in the world. It consists of three major storage reservoirs, 19 barrages, 12 inter-river link canals, 43 irrigation canal commands, and over 107,000 watercourses delivering water onto the farms. Practically the entire system is unlined, resulting in system losses due to seepage, particularly at the

10 Siddiqui, et al., Climate Change Impact Assessment and Adaptation Strategies for the Forestry Sector in Pakistan, Pakistan Forest Institute, September 1997

watercourses. Annually, the system draws an average of 106 million acre feet (MAF) of surface water for irrigation, supplemented by another 45 MAF of pumped groundwater, much of which is by way of recovery from system losses due to seepage in areas underlain by fresh groundwater. (Faruqee, 1999)

For the first forty years or so of its existence, agricultural policies in Pakistan were defined by the so-called "Green Revolution" strategy of agricultural growth. This strategy was premised upon a sufficiency of both land and water. Major irrigation schemes (Mangla and Tarbela) were launched to harness this water and to apply it at both the extensive and intensive margins. However, over the past ten years the scope for extensive cultivation (both in terms of land and water) has diminished progressively (NCS, 1992). Against finite supply constraints, sectoral (agriculture, households, industry, energy) demand for water is growing. Pakistan is transiting rapidly from a water surplus to a water stressed country.[11] The table below shows that even under the most optimistic precipitation scenario, water deficits are likely to become large. These are projected to be even larger in the more probable declining precipitation scenario, presented for the arid and semi-arid regions and in which Pakistan falls.

Table-4: Demand-Supply Balances With Climate Change (MAF)

Year	2000	2010	2020	2050
Projected Irrigation Water Demand)	104.87	110.04	110.04	110.04
Households &Industry	5.90	9.20	12.50	20.50
Total Projected Demand:	110.77	119.24	122.54	130.54
Projected Releases from Dams:	104.87	110.04	108.85	106.98
Projected Deficit:	5.90	9.20	13.69	23.56

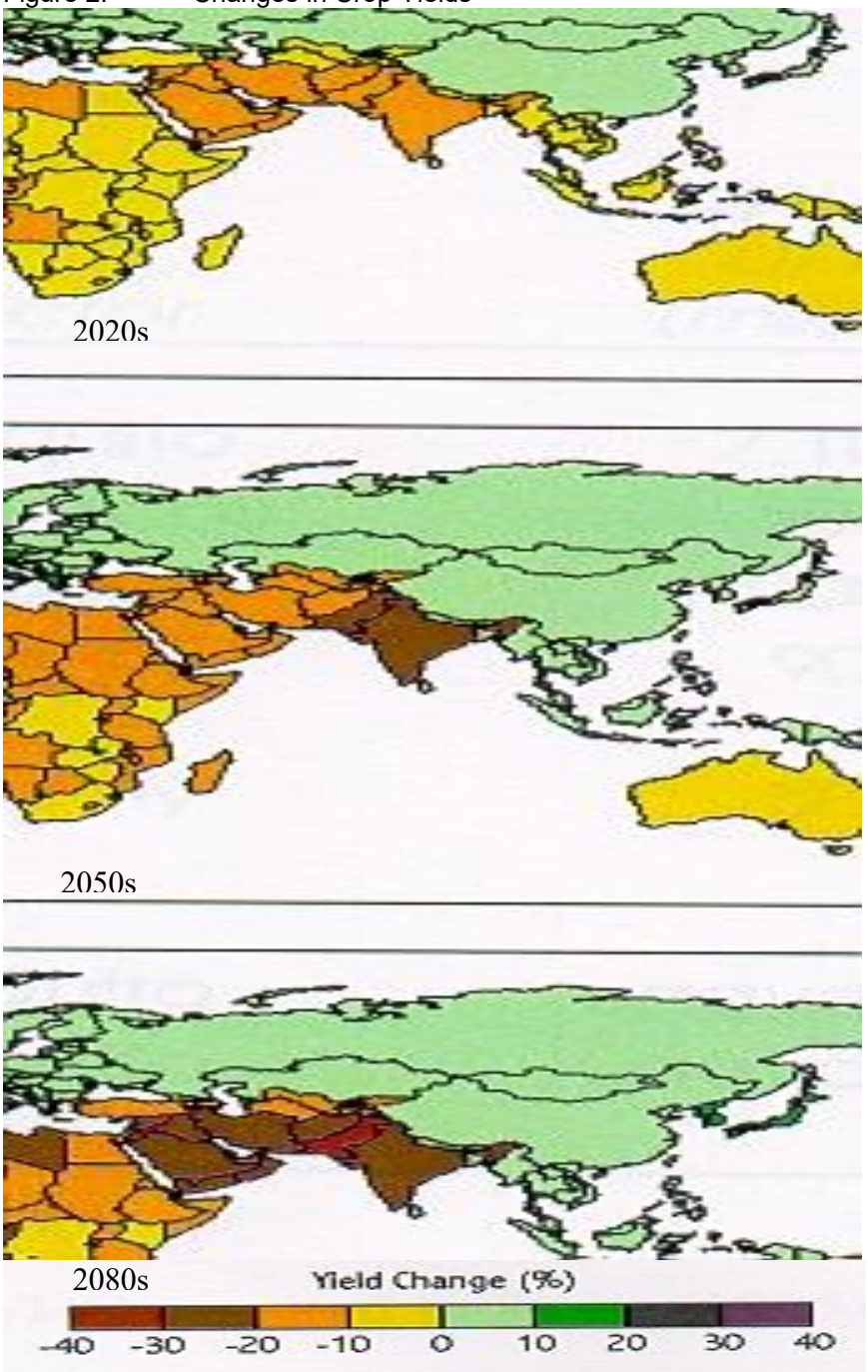
Source: SDPI in-house calculations. Report of the Water Sector Team, 1998

In terms of the impacts on agriculture, the primary concern is with growing food insecurity. In the modelled worst case scenario of increased warming and falling precipitation, growing season length reduces, especially in the arid areas where crops are already on the margin of stress.[12] Increased heat and reduced soil moisture also causes accelerated growth early in the season and affects changes in the partitioning and quality of biomass. In combination these factors have yield reducing effects. This is offset by higher CO_2 levels, which have yield enhancing effects, especially on C3 – to a much lesser extent on C4 crops, like wheat, rice and maize. The net effects, therefore, are indeterminate. On the other hand, crops like rice and sugarcane would be hard hit by water scarcity. Spatial shifts in production are also predicted, especially in the crop zones dominated by wheat, rice, cotton and maize. Figure 3 below projects regional climate change impacts on major crops:

11 From being a water affluent country in 1951, with a per capita availability of 5,300 cubic meters, Pakistan is bordering on becoming a water scarce country in 2000, with a per capita availability of 1300 cubic meters (GOP, 1998)

12 Ahmed, S., et al, Climate Change Impacts and Adaptation Assessments in Pakistan: Agriculture Sector Study, September 1997

Figure 2: Changes in Crop Yields



Source: Jackson Institute, University College London/Goddard Institute for Space Studies/International Institute for Applied Systems Analysis

In the case of water, the two most critically required – and related -- interventions are water use efficiency and equity in its distribution. In the case of agriculture, it is adaptive research and improvement in extension services to poor farmers, as they cultivate areas which are already on the margin of stress and, therefore, most

vulnerable to adverse climate impacts. But the constraints imposed by the existing development biases are likely to prevent such institutional and technical transitions from taking place.

Irrigation system management reforms face formidable obstacles in the shape of institutional gridlock and feudal institutions, which have resisted efforts to increase water charges (abiana) and to improve the quality of O&M. More critically, both have combined to subvert efforts at decentralizing irrigation system management and commercializing its distribution. Specifically, the intent is to form representative farmer organizations (FO) and transfer management of the tertiary irrigation and drainage system to them.[13] The provincial irrigation departments are resisting the reforms because of the perceived threats to jobs, perks and privileges. The large farmers see them as reducing opportunities for collusion with irrigation department officials in water theft and as undermining their traditional hold over small and landless farmers.

Adaptive research and extension needs to focus on climate resistant varieties, environment friendly agronomic practices and on establishing a social-environmental interface, with communities participating actively in environmental management. However, a large and inflexible research infrastructure continues to remain locked into a more of the same mindset, namely research into high-yielding, input intensive hybrid varieties, which benefits large farmers primarily. As little research is being carried out on the effects of current farming practices on soil and water quality, climate change driven research would appear to be many light years away.

4. Responding to Climate Variability: Case Studies

The case studies on droughts and floods demonstrate that weak adaptive responses are rooted in the neglect of the affected areas. An extension of such neglect is the failure to monitor the situation once floods and droughts are underway and the knee-jerk, uncoordinated responses to them. Emergency and mitigatory measures are carried out without involving the communities, adding new problems to the existing ones. Ultimately, response capabilities are a function of the level of preparedness and this entails laying down an infrastructure and service support network in the area. This will allow resident communities to benefit from opportunities which good years bring and have ready access to emergency relief and assistance during the disaster years. The case study on Kalabagh Dam illustrates that large infrastructure projects which disturb and fragment ecosystems increase the vulnerability of such systems to climate change impacts.

4.1 Adaptability: Droughts and Foods

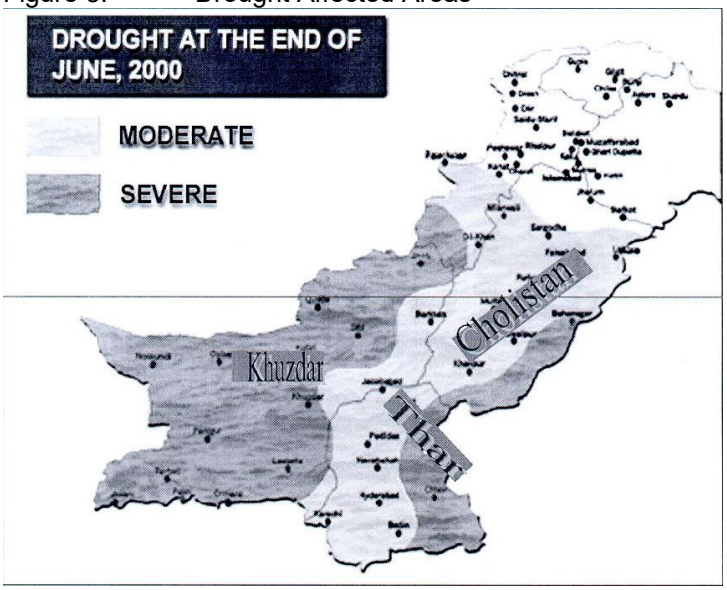
4.1.1 Droughts [14]

The Thar, Cholistan and Khuzdar regions are arid areas, ecologically diverse and rich in biodiversity. Living conditions fall below subsistence levels. The inhabitants are nomadic grazers primarily, traveling vast distances with their livestock across sparse rangelands. Transient agriculture is practiced, with crops such as barley, maize, millet and vegetables grown as and when rains do come. There is little government infrastructure – schools, health centers, piped drinking water, roads. Women fetch brackish water for drinking from enormous distances, snake bite victims rarely survive because of lack of access to vaccines and food purchases from distant towns have to be planned carefully. A single rainless year drives residents far from their homelands. Ironically, the only time official interest is shown is during the hunting season, when functionaries help well-connected hunters take a heavy toll of the local biodiversity.

13 The responsibilities would entail O&M of the distributaries and minors, assessing and collecting water charges, distributing water among its members. See (Khan et al, 2000)

14 Based on a report from SCOPE a Pakistani NGO, specializing in desertification and related issues.

Figure 3: Drought Affected Areas



Arenji – Khuzdar: Arenji a sub-tehsil of Khuzdar district of Balochistan province lies some 430 kilometres, south-west of Quetta. About 35,000 people live in and around scattered villages in the sub-tehsil. Livestock raising and, more unpredictably, agriculture are the two sources of income. There have been no rains in the area since 1997. Prolonged drought has created a severe emergency situation, affecting both people and livestock. Fatalities have been high due to hunger disease and malnutrition.

Arenji illustrates the classic Sen syndrome of poverty amidst plenty. Compounding the lack of infrastructure and services, the government has taken decisions, which aggravate the consequences of its neglect of the area. An administrative order has banned the inter-provincial movement of wheat and flour and restricted individual purchases to 25 kg of wheat flour at one time, also making it mandatory to produce identification at the time of purchase. Traditionally, the purchase of necessities is undertaken by one or a few individuals for the whole community, saving time and expense in traveling long distances. The new restrictions on both per capita entitlements and food movements has created scarcity. People are being forced to consume degraded rice and wild vegetation. Instances have also been cited of starved buffaloes and sheep trying to eat dead animals. Malnutrition is on the rise, drastic drops in haemoglobin levels have been recorded, increasing vulnerability to disease. Contaminated water complicates the problem further.

Relief work is sporadic. Political party and religious activists, the Red Crescent Society (Red Cross) and the government are all involved in the relief effort. However, the amount of relief is inadequate (the district administration has provided less than $1,000/- for about 35,000 affectees) and there is no planning and coordination of the work of the various relief agencies.

Cholistan Desert: Rohi is the Seraiki name for Cholistan, which starts from Bahawalpur, forming the south-eastern part of the Seraiki Region in Punjab. Rohi or Cholistan comprises immense deserts and plains renowned for their tranquility and harmony. Cholistan consists of two parts: Greater Cholistan, and Lesser Cholistan. Greater Cholistan is a vast sand desert where human survival is extremely difficult. Lesser Cholistan, spread over a vast flat area, is relatively more populated, even though here too, the settlements are scattered. The word ‘permanence’ has a different meaning in Cholistani context. While

never settling permanently in any specific place, searching constantly for water and pastures, the inhabitants would not conceive of leaving their ancestral abode for the comforts of the city. However, over the last few years life has becoming increasingly difficult due to the dry spell.

The total population is estimated to be between 120000 and 150000 (the source documents vary in their estimates). The livestock population is roughly 11 times the human population. According to the 1996 census, the count was 407,350 cattle, 1,365 buffaloes, 650,558 sheep, 275,277 goats, 20,000 camels, 156 horses, 14,594 donkeys and 300 mules.

Mirroring the situation in Arenji, basic infrastructure: roads, public transport, electricity, health and educational facilities are non-existent in the Greater Cholistan. However, Lesser Cholistan has relatively better availability and access to services because of its proximity to the settled/developed areas.

Water is a vital resource given the extremely low rainfall in the area. The nomadic Rohians practice traditional rainwater conservation. Many reservoirs have been dug in the flat areas, called 'tobas' (an artificial lake in the Seraiki language). The tobas are identified by names and associated with clans which settle around them for as long as they last. There are, also, about 50 permanent settlements where deep wells -- a permanent source of water have been dug. A good rainfall turns Cholistan green overnight, with an abundance of flowers and perennial grass. It also gives the people an opportunity to plant crops.

Clearly, infrastructure and services are vital to the area. In times of prosperity, they facilitate access to markets for livestock and related products. During lean periods, they are critical both in terms of human health and access to food and water and providing emergency relief assistance.

Thar Desert: The Thar desert is a vast dryland and home to 1.5 million people. The ecology and economy of Thar depends on rainfall. The grass and shrub lands support large livestock populations and the inhabitants grow crops and vegetables in good years. However, a prolonged four-year drought has disturbed the desert's life cycle. In a break with pre-partition practice, the government has yet to declare the Thar desert a calamity hit area. Facing famine and disease, thousands of Thari families have started migrating to the barrage areas in search of work and sustenance.

4.1.2 Floods[15]

Extensive flood damage occurred along the Leh Nullah, passing through Rawalpindi, due to heavy monsoon rains this summer (August 2001). Although small compared to the scale of floods along the Indus River, the flood responses illustrate institutional inadequacies, especially as Rawalpindi is one of the major urban centers of Pakistan and situated close to the federal capital.

While the floods caused little loss to human life, 3,000 homes were destroyed, considerable assets and livelihoods were lost and diseases such as diarrhea and typhoid have become endemic. The relief needs were, sequentially, meals and drinking water; dry rations and clothes; emergency health services; sanitation and clean-up and; finally, reconstruction and rehabilitation.

In contrast, the real-time responses had a knee jerk character to them. Due to municipal oversight, people had constructed homes and shops in the low-lying areas causing the nullah to clog up with garbage and refuse. This proved to be a major factor in the damage wrought by the floods. Subsequently, the administration has imposed a building ban across the board and offered to relocate the communities, who have rejected the proposal outright. They do not believe the government will compensate them for the

15 Based on an SDPI Flood Damage Assessment Report, August 2001

loss of their property (the investment of their life-time savings). Second, relocation poses a major logistic and financial inconvenience (longer distances traveled to schools and jobs). By the same token, a survey should precede a building ban to determine where the unsafe areas are. Finally, technical solutions, such as deepening the nullah, reflect little awareness of social realities. The nullah is likely to become clogged again, unless communities are made part of a continuous sanitation program.

Voluntary donations of food water and essential supplies have poured in, reducing the threat of starvation. However, ordinary citizens are not in a position to address the emerging health and rehabilitation problems. A number of NGOs have volunteered assistance in the following areas:

- Immediate relief operations
- Assessing the nature and extent of the damage
- Rehabilitation. The municipal government has limited resources, but people are willing to rebuild at their own cost.

However, at present, the government has adopted a somewhat hands-off attitude which precludes constructive engagement with civil society. This is underscored by the fact that the majority of those affected are poor communities, living in slum settlements and with little political clout.

4.2 Specific Adaptation: Kalabagh Dam

Large infrastructure projects continue to occupy center-stage in the development schema of most developing countries, with Pakistan no exception. The Kalabagh Dam project is one such example and is shown to be unviable on both social and environmental grounds. Also, climate change, reinforces the case against building the dam. However, the disregard of such considerations underscores the need to address generic development criteria rather than tinkering with the projects/outcomes it gives rise to. Thus, the key issue is not whether climate change concerns can be integrated in such projects but, more fundamentally, whether the decision to build such projects is appropriate in the first place.

The Indus River, the agricultural lifeline of Pakistan, flows in a southwesterly direction for about 2,500 km and empties through an immense delta into the Arabian Sea. The river system and its tributaries have provided Pakistan with some of the most fertile and best-irrigated land in the subcontinent, measuring about 200,000 square miles. Two large dams across the Indus River (Tarbela and Mangla) and a vast supporting irrigation network have both fragmented and altered its original ecosystems. A growing concern is that yet another dam across the Indus would prove environmentally disastrous; that it could trigger irreversible degradation of an already fragile ecosystem.

The expectation is that Kalabagh Dam would store an additional 6 million acre feet (MAF) of water. Also, it would produce over 1200 MW of hydroelectric power. However, the global and regional context for assessing large dams like Kalabagh is changing, with conventionally described irrigation, flood control and energy benefits being viewed through the prism of sustainable development and this provides the contextual back-drop for a review of the professed benefits.

4.2.1 Water Availability and Flood Control

In the first place, the water availability claims to justify a major dam at Kalabagh appear doubtful. WAPDA has used a wet cycle period to show higher inflows at the rim stations (146 MAF). The longer period, which includes both wet and dry cycles, indicates relatively lower inflows (139 MAF). A climate change scenario which includes increased temperature and reduced precipitation lends even less credence to surplus water availability claims.

There is also a perception in the minds of planners is that large dams are the perfect flood prevention devices. The evidence for Pakistan shows otherwise; that its large dams not withstanding, there has been no reduction in the incidence and intensity of floods nor in the associated losses in lives, crops, livestock and infrastructure.

Table 5: Flood Damages in Pakistan

Year	Monetary Losses (Billion Rs. In 1955 prices)	Lives Lost (No.)	Villages Affected (Nos.)	Area Flooded (Sq. miles)
1950	9.08	2,910	10,000	7,000
1955	7.04	679	6,945	8,000
1956	5.92	160	11,609	29,065
1973	5.52	474	9,719	16,200
1975	12.72	126	8,628	13,645
1976	64.84	425	18,390	32,000
1978	41.44	393	9,199	11,952
1981	N/A	82	2,071	N/A
1982	N/A	350	7,545	N/A
1988	15.96	508	100	4,400
1992	56.00	1,008	13,208	15,140
1995	7.00	591	6,852	6,518

Source: Water Sector Report, Climate Change Impact Assessment and Adaptation Strategies, July 1997

There is no seeming pattern to the floods other than the fact that they could have coincided with wet cycles. In actual fact, the flood impacts appears more severe after 1973, which is after the two major dams at Tarbela and Mangla, were built. As Bayley (Abramovitz, 1996) has so aptly put it, "the 'flood pulse' is not a disturbance, flood prevention is." And that is exactly what large dams like Tarbela and Mangla have contributed to; disturbances on a large scale, which also supports the view that dams don't prevent floods, they merely create 'flood threat transfer mechanisms.'(Abramovitz, 1996) 15). The solution is to work with communities, rely on their knowledge and supplement their flood mitigation and coping strategies. With a predicted increase in the frequency and severity of floods, thanks to ENSO and glacial melt, this logic appears even more appealing.

4.2.2 Ecosystem Degradation

Degradation of the Indus delta ecosystem, as a result of reduced water outflows, is already a highly visible phenomenon. The present level of silt discharge, estimated at 100 million tons per year, is a four-fold reduction from the original level before the rivers were dammed. The combination of salt-water intrusion (some reports show this as 30 kilometer inland), and reduced silt and nutrient flows has changed the geomorphology of the delta considerably. The area of active growth of the delta has reduced from an original estimate of 2600 square kilometers (growing at 34 meters per year) to about 260 square kilometers. Freshwater reaches only a few of the creeks and others have become blocked. The delta is being transformed by strong wave erosion, an increasing dominance of sand at the delta front and an increase in wind-blown sand deposits as a result of losses in vegetation (IUCN, 1997)

The consequent ravages to the ecosystem have been exceptionally severe, in particular to the mangroves, which are its mainstay. They sustain its fisheries, act as natural barriers against sea and storm surges, keep bank erosion in check and are a source of fuelwood, timber, fodder and forest products, a refuge for wildlife and a potential source of tourism. Without mangroves and the nutrients they recycle and the protection they provide, other components of the ecosystem would not survive. In this case, the predicted climate change

scenario is doubly harmful. Not only does it reduce further freshwater outflows to the sea but exacerbates the consequent salt-water intrusions, via sea level rise.

4.3 The Crisis of Governance

The Kalabagh Dam typifies government insensitivity, in this particular case, to inter-provincial concerns regarding water availability, environmental degradation and social displacement. An important factor in good governance is decentralized and consultative decision making. By contrast, Kalabagh has been the very antithesis of this, with policy decisions being made in a highly centralized, often secretive, politically coercive and technically flawed manner. Indeed, WAPDA (Water and Power Development Authority), the government agency responsible for large water projects appears bent upon an ex-post vindication of a politically motivated step.

The present drought situation typifies this alarming blend of arrogance and ignorance. In defiance of all belief, WAPDA continues to lobby for the dam, even as the Indus runs completely dry in the most improbable place, namely, at the confluence of the four main feeder rivers. Suggestions as outré as laser-melting the glaciers are gaining currency in the popular press. More substantively, Sindh continues to take proportionate reductions in water, with the result that river flows downstream of Kotri to the sea have stopped completely (IUCN, 1997)

5. Spontaneous Adaptation to Crop Zone Shifts: A Potential Area for Research

Climate changes can have crucial effects on agricultural productivity. Countries like Pakistan, which fall in the semi-arid zone of the continent, are expected to be affected by adverse climatic changes; most crop zones in this region are on the marginal extremes of temperature and precipitation and, hence, particularly vulnerable to any unfavorable shifting of these climatic features.

That the climate of Pakistan is changing, and is expected to change further, is generally accepted. Although the precise nature of future trends is still unclear, increase in temperature, with corresponding decrease in soil moisture, is anticipated. Thus future climatic changes and other stresses could interact to affect crop yields and productivity in various, possibly adverse, ways, depending on agricultural systems and practices. Further, changes in the timing of critical events relating to crop development and changes in composition and distribution of vegetation types are expected. There is also the danger that climate-related factors plus human-induced stresses may cause land degradation. At the same time, it has been pointed out that future increased atmospheric concentrations of carbon dioxide are likely to have a beneficial effect on plant productivity; what the net impact will be of all the factors identified is not certain.

Averting potential agricultural decline, or devising compensatory strategies, will depend substantially on the ability of rural communities to adapt spontaneously to changing external circumstances. The term “spontaneous” is significant in this context as planned adaptation has not proven as effective in the past; often based on short-sighted policies, formed with inadequate understanding of various factors/impacts, externally imposed measures seldom achieve desired results on a long term basis. Rather than take refuge in planned adaptation theory, one could do well to learn from the indigenous responses of agricultural communities that have adapted successfully to climate change and shape enabling policies in the light of such responses. This study aims to examine climate change impacts on and spontaneous responses of the cotton-growing communities of the Punjab.

Cotton is one of Pakistan's important cash crops. In the late sixties, cotton production was fairly uniform across northern and southern Punjab. However, as Figs. 4 and 5 show, production and area trends began to diverge for both regions over time. The contrasts are interesting: the area divergence began earlier than in the case of production. The difference can be attributed to differential responses to the introduction of fertilizers, pesticides and high-yielding varieties. It is the decrease in yield and area in southern Punjab that is interesting; the fact that cotton is an important cash crop makes it unlikely that farmers would switch from cotton to another crop unless cotton-growing was no longer profitable. The inference is that other factors were at work that altered cotton-growing conditions in the southern part of the province.

Figure 4: Production Trends

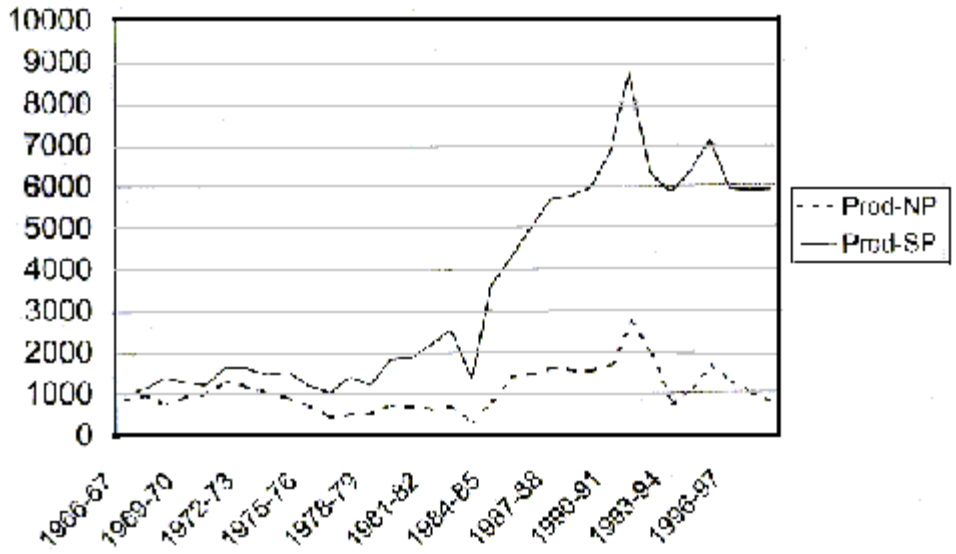
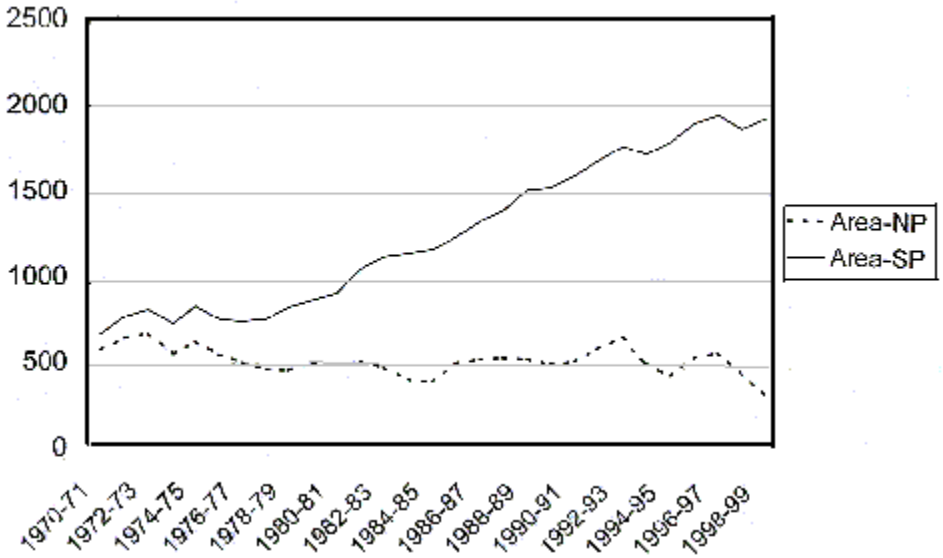


Figure 5: Area Trends



This study will try to ascertain (i) whether the decline of production in the south is a direct result of changes in climatic trends and, if so, (ii) the manner in which the affected communities have adapted themselves to meet the new conditions. The observed responses should furnish examples of the ability and resilience of communities to survive livelihood-threatening external change through indigenous adaptive responses.

The paper will begin with an analysis of climatic changes that have occurred in Pakistan over a long period of time and will also view the predictions for future climate change in the country. This will be followed by a review of the literature on autonomous adaptation to climate change in a number of agricultural regions of the world. Following this, the Punjab case study itself will be taken up, including identification of former cotton-producing communities, linkage of decline in cotton production to changing climatic trends, and observation of the measures devised by the affectees for sustaining livelihood. This data will be used to frame policy recommendations for assisting cotton growing communities in their adaptation to future climate changes in Pakistan.

6. Conclusion

Society's ability or inability to adapt successfully reflects its state of development. The UNFCCC Article 3.4 enjoins countries to promote sustainable development, so that they are prepared for and can deal effectively with climate change impacts. A more rigorous expression of this theme, articulated in the TAR, is represented by the conjunction of and synergies between development, sustainability and equity (DSE: Munasinghe, 2000).

The TAR posits a strong coincidence between the imperatives of sustainable development and the requirements of enhanced adaptive capacity. In other words, promoting sustainable development is tantamount to improving society's capacity to adapt to climate change.

The TAR proposes two general strategies on adaptation. The first is a macro-strategy which involves rapid development. Its elements are sustainable and equitable development aimed at increasing income levels, education and technical skills and improving public food distribution, disaster preparedness and management, and health care systems in developing countries of Asia. The second strategy is a micro strategy that involves modifying the management of sectors most sensitive to climate change. This approach entails developing new institutions or modifying existing institutions related to these sectors that promote rather than discourage adaptation to climate change. It also involves modifying climate sensitive infrastructures that are already planned or implemented or other long-term decisions that are sensitive to climate to incorporate the risks of climate change.

In this paper we have attempted to show, with the help of two case studies, that the first strategy is a pre-condition for the second, that it is not possible to adopt one without the other already in place. The first case study examines adaptive response capabilities to extreme events (droughts and floods). It validates the TAR hypothesis that unsustainable development can leave poor vulnerable communities completely exposed and unable to cope. Poor institutional responses reflect another aspect of such development processes. This provides worrisome signals for the future, when both the incidence and severity of such events is expected to increase

Large dams in Pakistan are another illustration of the failure of micro-strategy when macro-strategy is inappropriate. In the present development climate, the planning of such large infrastructure

projects violates all social and environmental norms. Further, that in their present configuration and numbers, large dams are likely to exacerbate adverse climate impacts rather than alleviate them.

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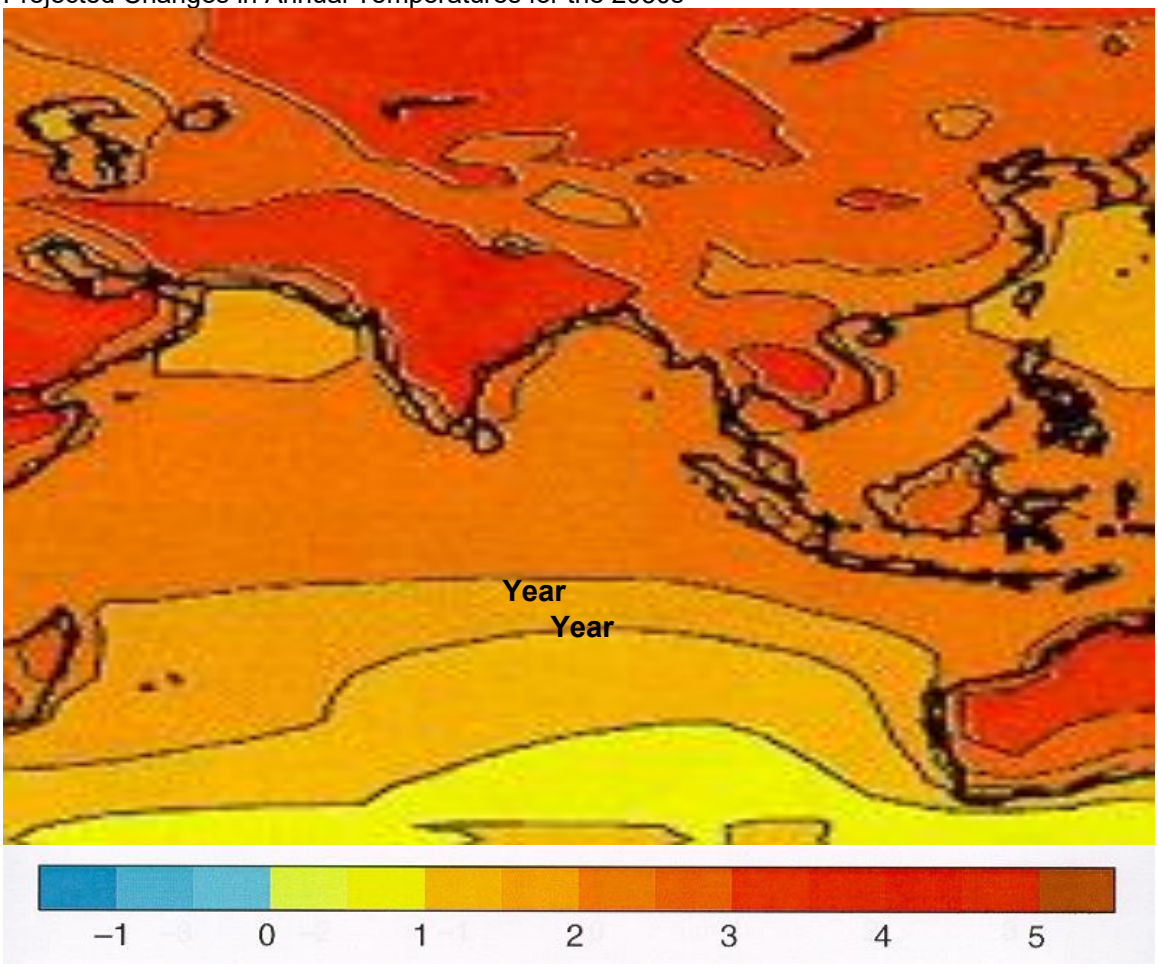
Annex-1

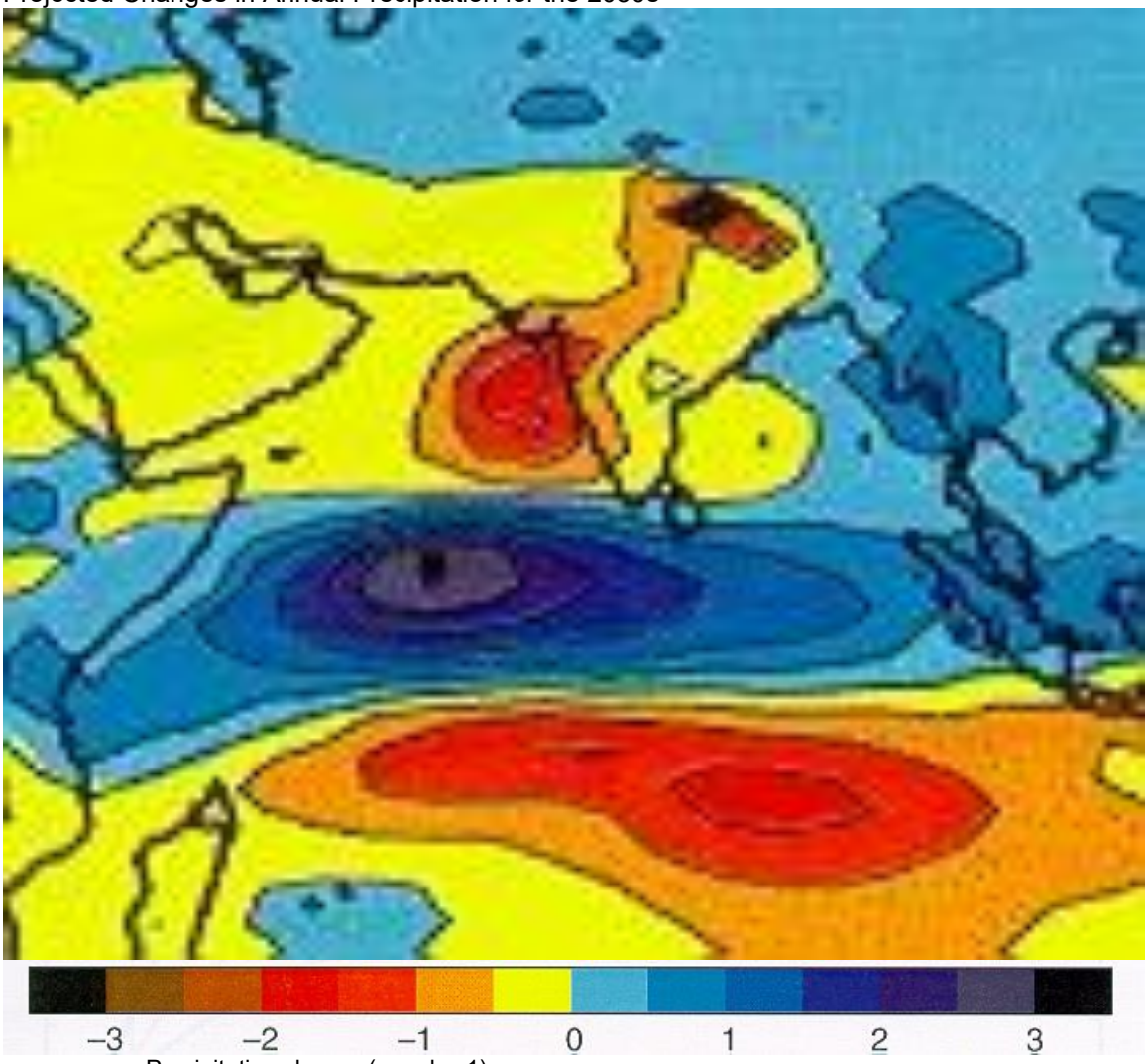
Projected Changes in Annual Temperatures for the 2050s



Annual mean temperature change (° C)

Source: The Met Office. Hadley Center for Climate Prediction and Research

Projected Changes in Annual Precipitation for the 2050s



Precipitation change (mm day-1)

Source: The Met Office – Hadley Center for Climate Prediction and Research

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